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Review

Local Food Systems under Global Influence: The Case of Food, Health and Environment in Five Socio-Ecosystems

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Abstract: Globalization is transforming food systems around the world. With few geographical areas spared from nutritional, dietary and epidemiological transitions, chronic diseases have reached pandemic proportions. A question therefore arises as to the sustainability of local food systems. The overall purpose of this article is to put in perspective how local food systems respond to globalization through the assessment of five different case studies stemming from an international research network of Human-Environment Observatories (OHM), namely Nunavik (Québec, Canada), Oyapock (French Guiana, France), Estarreja (Portugal), Téssékéré (Senegal) and Littoral-Caraïbes (Guadeloupe, France). Each region retains aspects of its traditional food system, albeit under different patterns of influence modelled by various factors. These include history, cultural practices, remoteness and accessibility to and integration of globalized ultra-processed foods that induce differential health impacts. Furthermore, increases in the threat of environmental contamination can undermine the benefits of locally sourced foods for the profit of ultra-processed foods. These case studies demonstrate that: (i) the influence of globalization on food systems can be properly understood by integrating sociohistorical trajectories, socioeconomic and sociocultural context, ongoing local environmental issues and health determinants; and (ii) long-term and transverse monitoring is essential to understand the sustainability of local food systems vis-à-vis globalization.

Keywords: nutrition and food transition; One Health; globalization; chronic diseases; epidemiologic transition; Canada; French Guiana; Senegal; Portugal; Guadeloupe

1. Introduction

The globalization of food is old [1]; processes like the exchange of seeds, plants and their cuttings, as well as the circulation of food products in general between human populations have occurred consistently with varying intensity. The novelty today lies in the massiveness of these exchanges and the nature of food that brought about a "monolithic global industrial food system" in the latter half of the 20th century [2]. Globalized food products are cheaper and more available [3]. They have the characteristic of being highly processed and manufactured, thus presenting fattier and sweeter attributes than so-called "traditional" food [2,4–6], therefore generating nutritional disruptions with hefty health impacts [3,7]. It is estimated that roughly 24% of total deaths worldwide in 2017 (i.e., 11 million premature deaths) were attributed to unhealthy diets linked with the development of several chronic non-communicable diseases [8]; over 2.8 million deaths annually are related to being obese or overweight alone [9]. This does not include the number of people whose quality of life is greatly impacted by living with such diseases and their comorbidities, e.g., diabetes (463 million individuals in 2019, accounting for 9.3% of the global population [10]), obesity and overweight (671 million and 1.3 billion adults in 2016, respectively [11]), hypertension (1.278 billion adults in 2019 [12]) and cancer (19.3 million new cases in 2020 [13]). Notwithstanding numerous risk factors in the development of a diverse range of cancers, obesity and overweight have been found to contribute a population attributable fraction of over 30% for esophageal adenocarcinoma [14].

Food systems consist of a complex web of activities that involve, among other things, the production, aggregation, processing, transport, consumption and disposal of food products [15]. Major changes to the global food system have resulted from the massification of transport and communication networks that modify the face of the earth like the relations that human societies maintain between themselves and with their environment: they make globalization a "geographical power" [16] (p. 65). This globalization in turn leads to a decrease in planetary geographical diversity that occurs through the process of "geographical opening", i.e., deep and rapid economic and social transformations of hitherto isolated regions [16] (p. 68). Working hand in hand with the industrialization of food, the global production, manufacturing and distribution of ultra-processed products also leads to excessive use of non-renewable energy and the emission of greenhouse gases that contribute to climate and environmental disruptions, which include biodiversity loss as well as the degradation of soil, water and air quality [3,4,17]. Given the compounding effects of the global food system on human and environmental health, the United Nations (UN) General Assembly has proclaimed a UN Decade of Action on Nutrition from 2016 to 2025, in support of their Sustainable Development Goals [18].

Considering the prevalence of food in the global circulation and trade of goods, almost no geographical area is today spared by its globalization [19]. With more or less intensity, food availability has thus increased over many geographical areas: at local scales, the choice of products and the range of nutritional values are more extensive, while contributing to a global standardized diet [3]. However, availability does not mean consumption because of both the financial resources and the cultural practices of human populations [7,20]. As pointed out by Douglas [21] (p. 146): the principles of selection which guide human beings in the choice of their food resources, in all likelihood, are not physiological but cultural.

In fact, the mechanisms that preside over food syncretism resulting from globalization are diverse, being: (1) ecological (i.e., environmental consequences of sourcing and supply, nutritional composition), (2) technological (i.e., conservation techniques, transportation networks), (3) cultural and symbolic (i.e., acceptability of consumption, ways of preparing, ways of organizing meals, gifts and sharing) and (4) social (i.e., socio-demographic consequences of access and possibility to consume). Food therefore appears as a nexus that integrates many dimensions and that, at the same time, is the expression of a relationship with the singular world. Hubert [22] (p. 34) adds that dietary patterns and ways of eating reflect the values, beliefs and aspirations of a social group, and these patterns, far from representing stable entities, are in constant transformation, just like the society of which they are an expression. Indeed, when new food items are introduced to the food system, these can alter an individual's cultural (i.e., what foods one has access too) and social (i.e., what interpersonal network one has to access said food) capital standing depending on the values a social group has afforded these new items. Ultimately, this challenges the resilience of the local food system.

Food security occurs when there is physical, social and economic access to available and healthy food that is consumed in sufficient quantity [23,24]. Although it depends on the local supply of food, it is also contingent on global trade [3]. Owing to an increasing dependence on a global food system in many countries and regions [3], a question arises as to the sustainability of local food systems, particularly in connection with environmental and human health. Though large-scale changes to food systems are observed overall, one may be driven to the impression that these are the same everywhere. Yet, to grasp the complexity of transformations of food systems in their diachronic and synchronic dimensions, it is necessary to study their variability and recurrences in differentiated socio-ecosystems.

The overall purpose of this article is to put in perspective how food systems respond to globalization through the assessment of five different case studies centered around an international research network known as the Human-Environment Observatories (OHM). This is achieved by questioning the influence of the global trade of industrialized and ultra-processed food at a local scale through an analysis of consequences and dynamics. Three objectives are defined to accomplish this. First, the nutritional and dietary transitions are presented, which have been extensively studied through the lens of public health issues. Second, the food systems characterizing the socio-ecosystems present within five OHMs and their evolution are described. Third, an attempt is made to describe the impacts of these transformations on the health of human populations based on a One Health perspective that ties environmental health to human health [25].

2. Analytical Approach

First and foremost, this article contextualizes the links between globalization and the evolution of local food systems through the lens of nutrition and food transitions and their impact on the development of chronic diseases. The analytical approach adopted an interdisciplinary synthesis and examination method theoretically rooted in geography, anthropology of food, nutrition, health and environmental sciences. The literature review centered on five regions that are of interest to the interdisciplinary and international OHM research network. Their conception and implementation are thoroughly described by Chenorkian [26].

Briefly, OHMs have been implemented as part of the French government's "Investing in the Future Program" (*Programme d'investissement d'avenir*) [26]. Their role is to enable the study of anthropized ecosystems that are susceptible to socio-ecosystemic crises; they have "been designed as a means of stimulating, supporting and organizing the interdisciplinary approach required to deal with the very great complexity of these phenomena" [26] (p. 294). To study the influence of unique disrupting events on the trajectory of local and anthropized socio-ecosystems, they are built on a ternary that consists of: (1) a "socio-ecological framework", which describes the context of a given place, (2) an anthropogenic "disrupting event", which disturbs it, and (3) a "focal object", the product of the first two components [26]. This provides a suitable framework for studying the transformations of local food systems within a globalized context that can be demonstrated through the comparison of five OHMs whose disrupting events can be linked to the process of food globalization at different temporal scales and intensity (Table 1; Figure 1).

Table 1. Description of the social-ecological framework, the disrupting event and the climate that describes the location of each OHM.

OHM	Social-Ecological Framework	Disrupting Event (Date)	Climate [1]
Téssékéré Senegal	Desertification of the Sahel region	Great Green Wall (2008)	Hot semi-arid (arid, steppe and hot; *BSh*)
Oyapock French Guiana, France	Opening of the Franco-Brazilian cross-border region by road access	Oyapock River Bridge (2017)	Tropical rainforest (*Af*) to tropical monsoon (*Am*)
Littoral Caraïbes Guadeloupe, France	Development of an urban port complex in an island context	Transformation and acceleration of maritime trade (from the 1970s)	Tropical rainforest (*Af*)
Nunavik Québec, Canada	Sedentarization, urbanization and economic development of Québec's arctic region	Plan Nord, i.e., Plan North (2011)	Tundra (polar tundra; *ET*) to subarctic (cold, without dry season and cold summers; *Dfc*)
Estarreja Portugal	Environmental pollution linked to a complex of chemical industries (CQE) near the Aveiro Lagoon	Adoption of virtuous practices within the CQE (1990)	Warm-summer Mediterranean (temperate, dry and warm summers; *Csb*)

[1] Based on the most recent maps of the Köppen-Geiger climate classification [27].

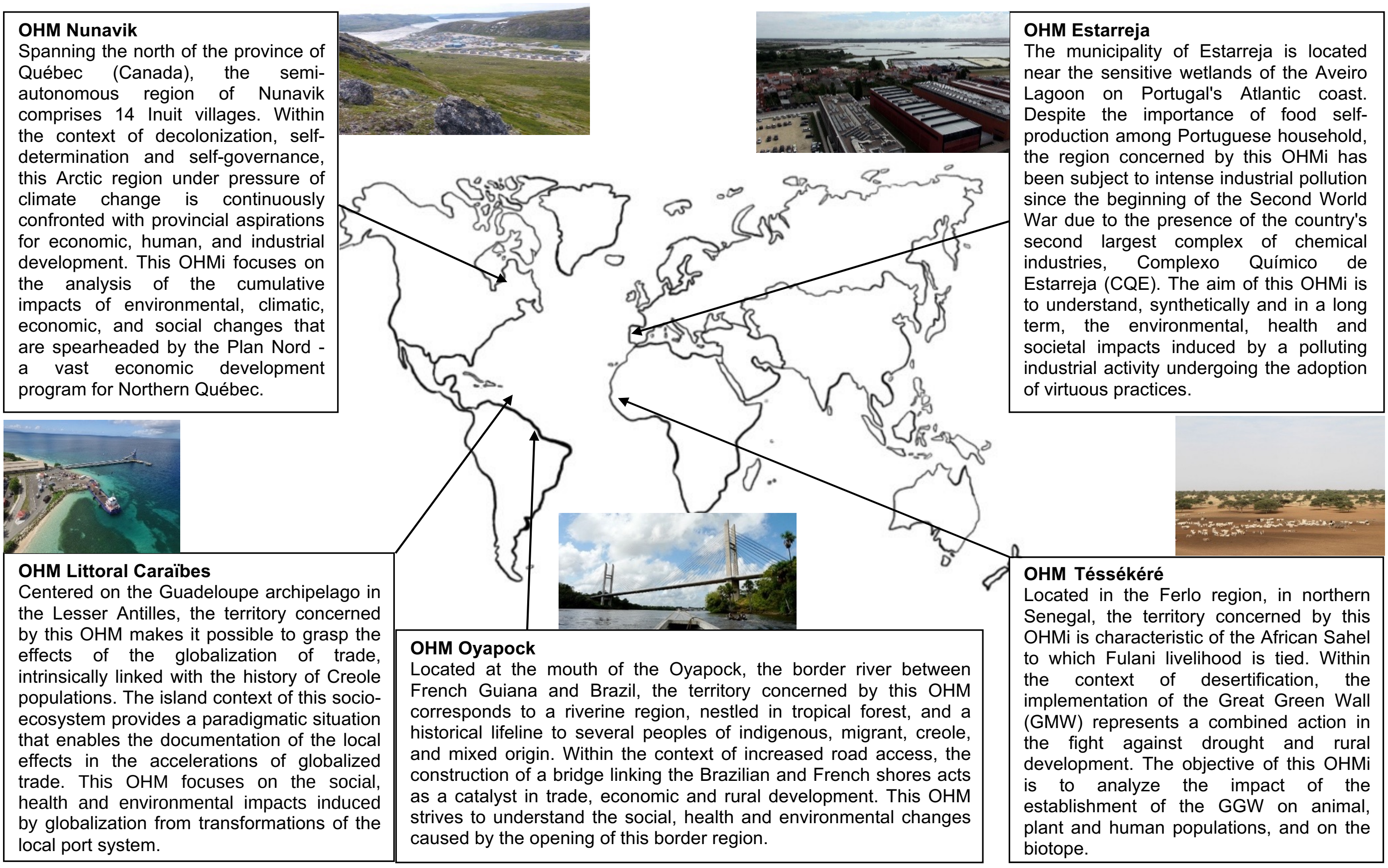

Figure 1. Description of the regions impacted by the disrupting event identified by each OHM, i.e., the focal object [26].

These five OHMs were selected for their geographical, social, cultural and environmental diversity within the network. They span four continents (i.e., Africa, Europe, North America and South America), thus including diverse peoples with unique food systems of Indigenous and non-Indigenous heritage. More precisely, they are all characterized by mixed food consumption, between the use of local products and imported industrialized products introduced into family consumption circuits. Furthermore, each region is characterized by a distinct environment with different levels of geographic isolation and integration into the global food trade, therefore justifying their inclusion in a transverse assessment of globalization's impact on local food systems. A large majority of the authors have been working in the selected OHMs since their creation. Ahead of a concerted effort to document and transversally analyze the evolution of local food systems through a communal protocol, this study provides a perspective based on years of past research and immersion, feedback from experience as well as ongoing research in every socio-ecosystem included herein. Hence, the bibliographic work carried out was not intended to be exhaustive. Instead, it was guided by interdisciplinary research activities conducted in each OHM to mobilize: (i) the scientific and grey literature that they have produced in relation to their concerned food systems and (ii) relevant and complementary literature to facilitate a cross-comparison of each region.

3. Impacts on Human Health: Nutritional and Dietary Transitions

Global trends in the evolution and increasing prevalence of non-communicable diseases were first theorized in 1971 by Omran [28], who posited a model of epidemiological transition whereby patterns of high prevalence of infectious diseases are replaced by high prevalence of chronic and degenerative diseases associated with urban and industrial lifestyles. This is accompanied by a demographic transition, theorized formally in the 1940s by Notestein [29,30], whereby high fertility and mortality rates in societies shift to lower rates of fertility and mortality. The model is further complemented by the notion of nutritional transition, first proposed by Popkin [31] to describe a series of changes in the composition of dietary regimes (i.e., structure and composition of meals) that accompanies the technical development and urbanization of societies. These three models are indissociable from one another, as shifts in diet structures are linked to the nature of diseases, which therefore accompany demographic shifts associated with life expectancy [31–34].

Overall, nutritional transition describes shifts where "diets high in complex carbohydrates and fiber give way to more varied diets with a higher proportion of fats, saturated fats, and sugars" that have been associated with a higher prevalence of non-communicable diseases like obesity and type 2 diabetes [32] (p. 31). Whereas energy intake is mainly provided initially by complex sugars with an important share of vegetable proteins and lipids, the proportion of food of animal origin increases in diets that have transitioned, thus giving way to a greater contribution of animal protein and lipids to energy intake, and simple sugars take precedence over complex sugars [35]. These changes have been observed in populations from high- to low-income countries under the influence of urbanization, the commodification of food (i.e., transition from self-production to a market economy), the industrialization of the food chain and globalization [7].

Originally developed to describe and predict global trends, the linear patterns and stages of these transitions (i.e., epidemiological, demographic and nutritional) have since been revisited in light of certain countries that do not perfectly fit into these models due to several factors—social, political and economic—that characterize different human populations [7]. In developing the notion of nutrition transition, Popkin [31,33] described five broad dietary patterns (i.e., 1—collecting food, 2—famine, 3—receding famine, 4—degenerative diseases and 5—behavioral change) that are summarized by nutritional, economic and demographic factors and characteristics, as well as levels of food processing. Although they are outlined as historical developments, Popkin noted that "they are not restricted to peculiar periods of human history" and that they "continue to characterize certain geographic and socioeconomic subpopulations" [31] (p. 139). Furthermore, the historical and current dietary patterns of many peoples around the world do not necessarily fit perfectly into these five broad patterns outlined above. For a long time now, the traditional diets of the Inuit and many First Nations people across North America's arctic and boreal forest regions have been notably characterized by considerable energy intake from animal protein and fat [36–39]. Although the contribution of foods of plant origin is not negligible, these dietary patterns remain nonetheless far and away from those high in complex carbohydrates and fiber that characterize the starting point of the nutrition transition.

In resolving such incongruities, the nutrition transition, which may best be qualified as many nutrition transitions [20], is frequently employed in a broader fashion to describe dietary changes from "traditional" foods to industrialized, marketed and processed foods through the ever-increasing influence of a globalized food system that drives global shifts and behavior [40]. One of the major global shifts in line with nutrition transitions is the contribution of fat and edible oils to energy intake. Most notably, the consumption of vegetable oils all over the world has seen great changes since the 1940s following a generalized policy of production and subsidies, which has enabled many societies to access diets richer in lipids at income levels much lower than before [32]. This is exacerbated by an acceleration in urbanization rates that allows nutrition transitions to occur in nations with much lower levels of gross national product; documented in South and North America [41,42], Asia [33,43–45] and Africa [46–48], the shift to high-fat diets is no longer an issue of rich and industrialized nations [32]. In the United States, for example, the percentage of energy intake from fat increased from 32.0% to 33.2% from 1999–2016 [41]. In the Philippines, it increased from 10% to 28% from 1983–2004 [45]. In China, it increased from 23.1% to 35.6% from 1991 to 2015 [44].

A second major global shift is the sweetness of food. Although added sugars from beverage sales decreased by 22% in high-income countries from 2007–2019, they increased up to 40% in middle-income countries, and added sugars from packaged food sales increased by 9% globally [49]. Finally, the contribution of snacking on energy-dense and nutrient-poor foods and beverages towards energy intake has become an increasing cause of concern globally [50–53]. Global trends in sales of ultra-processed foods and drinks increased from 2002–2016 [54]. Exceptions to this trend in Western Europe, North America and Australasia reveal the efficacy of statutory policies on the marketing of such products in reducing the sale of snack foods [54,55]. Nonetheless, this highlights how marketing is changing the way the world is eating and how big players, namely global agribusinesses, retailers, food manufacturers and large restaurant chains, are turning their attention from high- to low- and middle-income countries in driving food system changes [56,57].

Aside from nutritional changes in diets, these global shifts also demonstrate how the process of food transformation is changing as well. Dubbed by some as the food transition, this notion focuses more on the social processes by which food is produced and consumed [7]. These processes include social differentiation, identity construction and forms of regulation, which have consequences for changes in the origin of food, their modes of acquisition and on the distance they impart to the relationship between eaters and their food [7]. The big players of the global food systems certainly play an important role in changing and structuring this system, such as the importation or on-site manufacturing of processed products, and the behavior of consumers, such as out-of-home eating exemplified by the likes of the fast-food phenomenon [35]. Nonetheless, their success at a local level also depends on the social constructs and representations surrounding pre-existing food systems with which they can integrate, compete, co-exist, or outlast. The notions of food and nutrition transitions are undeniably intertwined, as changing foods implies changing nutrients. They are also inseparable in understanding how food systems evolve locally in different socio-ecosystems. Hence, the stakes involved in changing food systems are multifaceted and are not simply issues affecting nutrition and public health.

4. Food Systems and Their Transformations

Changes in the food systems of different socio-ecosystems are subject to many geographical, economic, cultural, and environmental factors, among others. Access to different categories of food depends on the places and living standards of human populations, as well as on production and distribution systems, which vary from place to place. Throughout the 20th century, all the populations living in the regions concerned by the five OHMs experienced substantial changes to their environment and their food systems linked to their identified disrupting event (Table 1; Figure 1), due in particular to the physical opening up of these territories, a greater connection to a globalized system extending hand in hand with global trade liberalization, as well as environmental degradation (Table 2).

Table 2. Summary of factors influencing the food systems of regions concerned by one or more OHMs.

Factors of Influence	Examples
• Socioeconomic	Purchasing power of individuals and households
• Environmental	Climate change, industrial pollution
• Geographical	Level of isolation and connectivity, proximity to markets
• Globalization	Supermarket chains, containerization, trade liberalization
• Governmental policy	Economic, geographical and industrial development, trade liberalization
• Historical	Colonization, sedentarization, assimilation
• Identity and cultural	Customs, practices, values, both shared and individual
• Industrial	Massification of crops, transformation and distribution of food products
• Sanitary	Food contamination (e.g., pollutants), consumption of "good" and "bad" food

4.1. Regional Examples

4.1.1. Nunavik, Canada

During the 1950s in the Canadian Arctic, governmental policies concerning the sedentarization of Inuit Peoples led to a gradual reduction in self-sufficiency from local country food issued from hunting, fishing and wild harvesting activities that include marine mammals (e.g., beluga (*Delphinapterus leucas* (Pallas, 1776); Monodontidae), walrus (*Odobenus rosmarus* (Linnaeus, 1758); Odobenidae) and seals (Phocidae)), fish (e.g., Arctic char (*Salvelinus alpinus* (Linnaeus, 1758); Salmonidae) and sculpins (*Myoxocephalus* spp.; Cottidae)), land mammals (e.g., caribou (*Rangifer tarandus* (Linnaeus, 1758); Cervidae)), wildfowl (e.g., Canada goose (*Branta canadensis* (Linnaeus, 1758); Anatidae) and ptarmigan (*Lagopus* spp.; Phasianidae)), as well as rosaceous (cloudberries (*Rubus chamaemorus* L.)) and ericaceous berries (*Vaccinium* spp. and crowberries (*Empetrum nigrum* L.)) [37,58–64]. In Nunavik, this has led to an increase in the consumption of imported, store-bought food from supermarkets located in each northern village of the region [65–67]. By 2011, globalized commercial foods had integrated well into a food system still characterized by local country foods. Yet, Plan Nord promises to intensify changes to the food system, particularly through regional development that will have an impact on access to store-bought and country foods. The share of ultra-processed foods, rich in saturated fats, sugars and additives, remains particularly significant in current dietary practices, while physical exercise is reduced due to an increasingly sedentary lifestyle, even if hunting, fishing and gathering practices maintain a strong identity role even for the younger generation [65,68,69].

4.1.2. Ferlo, Senegal

During the 1970s, the food system of the Fulani herders of the Ferlo in Senegal experienced important transformations due to an episode of intense drought in the Sahel. By the time the Great Green Wall was initiated with the intent of minimizing the expansion of the Sahara Desert, the food system in Téssékéré and its surroundings, located in the Ferlo, had transitioned from almost total dietary self-sufficiency based on livestock (e.g., Bovidae like cattle (*Bos taurus indicus* Linnaeus, 1758), goats (*Capra hircus* Linnaeus, 1758) and sheep (*Ovis aries* Linnaeus, 1758)), dairy products (e.g., butter and curdled milk from livestock, cattle in particular), local fruits (e.g., desert date (*Balanites aegyptiaca* (L.) Delile; Zygophyllaceae), tamarind (*Tamarindus indica* L.; Fabaceae) and baobab (*Adansonia digitata* L.; Malvaceae)), wild dietary plants (e.g., *thiaftoki* (*Leptadenia lancifolia* (Schumach. & Thonn.) Decne.; Apocynaceae) and sicklepod (*Senna obtusifolia* (L.) H.S. Irwin & Barneby; Fabaceae)), local cereals and legumes (e.g., pearl millet (*Pennisetum glaucum* (L.) R.Br.; Poaceae) and niebe (*Vigna unguiculata* (L.) Walp.; Fabaceae)) and game (e.g., gazelles (*Gazella dorcas* (Linnaeus, 1758); Bovidae), ostriches (*Struthio camelus* Linnaeus, 1758; Struthionidae) and guineafowl eggs (*Numida meleagris* (Linnaeus, 1758); Numididae)) to a diet increasingly dependent on imported products offered on local weekly markets (e.g., China tea (*Camellia sinensis* (L.) Kuntze; Theaceae), Asian rice (*Oryza sativa* L.; Poaceae), sugar, vegetable oils and milk powder) [70–74].

4.1.3. Guadeloupe, France

At the same time in Guadeloupe, the growing containerization of maritime trade contributes to the intensification of trade, particularly regarding perishable goods [75]. As a French overseas department, the Caribbean island has access to the European Economic Area and therefore benefits from trade liberalization with other member states via France. Inevitably, the island population has moved away in part from the Caribbean Creole food model [76,77]. This model is characterized by an important contribution of fish to the diet (e.g., mahi-mahi (*Coryphaena hippurus* Linnaeus, 1758; Coryphaenidae), bigeye scad (*Selar crumenophthalmus* (Bloch, 1793)) and snappers (*Lutjanus* spp.; Lutjanidae)), as well as meat from livestock (e.g., chicken (*Gallus gallus domesticus* (Linnaeus, 1758)) and goats) and plant-based foods from Creole gardens, both of which hint at Guadeloupe's colonial past of incorporating several species introduced to the island during that era [76–80]. These gardens include fruits (e.g., bananas (*Musa paradisiaca* L.; Musaceae), guava (*Psidium guajava* L.; Myrtaceae), pinneaple (*Ananas comosus* (L.) Merr.; Bromeliaceae), soursop (*Annona muricata* L.; Annonaceae), mangoes (*Mangifera indica* L.; Anacardiaceae), passion fruits (*Passiflora edulis* Sims; Passifloraceae) and various citruses (*Citrus* spp.; Rutaceae)), vegetables (e.g., chayote (*Sechium edule* (Jacq.) Sw.; Cucurbitaceae), avocado (*Persea americana* Mill.; Lauraceae), gombo (*Abelmoschus esculentus* (L.) Moench; Malvaceae) and squash (*Cucurbita maxima* Duchesne; Cucurbitaceae)), legumes (e.g., pigeon pea (*Cajanus cajan* (L.) Huth; Fabaceae)) and tubers (e.g., yams (*Dioscorea* spp.; Dioscoreaceae), sweet potatoes (*Ipomoea batatas* (L.) Lam.; Convolvulaceae), dasheen (*Colocasia esculenta* (L.) Schott; Araceae), arrowroot (*Maranta arundinacea* L.; Marantaceae) and cassava (*Manihot esculenta* Crantz; Euphorbiaceae)) that characterize small family farming or that can be acquired on local markets [79–82]. Nowadays, the food system increasingly includes products from international trade, such as potatoes (*Solanum tuberosum* L.; Solanaceae), wheat (*Triticum aestivum* L., Poaceae)-derived products like pasta as well as poultry, biscuits, sugary drinks and other ultra-processed products [76,77].

4.1.4. French Guiana, France

The status of French Guiana as a French overseas department enables it to access international markets in a similar fashion to Guadeloupe. Nonetheless, it was not until the opening of the road network in the early 2000s that the food systems of the lower course of the Oyapock River, which was only accessible by plane and boat until then, in the department's eastern region experienced a stark reduction in the contribution of food from self-production [83–85]. Due to an important Creole population residing in the region, Creole gardens have played an important role in shaping the local food system, where fruits, vegetables, legumes and tubers, such as those listed for Guadeloupe, are cultivated. The food system is further enriched by Indigenous swidden-fallow models of cultivation that center on cassava crops [83,85–87], along with game hunting that includes land mammals (e.g., collared peccary (*Pecari tajacu* (Linnaeus, 1758); Tayassuidae), brocket deer (*Mazama* spp.; Cervidae) and agouti (*Dasyprocta leporina* (Linnaeus, 1758); Dasyproctidae)), wildfowl (e.g., black currasow (*Crax alector* Linnaeus, 1766; Cracidae) and grey-winged trumpeter (*Psophia crepitans* Linnaeus, 1758; Psophiidae)) and reptiles (e.g., iguana (*Iguana iguana* (Linnaeus, 1758); Iguanidae) and tortoises (*Chelonoidis* spp.; Testudinidae)), as well as fishing (e.g., giant wolf fish (*Hoplias aimara* (Valenciennes, 1846); Erythrinidae), stripped mullet (*Mugil incilis* Hancock, 1830; Mugilidae) and banded cichlid (*Heros efasciatus* Heckel, 1840; Cichlidae)) and wild harvesting of dietary plants (e.g., maripa palm (*Attalea maripa*

(Aubl.) Mart.; Arecaceae), açaí (*Euterpe oleracea* Mart.; Arecaceae), *aymoutabou* (*Moutabea guianensis* Aubl.; Polygalaceae); bagasse (*Ambelania acida* Aubl.; Apocynaceae)) [84,88–93]. Introduced and imported products such as Asian rice are now more consumed than couac (i.e., roasted cassava flour, a staple of the lower Oyapock diet) [84], while chicken and pork from global factory farms have supplanted the consumption of wild game.

4.1.5. Aveiro, Portugal

Finally, the situation of the Aveiro district is different. As a member of the European Economic Area, Portugal benefits from trade liberalization with other member states. However, modifications to the food system there are old, notably due to the country's historically close contacts and exchanges with other continents (Africa and the Americas in particular). Therefore, transformations linked to globalization can hardly be interpreted in the same way as in other socio-ecosystems. The appearance of supermarkets in this area is relatively recent (2000s), and industrial foodstuffs from the globalized food system are increasingly accessible and therefore more present despite the presence of local markets that continue to offer locally produced and harvested food. Small-scale farming and self-production from kitchen gardens (e.g., tomatoes (*Solanum lycopersicum* L.; Solanaceae), cabbage (*Brassica oleracea* L.; Brassicaceae), maize (*Zea mays* L., Poaceae), potatoes [94–97]), livestock (e.g., cattle (*Bos taurus taurus* Linnaeus, 1758; Bovidae), pigs (*Sus domesticus* Erxleben, 1777; Suidae), poultry [98]) and milk production from cattle [98], along with shellfish harvesting (e.g., European cockle (*Cerastoderma edule* (Linnaeus, 1758); Cardiidae), peppery furrow shell (*Scobicularia plana* (da Costa, 1778)); Semelidae) [99,100]) and fishing (e.g., European bass (*Dicentrarchus labrax* (Linnaeus, 1758); Moronidae), sea lamprey (*Petromyzon marinus* Linnaeus, 1758; Petromyzontidae), European eel (*Anguilla anguilla* (Linnaeus, 1758); Anguillidae) [100,101]) remain important and valued. These activities of self-sufficiency are coupled with commercial activities in a constantly changing foodscape. The production of rice, for example, once played an important economic role in the region, but its cultivation is now practiced on a considerably reduced scale [98]. Furthermore, the presence of a polluting chemical complex (CQE) in the municipality of Estarreja has long brought attention to health risks associated with exogenous contamination linked to this industrial activity [94–97,102–104]. Despite the adoption of virtuous practices within the CQE, there is an increased sensitivity regarding different sources of pollution and an apprehension regarding industrial pollution. This appears to reflect the last pattern of Popkin's model of the nutrition transition that corresponds to behavioral changes [31]. This resonates with the region's disrupting event (Table 1, Figure 1); promoting virtuous industrial practices in accordance with Portugal's public health policies potentially favors the preservation and emergence of short food circuits centered on local production so that the local population can integrate healthy food products into their diet to promote the reduction of chronic non-communicable diseases.

4.2. Food Profiles and Typologies

As Fumey [105] (p. 74) points out, modifications to food systems take place over the long term, and the societies concerned, far from making a clean sweep of the past, integrate new products by adapting them to their needs built from past consumption, which are themselves based on dietetics and religions, tools and techniques, availability and exchanges, desires or rejections. Thus, and in most of the socio-ecosystems included herein, several food system profiles co-exist.

Several food profiles distinguished in French Guiana and Guadeloupe reflect populational distinctions as well as similarities due to increasing exposure to a globalized food system [76,77,106]. Along French Guiana's Oyapock River, the Indigenous food profile is characteristically based on the cultivation and consumption of cassava along with meat and fish from hunting and fishing, complemented with plant-based products from wild harvesting [76,89]. This coexists with an Amazonian Creole food profile that, despite the historical influence of Indigenous food systems, shares some similarities with the Caribbean

Creole model from Guadeloupe; both are characterized by a predominance of rice over cassava, as well as high consumption of fish, fruits, vegetables and tubers. All three typologies are inevitably low in products processed by the food industry and fast food, yet they are changing rapidly, such as through the reduction of hunting, one of the features distinguishing the Amazonian Creole food profile from its Caribbean counterparts, and agricultural practices.

In French Guiana, both typologies described undeniably have influenced and continue to influence one another. Although geographical isolation has historically facilitated the preservation of the food system on the Oyapock River, proximity to Brazil has always enabled exchanges, and more recently, the introduction of ultra-processed foods. Nonetheless, food systems in both French Guiana and Guadeloupe have consistently been under the influence of imported food items and practices attributed to French populations from the European territory of France, along with evolutions to their associated food system. In Guadeloupe, not only has this led to a profile, characterized by a low proportion of fatty and sugary products with a high proportion of fruits, vegetables, legumes, cereals and dairy products, that mirrors the nutritional recommendations of the French National Health Nutrition Program (*Programme national nutrition santé*—PNNS), but has also led to one characterized by large consumption of processed products at the other extreme. Méjean et al. [76] identified a fourth profile in Guadeloupe that mixes agro-industrial foods and so-called "traditional" foods, hybridized and dubbed "in transition", which analyses from nutritional surveys corroborate as ongoing [107,108]. Although this pertains to Guadeloupe, this may very well apply to both French overseas territories that are increasingly being opened up.

Just as Méjean et al. [76] described the nutrition transition towards globalized foodstuff in the Caribbean to be advanced, a similar trend is described in Arctic Canada [39,109,110]. This trend dichotomizes two different typologies that are ascribed to Inuit food systems in Nunavik, namely one characterized by traditional Inuit food and another characterized by introduced market foods [111,112]. Despite important changes to Inuit lifestyles, hunted and wild-harvested foods are still stored in community freezers that are made available to village residents, thus supporting two key elements of Inuit culture: hunting and sharing [113]. Although imported and purchased foods are increasingly taking hold of the local food system, Inuit people maintain a strong link with the practice of traditional and subsistence activities [59,65,69], and the local food system can be more accurately described as hybrid. In keeping with this notion of hybridization, greenhouse projects that are being implemented in Nunavik reveal that these are being appropriated as a new practice of cultivation through the connection between gardening and berry picking, though local production of fruits and vegetables by these means is still limited and virtually inaccessible in most villages [66,67,114].

What the cases of Nunavik, French Guiana and Guadeloupe tell us is that typologies are not mutually exclusive. As the term "transition" implies, they exist on a spectrum and involve a process that is inevitably navigated by individuals and groups of people. The geographical opening of territories by infrastructure development (i.e., Plan Nord in Nunavik, port development in Guadeloupe and road access on the Oyapock) has and will likely continue to facilitate the importation of globalized ultra-processed and industrialized foods into local food systems. This implies a transition into an increasingly globalized food system that supposes a convergence towards homogeneity. Yet, this premise does not account for interactions between co-existing food systems, as is the case in French Guiana (e.g., Indigenous and Creole typologies), the possible divergence of paths as testified in Guadeloupe (i.e., typologies reflecting the French National Health Nutrition Program as opposed to processed foods) or active attempts at reappropriating the evolving food system on the premise of self-determination and increasing food security, as observed in Nunavik.

Both Estarreja and Téssékéré present cases where it is very difficult to say that several typologies co-exist. Indeed, the composition of meals is relatively stable, though the external offering is high in the former and low in the latter. Possibilities for local supply in both regions have both been undermined by environmental degradation in the past. Industrial pollution has been a source of contamination to locally produced food near Estarreja, but agriculture remains an important sector, just as households continue to grow vegetables and raise poultry despite the presence of supermarkets and large fast-food brands that offer alternatives [115,116]. In Téssékéré, desertification has led to the disappearance of winter crops and dairy resources; the Fulani food system therefore relies heavily on the weekly market for fresh produce and the village grocery stores, which is very clearly reflected in the discourse of the local population [117]. As opposed to Nunavik, French Guiana and Guadeloupe, which are experiencing rapid changes in recent times, the reason for the relative stability of the Estarreja food system may in part lie in the fact that it has evolved and changed slowly over time, modulated by a process of food globalization to which Portugal has contributed since the Colombian exchange. In Téssékéré, the attachment to Fulani culture and way of life remains linked to a few dietary traits, such as a central consumption of milk, but the latter is now imported and mainly purchased in powdered form [71,72]. Despite the population's limited financial means [117–120], junk foods (e.g., carbonated soft drinks and chips) are available, and their consumption is also restrained in part by their cultural and social representations [73,121]. One might argue that the relative stability of the Fulani food system is in part due to a low exposure to imported ultra-processed foodstuffs. However, local markets provided a point of entry for these products into a system whose resilience is rendered vulnerable by climate change, and is therefore susceptible to experiencing increasingly rapid changes.

5. Health Outcomes of the Nutrition and Dietary Transitions in the Five OHMs' Socio-Ecosystems

Nutrition and food transitions make it possible to set the framework for a comparison between the socio-ecosystems dealt with in this article. It appears that in Senegal, in the area concerned by the OHM Téssékéré, recovery from the consequences of the 1970s' drought would situate it in the pattern of receding famine, according to Popkin's model of nutrition transition [31]. Unlike the regions concerned by the other OHMs, the Ferlo region has not experienced the same level of reduction in the friction of the terrain, that is, the constantly increasing capacity to lower transport costs and delays that allows greater state control of these areas and thereby facilitates global food upheavals, constrained or not [122]. In the early 1980s, the Fulani diet was associated with a caloric intake in line with WHO recommendations, but not very diversified [74]. Forty years later, the diet characterizing the population of the rural commune of Téssékéré is a little more diversified, particularly in terms of manufactured and ultra-processed foods, and quantitatively a little more important than in the 1980s [70,71]. Acute malnutrition nevertheless remains a characteristic of the populations of the area [120]. The consumption of processed products from industry and brought to Ferlo is rare due to the lack of financial means, of course, but also due to the still-significant isolation of the region. On the other hand, the consumption of vegetable oil has increased considerably [71,73]. Nonetheless, if the presence of diseases associated with dietary imbalances is any indication, this would indicate that populations in Ferlo are gearing towards Popkin's fourth pattern of nutrition transition (i.e., degenerative diseases [31]); in 2015, the prevalence of diabetes was 4.2% [118], whereas those of overweight and obesity were 13.2% and 3%, respectively [119] (Table 3).

Table 3. Summary of the prevalences of diet-related non-communicable illnesses in each OHM. Prevalences in percentage (%) for each region are presented with the national average in parentheses. References are in brackets. ND = not determined.

Illness	**Nunavik (Canada)**	**French Guiana (France)**	**Guadeloupe (France)**	**Estarreja [1] (Portugal)**	**Téssékéré (Senegal)**
Overweight ($30 < BMI \geq 25$ kg/m^2)	29.8 (34) [123,124]	34 (29) [125]	31 (29) [126]	6.0 (6.4) [127]	13.2 (ND) [119]
Obesity (BMI ≥ 30 kg/m^2)	28.3 (15) [123,124]	18 (12) [125]	17 (12) [126]	10.1 (8.0) [127]	3.00 (ND) [119]
Diabetes	4.8 (4.8) [123]	8.08 (5) [128]	9.12 (5) [128]	8.3 (7.8) [127]	4.2 (ND) [118]
Ratio (Overweight+Obesity): Diabetes	12 (10)	6.4 (8)	5.3 (8)	1.9 (1.8)	3.9 (ND)

[1] Percentage of diagnosed cases in the region of Baixo Vouga where Estarreja is located.

In the regions concerned by the other four OHMs, however, the prevalence of non-communicable chronic diseases, namely diabetes, overweight and obesity, bears witness to Popkin's fourth pattern of nutrition transition (Table 3). The cases of French Guiana, Guadeloupe and Nunavik underscore notable health disparities and inequities when compared to their associated states, namely France and Canada (Table 3). Such disparities are well illustrated in French Guiana, where there is a lower density of liberal and mixed health professionals [107]. Diabetes, obesity and hypertension, whose prevalence was estimated at 18% in 2011 [129], are considered the most common chronic pathologies [130]. Furthermore, this region has a younger diabetic population than the European territory of France [131]. Adjusted for age, the prevalence of diabetes was 1.6 times higher than the national rate in 2015 [128] (Table 3). Furthermore, Richard et al. [125] estimated that more than half of the French Guianese population (52%) were overweight and obese (i.e., body mass index (BMI) ≥ 25 kg/m^2) compared to 41% in the European territory of France and that these disparities were greater in obese people, for which the rate in France was two-thirds of that in French Guiana (Table 3). Moreover, Delocalized Centers for Prevention and Care (*Centres Délocalisés de Prévention et de Soins*) of the Andrée Rosemon Hospital Center (*Centre Hospitalier de Cayenne Andrée Rosemon*) recorded the largest number of treated diabetic patients in Saint-Georges de l'Oyapock on the Oyapock River [132]. This reality was expressed through the discourse of Saint-Georges' residents who identified diabetes as one of the main health problems among the population [133]. Indigenous populations of the region, such as the Palikur, have been particularly concerned by diabetes for several decades. As one resident pointed out:

> *"There has been a big change in Saint-Georges since the 2000s; diabetes has doubled since the change in diet, the meals eaten now are not at all the meals eaten before because there was no freezing. To keep, it was only the things you could smoke, salt..."* [84].

In Guadeloupe, the distribution of dietary profiles created in the wake of such a dietary and nutrition transition were marked by a generational effect: older populations adopted a so-called "traditional" profile, whereas younger populations had a so-called "modern" profile, transformed and more caloric [77]. The consequences of this nutritional transformation are significant, as the first cause of mortality in Guadeloupe is attributed to the development of chronic diseases [134]. In 2014, nearly half of the population was overweight or obese (Table 3), and these conditions are accompanied by an increased risk of many cardio-metabolic pathologies. For example, diabetes-related mortality, which is higher in Guadeloupe than in the European territory of France [135], increased between 2010 and 2015 [136]. To deal with these health problems, many public policies are undertaken to promote a transition towards a more sustainable agri-food system [137]. In Canada, however, various public health policies have failed to curb the incidence of pathologies associated with weight and diabetes. Among Inuit women, abdominal obesity was observed in nearly 71% of the group, while 15% were affected by hyperinsulinemia [138]. Consumer preferences are partly influenced by socio-economic characteristics, as ultra-processed foods (i.e., chips, sweets, sodas, etc.) appear more affordable and more nutritious when compared to unprocessed store-bought produces like fruits, vegetables and meat, all of which remain expensive [139]. The economic dimension of processed food is compounded by elevated costs associated with hunting (i.e., snowmobiles, boats, gas, guns and ammunitions), which can widen inequality and decrease food security by hindering access to country foods among financially precarious families [66,67,140,141]. According to the Health Quebec survey, such foods accounted for "16% of energy intake in 2004, compared to 21% in 1992" [142] (p. 2).

In contrast to French Guiana, Guadeloupe and Nunavik, Estarreja does not demonstrate the same level of geographical health disparities, as the prevalence of diabetes, overweight and obesity was similar to national rates (Table 3). Although the prevalence of diabetics in Portugal is comparable to that of French Guiana and Guadeloupe, the ratio of the overweight and obese population to diabetics is noticeably smaller than that observed for France and the two overseas departments included here (Table 3). This is alarming for the French territories, as the high rate of overweight and obesity, which remain the strongest modifiable risk factors associated with the development of diabetes [10,143], suggests that the number of diabetics will likely increase in those regions. This is also true for Canada, and even more so for Nunavik where the ratio of the overweight and obese population to diabetics reveals an even greater gap (Table 3). For Estarreja and Portugal, on the other hand, this could be an indicator that they are well on their way out of the fourth pattern of the nutrition transition described by Popkin [31] (i.e., degenerative diseases) and heading into the fifth (i.e., behavioral changes).

The fifth pattern of Popkin's nutritional transition lies in part in adopting behaviors promoting the consumption of healthier food [31]. Very often, short food circuits are perceived as being the best source from which to acquire healthy food. However, in the regions of four of the five OHMs herein, local products appear to be contaminated. Concerns over the impact of organic and inorganic contamination in food on human health remain elevated in Estarreja due to chemical industries (CQE) near the Aveiro Lagoon (Table 1; Figure 1). Geochemical studies have shown an evolution over time in the distribution of inorganic pollutants: (i) progressive confinement of certain trace metals (e.g., mercury) in the immediate environment of the chemical complex and (ii) continuous extension of water and soil contamination by other trace metals (e.g., arsenic) [103]. Several studies have shown such metals as the contaminants presenting the most cancerous and non-cancerous risks for the exposed population, particularly in three localities of the municipality of Estarreja: Veiros, Beduído and Pardilhó [94,102,104]. Furthermore, the content of trace metals (e.g., arsenic, mercury, copper and zinc) in soil and vegetables harvested in family gardens near the chemical complex indicates that 46%, 15% and 11.5% of soils, respectively, presented concentrations of arsenic, copper and mercury higher than the thresholds established by Canadian legislation [144]; while cabbage leaves concentrated arsenic, mercury and zinc, tomatoes concentrated copper [95–97]. Risk perceptions by individuals of Estarreja's population presented differences according to the environments frequented and the professional activities they have developed throughout life. More precisely, the greater the relationship with industrial activity (i.e., has worked or is working, has family members who have worked or are working) and the closer the activities are in the territory (e.g., subsistence agriculture, livestock farming), the greater the notion and visualization of the risk by the people interviewed [104]. On the other hand, a moderate presence of avoidance behaviors has been identified. Although 30% of the population declared that they did not consume local products, they did not express fears linked to contamination, and 10% declared they consume water from wells [104]. Despite this, the question as to whether or not fishing and local agricultural production activities present a health risk in the diet of local populations due to contamination persists. Among all factors presented herein, contamination undeniably presents itself as another influencing factor of transformation in the food system (Table 2). Moreover, how does this undermine efforts to tackle the incidence of chronic diseases like diabetes and obesity when the alternative that is increasingly presented is the "safe haven" of the global food system?

This conundrum is particularly relevant to Nunavik, French Guiana and Guadeloupe which are bearing the brunt of the nutrition and dietary transition in terms of health outcomes. In French Guiana, gold mining is a concerning source of environmental degradation. Such activities have led to mercury contamination in fish caught in the Oyapock River [145–147]. Furthermore, high lead levels detected in blood have been associated with the consumption of couac and other products derived from cassava, as well as big game [148,149], though the origin of this environmental contaminant has yet to be determined. Concerns associated with lead poisoning are particularly real among the inhabitants of the villages of the Oyapock [149,150], who still partially depend on hunting and fishing products, as well as cassava-derived products. This is all the truer for the Palikur, who also depend on these modes of subsistence and whose cultivation and consumption of cassava still define their identity [89]. In Guadeloupe, the banana plantation system has long been a source chlordecone input into the ecosystem, persisting in the soil and accumulating in root vegetables grown in family gardens [107,137]. Adding to this, *Sargassum* spp. (Phaeophyceae) seaweed blooms that act as sources of exogenous arsenic to the local socio-ecosystem have plagued the coast of Guadeloupe, and the Caribbean, since the beginning of the 2010s [151]. Notwithstanding threats to environmental health, this has increasingly become an international public health concern, let alone exposure to toxic gases produced by *Sargassum* decomposition [152]. In Nunavik, there is also an increasing concern regarding the contamination of local country foods by organic (e.g., polychlorinated biphenyls—PCBs [153–155], perfluoroalkyl acids—PFAAs [156]) and inorganic (e.g., lead [155,157], mercury and its organometallic counterpart methylmercury [37,154,157]) pollutants in fish and marine mammals, as well as the presence of zoonotic pathogens, such as *Toxoplasma gondii,* linked with the consumption of marine mammals and feathered game [158]. These situations that exacerbate food insecurity contribute to the social and psychological malaise of Inuit people residing in Nunavik, where country foods are associated with Inuit identity, are integrated with spiritual beliefs and play a role in health and well-being as an integral part of Inuit medicines [69,159,160].

Environmental contaminations in these regions are not isolated, nor are they issues that simply concern local food systems. While there are no known anthropogenic sources of mercury in the arctic region of Nunavik, the safety of local country foods is of great concern, as they bioaccumulate high concentrations of environmental contaminants [37]. Inorganic mercury emissions that are released from coal burning and artisanal gold mining in East and Southeast Asia, for instance, accumulate at the poles following long-range atmospheric, oceanic and river transport [37]. Moreover, many semi-volatile and persistent environmental contaminants that include PCBs are transported from warmer regions of the earth to colder regions by global distillation [161]. This geochemical process thus implies that few places on the planet can escape these pollutants, as they travel far from their source of emission, either anthropogenically or facilitated by climate change [161], and accumulate at the poles. While the decline in the consumption of marine country foods in Nunavik has been identified as the most important factor associated with decreasing levels of mercury and PCB contamination in individuals, it is inversely related with a shift towards an increased consumption of store-bought food [154]. With this in mind, the globalization of food takes a new meaning, one that extends beyond the capacity to transport industrialized and processed foods to all corners of the world but includes the health of environments that produce food. Transitioning between local food systems and the global food system ironically presents itself as a double-edged sword, both figuratively and literally, with favorable and unfavorable human health consequences in either direction, or more appropriately: a catch-22.

6. Conclusions: Interrogating the Relationship between Food Systems, the Environment and Health through the Lens of Populations

In the context of an increasingly globalized food system and increasingly contaminated local food supplies, consumers are left with choices that they may justify through a multitude of ways. Public health policies in a number of countries worldwide strive to act as beacons to guide societies out of the plunge into chronic and non-communicable diseases by attempting to change and influence diets based on the current state of knowledge in nutrition and dietetics: this is the *etic* perspective viewed through the lens of research and researchers. This is exemplified by the existence of a multitude of front-of-pack and back-of-pack labelling systems. Based on a meta-analysis of the efficacy of front-of-pack labelling, however, Ikonen et al. [162] (p. 1) argued that the ability of such labels "to nudge consumers toward healthier choices is more limited" because such labels may lead to a halo effect by positively influencing consumer health perceptions of both "good" and "bad" foods [162]. Furthermore, recent crises, such as the COVID-19 pandemic, and global food shortages due to 2022′s extreme drought in Europe and the conflict in Ukraine, continue to underscore vulnerabilities in the global food system. One of the outcomes of the COVID-19 pandemic, for example, has been the valorization (or revalorization) of smaller food supply chains and local produce in Guadeloupe based on the premise of solidarity towards local producers and the wish to eat healthily [163], despite general concerns of environmental degradation by chlordecone and contamination of local food supplies. The evolution of eating habits is based on long-, medium- and short-term events that may have a lasting or ephemeral impact on how certain foods are perceived and preferences justified: this is the *emic* perspective viewed through the lens of populations and their people. Thus, dietary habits, preferences and values given to the cultural capital of foods (e.g., traditional vs. exotic food; local vs. imported food; natural vs. processed food; non-contaminated vs. contaminated food; healthy vs. non-healthy food) play an important role in maintaining, improving or deteriorating the state of health, as well as driving changes to food systems in general.

Despite the pervasive nature of food globalization, all five regions presented here hang on to the particularities of their traditional food system. In Guadeloupe, French Guiana and Nunavik, this has led, in part, to the creation of different food typologies characterized by indigenous and introduced foods, for example, that interact with one another and may hybridize. The presence of industrialized and ultra-processed foods is imposing on these food systems in full transition, and their consequence on health, leading to relatively high prevalences of chronic diseases is in keeping with Popkin's model of the nutrition transition. Despite its relatively stable food system, the Ferlo (Senegal) appears as the most vulnerable one. Recovering from an historically important famine, the diversification of foodstuffs from global trade could spell the beginning of a shift towards an increasing incidence of chronic diseases. In Portugal, on the other hand, the current food system appears to cope well with globalization. However, to suggest that it has entered the last pattern of the nutrition transition (i.e., behavioral changes) does not shield it from change, nor from further succumbing to food globalization and the health impacts it carries.

Indeed, the notion of food systems makes it possible to consider the complexity of structures of which food is a reflection [164]. Herein lies one of the limits of this study: it is difficult to make broad generalizations regarding the evolution of food systems due to the complexity of local situations. Despite attempting an in-depth assessment of several case studies, these can be called into question when the influence of lifestyles that have not been considered or overlooked is appraised (e.g., Brazilian populations in French Guiana, Indian populations along with Creole populations from other Caribbean Islands in Guadeloupe, Wolof populations in the Senegalese Ferlo or simply the effect of any population migrating back and forth from a specific location, and in and out of a specific food system). To account for the composition and the overall functioning food systems, as well as manners by which they evolve and transform, the adoption of an interdisciplinary approach is essential. This is reinforced when attention is paid to consequences on health, both in humans and, more generally, ecosystems, which are both mutually influenced. The integrative notion of the One Health concept therefore takes on its full extent [165]. In keeping with this approach, OHMs provide an appropriate tool for the transversal and long-term analysis of food systems and their transformations. The strength of this research network lies in the diversity of socio-ecosystems where observations made in the long term can contribute to the development of detailed local knowledge and an understanding of the dynamics of change at a global scale. More precisely, such long-term monitoring can enable the observation of how the speed of change along with the nature of the implicated factors influence the sustainability and trajectory of evolving local food systems in a globalized world. Such results, including those presented here, can benefit (1) political decision-makers in adjusting local dietary policies or (2) local organizations implicated in indirect actions (i.e., promotion of culture, valorization of knowledge), in order to reinforce local food systems or insert desired social developments into local cultural contexts. The focus on socio-ecosystems and human-environment interactions promptly fosters interdisciplinary research conducted through multiple lens and perspectives, namely *etic* and *emic*, for a holistic understanding of food systems under influence.

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