

## Healthy and sustainable diet: a narrative review of the challenges and perspectives

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**Abstract** *Based on the principle that a non-sustainable food system is not capable of producing healthy food for consumption, food can only be considered healthy if it is also sustainable, going beyond the nutritional perspective. Therefore, a narrative review of the scientific literature on the sustainable and health food system was conducted, regarding aspects of production, processing, marketing and consumption, seeking to pinpoint the challenges and perspectives for its consolidation. Food systems needs to be related to a food production and consumption system which protects biodiversity and promote a diverse consumption, bringing back traditional dishes and preparation techniques. It should also be accessible and available for everyone, both in quantity and in quality, based on food that is locally produced by family farmers through agroecology and founded on fair trade, bringing production and consumption closer together. In addition, it must be free from physical, biological or chemical contaminants that cause damage to everyone involved, whether it be an isolated incident or chronically.*

**Key words** *Food production, Products commerce, Food-processing industry, Health behavior*

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## Introduction

Concerns with nutrition have changed over time. In 1934, Argentine physician and nutrition expert Pedro Escudero recommended that a healthy diet was one that was qualitatively complete, quantitatively sufficient, harmonious in its composition and adequate for its purpose and the individual<sup>1</sup>. For a long time, concerns with nutrition have focused on the consumption of large amounts of foods that are high in sugar, sodium and fat. These concerns are pertinent, as consuming large amounts of such foods, combined with factors such as stress and sedentary lifestyles, is related to the incidence of Non-Communicable Chronic Diseases (NCCD), which in recent years have accounted for high mortality rates among the population<sup>2</sup>. In light of these trends, the World Health Organization (WHO) has made recommendations in the form of a Global Strategy on Diet, Physical Activity and Health (DPAS)<sup>3</sup>. It is worth highlighting that Escudero's recommendations made in 1934 were ratified by the Global Strategy and remain relevant for the nutritional quality of food consumed. However, it is also undeniable that we must incorporate requirements related to food production and processing that, at the time, were unnecessary.

Changes in our food system are recent, yet the social, economic and environmental damages it causes are growing. The food system is a set of processes that include agriculture, animal husbandry, food production, processing, distribution, supply, marketing, preparation and consumption of food and beverages<sup>4</sup>. In our approach to food systems we must consider all of the determinants of food consumption, based on the relationship between the different players in the chain: producers, distributors and consumers<sup>5</sup>.

The contemporary diet is no longer sustainable<sup>6,7</sup>, as it is made up of foods whose production is energy intensive and has an impact on the environment, requiring vast tracts of land, which could exacerbate other problems related to food production and supply<sup>7</sup>. Recommendations for a healthy diet should therefore include sustainability as a key dimension. Healthy foods should be part of a food system that is economically viable, environmentally sustainable and socially fair or, in other words, a sustainable diet.

Sustainable diet or sustainable nutrition are not new terms, however there is no widely used

definition for them. They were described for the first time in 1986 by Gussow and Clancy<sup>8</sup> as a diet made up of foods that are not only healthy, but that also contribute to the sustainability of the entire nutrition system. The complexity of a sustainable diet was demonstrated by the United Nations Food and Agriculture Organization (FAO) in 2010. Sustainable diets are defined as those with "low environmental impacts which contribute to food and nutrition security and to healthy life for present and future generations. Sustainable diets are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable; nutritionally adequate, safe and healthy; while optimizing natural and human resources"<sup>9</sup>.

Despite the scope of sustainable diet dimensions, surveys have generally focused on environmental impact, in particular climate and GHG emission<sup>10</sup>. The quantitative analysis techniques that are often used, such as life-cycle analysis<sup>11-14</sup> focus only on the environmental aspects, and ignore the social and economic elements<sup>15</sup>. Based on this premise, one can have a low GHG diet that is not healthy, or a healthy diet with high levels of GHG emissions<sup>16</sup>. If we look at the bigger picture, lower environmental impact food is not necessarily more sustainable (broadly speaking) than other foods, if these damage society. For example, environmental efficiency may be reached by large-scale production, but when food is produced on a smaller scale it may support small producers and support local development<sup>17</sup>.

Considering that a healthy diet that is sustainable across all dimensions is impossible, and the absence of any sort of deeper thought on this element of food and nutrition, we propose to reflect on the scientific literature regarding the main challenges and the outlook for healthy and sustainable diet. This is an attempt to approach and problematize the theme, considering the need to explore its main challenges to bring it to fruition.

## Method

To achieve the proposed objective, we performed a narrative review. The aim of a review article is to describe and discuss the state-of-the-art of a given topic<sup>18</sup>. In light of the scope of this theme and the difficulty formulating accurate survey questions, a narrative review was used to foster expanded discussion.

This is a non-systematic review performed between November 2015 and November 2016. Our search sought to address the following question: What are the challenges for sustainable diet, given all of the steps in production, processing, marketing and consumption? The literature search used the Scopus, Pubmed and Gogle Academic databases, plus a manual search of the references of selected papers. The search used the following keywds: sustainable diet or sustainable nutrition or sustainable food or wholesome diet or wholesome nutrition combined with production or processing or marketing or consumption. All of the searches were performed by one of the authors, with no limitation in terms of date, country or area of knowledge. The study included original and review articles as well as grey literature in English, Spanish and Portuguese. The selection of domestic and international articles and official documents covered the period between 1986 and 2016.

Narrative reviews were considered to be of less value as scientific evidence because of the arbitrary selection of articles and the possibility of a selection bias<sup>18,19</sup>. However, they are considered essential contributions for the discussion of certain themes, raising questions and contributing to updated knowledge<sup>18</sup>.

Considering the themes related to the study questoin, results were grouped into four sections according to the steps in the food system. The first step covers the context and main observations of food production or manufacture. The second lists the main challenges related to food processing. The third discusses food marketing and sale, and the fourth food consumption. The final consierations lists outlooks for debating healthy and sustainable nutrition.

## Results and Discussion

Figure 1 shows the main elements of sustainable and non-sustainable food systems we found in our literature review, considering all steps in the process - from farm to table. This figure summarizes the elements we believe to be relevant in addressing the sustainability/non-sustainability of food systems, and are discussed later in this article.

Figure 2 is based on the data analyzed in our review and offers a graphic representation that synthesizes the main aspects related to healthier and more sustainable nutrition, providing a

ranked list of practices in each of the steps of the food chain - production, processing, marketing/sale and consumption. The core element of sustainable nutrition is the farm-to-path journey taken by the food. One must prioritize diversity as the basis of nutrition, followed by defining a hierarchy for each step and remembering that the models at the top should be avoided. One example of a healthy and sustainable diet is at the base of the figure, with foods produced according to the precepts of agro-ecology, purchased fresh directly from family farmers to prepare culturally acceptable meals.

### Food production

How food is produced has changed over the years. Production methods have change since the green revolution of the 1950s, justified by a need to increase food output and eliminate hunger. This marked the start of large-scale, high-technology farming dominated by large corporations, seeking higher levels of productivity<sup>20</sup>. Rural property ownership became more concentrated, income differences became larger and there was an exodus from rural areas, accompanied by an exploratin of the labor force in farming activities. All of this led to a worsening of the quality of life of farm workers<sup>21</sup>.

The land ownership structure is one of the greatest challenges for sustainable food production in Brazil. In 2006, less than 1% of the farming establishments occupied about 44% of the arable land in Brazil. Major areas are set aside for cattle, soy, corn and cotton as single crops, increasing the inequality of land ownership in Brazil<sup>22</sup>.

Cattle grazing is associated with major environmental impact and contributes to climate change, soil degradation, GHG emissions, water comination and loss of biodiversity<sup>23,24</sup>. Adopting a diet free of animal products could reduce GHG emissions and land use by as much as 50%<sup>25</sup>. Some measures may be adopted to mitigate the enviornmental aggesion of cattle raising. The process of integrating cattle raising, food production and forestry is mentioned as one way of enabling sustainable production<sup>26</sup>. International policies are also required for environmental protection in fishing and sea-food harvesting, and systems for company certification<sup>27</sup>. Despite the possibility of a more sustainable production system, any reduction in meat and meat products is viewed as emerging, given the high level of consumption across the

	PRODUCTION	PROCESSING	MARKETING	CONSUMPTION
<b>NON-SUSTAINABLE SYSTEMS</b>	<b>Conventional farming</b>	<b>Intense processing</b>	<b>Long chains</b>	<b>Non-sustainable consumption</b>
	Corporate	Nutrient removal	Large number of intermediaries	Unhealthy habits
	Monoculture	Refining	Long distances	Unwilling to purchase sustainable foods
	Genetically Modified Foods	Addition of trans fats	Not valuing local products	High levels of ultra-processed foods consumed
	Ag chemicals	Addition of additives and preservatives	High prices	Search for foods that are quick and easy to prepare
	Intensive cattle/poultry raising	Additives based on soy and corn byproducts	Value large retail chains	Non-diversified diet
	High levels of waste: food, water, energy			
<b>SUSTAINABLE SYSTEMS</b>	<b>Agro-ecology</b>	<b>Limited processing</b>	<b>Short chains</b>	<b>Sustainable consumption</b>
	Family farming	Nutrient maintenance	None or few intermediaries	Fresh, agro-ecological food
	Diversified	Minimal processing	Proximity between producers and consumers	Willingness to purchase sustainable products
	Organic	No addition of trans fats	Fair trade and solidary economy	Purchase directly from family farmers
	Seasonal	No preservatives added	Value the product and producer	Regional, traditional and diversified foods
	Integration between farm-cattle-forest	No other food additives	Trust in producers	Culinary skills
	Low levels of waste: food, energy, water			

Figure 1. Main counterpoints of sustainable and non-sustainable food systems found in the literature review.

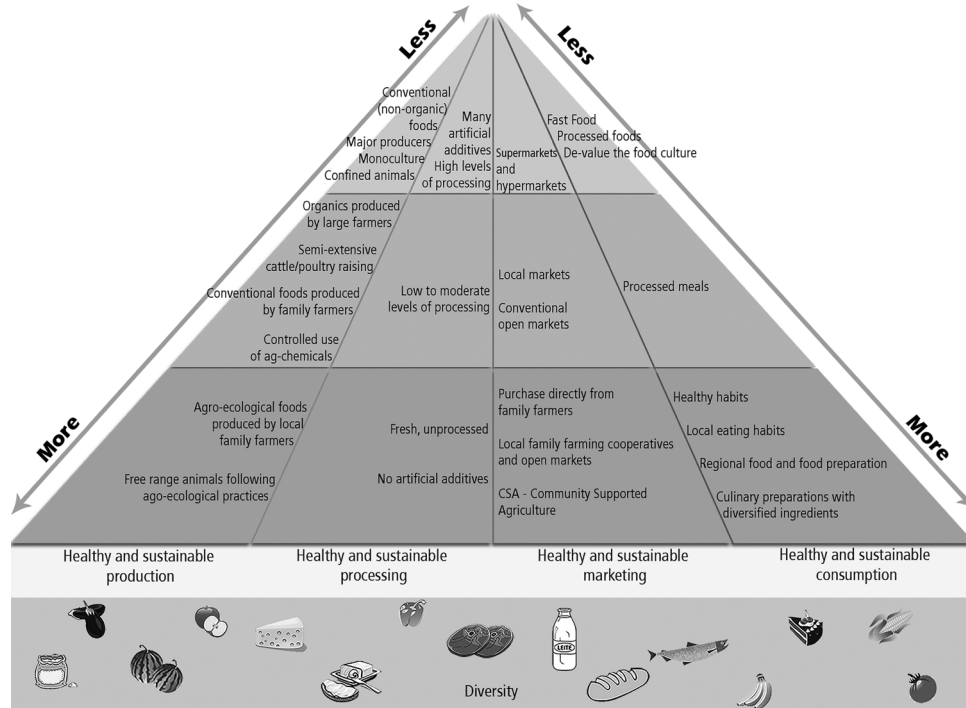


Figure 2. Graphic representation of the guidelines and operation of a healthier and more sustainable diet.

world<sup>24</sup>. However, it is important to discuss production in this context, as an omnivorous diet based on organic products may have a smaller environmental impact than a vegetarian diet comprised of foods produced with large amounts of ag chemicals<sup>28</sup>.

In addition to concerns regarding the emission of gases that are harmful to the environment, intensive cattle and poultry raising generates major discussion as their feed is corn and soy-based, both of which require large tracts of land. Soy and corn production have been increasing in recent years, especially crops using GM seed. One of the initial justifications for using GM seed was a reduction in the amount of ag chemicals needed. However, adding ag-chemical resistant genes to some crops makes them resistant to pests and weeds, leading to an imbalance in the ecosystem and the use of more ag chemicals<sup>29</sup>. The production of GM crops is a major risk to the sustainability of the food system, primarily due to a loss of biodiversity, the use of ag chemicals and the contamination of heirloom seeds<sup>30,31</sup>.

Brazil has been the leading user of ag chemicals since 2008, primarily because of soy<sup>31</sup>. Consuming GM foods with associated ag chemicals has been linked to neurological problems, hormonal changes, infertility, cancer<sup>32</sup> and celiac disease in humans<sup>33</sup>. Occupational exposure to ag chemicals is related to, among other diseases, increased incidence of cancer in the different body organs and systems<sup>34</sup>, respiratory disorders<sup>35</sup> and chronic diseases<sup>36</sup>. Exposure of farmers and the surrounding population is also related to diseases such as delayed mental development and mental disorders in children<sup>37</sup>, and an increase in congenital malformations due to maternal exposure to ag chemicals<sup>38</sup>.

For nutrition purposes, an important reason for consuming organic foods is their superior nutritional quality compared to conventional foods. Organically produced foods have higher total and absolute levels of nutrients<sup>39</sup>, and greater concentrations of polyphenols, phenolic acids, isoflavones, stilbene and anthocyanins<sup>40</sup>. Studies have also found greater concentrations of total omega-3-polyunsaturated fatty acids in organic meats<sup>41</sup>, and greater concentrations of alpha-linolenic acid, total omega-3 fatty acids, protein, fat, poly-unsaturated fatty acids and eicosapentanoic acid in organic dairy products compared to conventional ones<sup>42</sup>. Furthermore, cadmium and heavy-metal concentrations are twice as high in conventional foods than in

their organic equivalent. Researchers suggest that consuming organic foods could increase antioxidant ingestion by 20 to 40%<sup>40</sup>.

In terms of environmental impact, organic farming contributes to keeping more organic material in the soil, diminished nutrient loss, less use of energy and increased biodiversity<sup>43</sup>. Here, agro-ecology appears as a new path for agriculture and hence for healthy and sustainable diet. Family farming is considered ideal for developing environmentally sustainable agriculture, given that it tends to be diversified, integrates agriculture and animal husbandry activities, and is generally smaller scale<sup>44</sup>. Over 12 million people are involved in family farming and produce most of the basic foods such as rice, beans, mannioc, potatoes and several types of vegetables, fruits and legumes. Consuming these foods naturally stimulates family farming and local economies<sup>45</sup>.

### Processing

Food processing refers to methods used by manufacturers to transform primary foods<sup>46</sup>. This can be beneficial in a number of ways - increase the variety of foods eaten, enable conservation and storage for longer periods, increase food safety, palatability and convenience<sup>47</sup>. High amounts of processing and conservation techniques however can pose a major risk for healthy and sustainable diets, especially as many of the original nutrients are lost and fats, sodium, sugars, additives and preservatives are added.

Processing to manufacture meals and flours is just one example. In processing the whole grain can lose 90% of the vitamins and minerals contained<sup>48</sup>. Highly processed and preserved foods contribute to high fat intake in general, saturated and trans fats and free sugars. It also contributes to diminished fiber, protein and potassium in the diet of the Brazilian population<sup>49</sup>. Consuming these foods is related to a process that may make it harder to determine the source of the ingredients that make up a given food, distancing people from the cultural act of eating<sup>50</sup>.

Excessive processing is also not sustainable in other dimensions, such as the social dimension. Processing is normally done by large companies<sup>45</sup>, rather than small farmers, and processed foods are sold by large supermarket chains rather than being part of short-chains that benefit small local producers. There is no value for farmers, for maintaining agriculture and biological diversity

when foods are converted into refined versions with high sugar and salt content<sup>8</sup>. Furthermore, major corporations acting in the food industry results in these products being marketed at very low prices and thus widely consumed<sup>51</sup>.

The Nutrition Guide for the Brazilian Population recommends avoiding processed foods made by large corporations, especially due to their nutrient composition and the impact of how they are manufactured, distributed, marketed and used on our culture, social life and the environment<sup>45</sup>. In addition to encouraging the population to avoid these products, we need public policies that encourage and facilitate healthy choices, as structural changes in the Brazilian agro-nutritional system will never happen as a result of spontaneous initiatives by the production sector<sup>52</sup>. Food policies that promote a balanced diet can contribute to sustainable development<sup>53</sup>. In terms of food processing, regulations and oversight are required for processing itself, labeling and advertising. However, there is tension in the negotiations between representatives of the food industry and the state<sup>54</sup>, which makes it harder to provide healthy and sustainable foods to the population.

### Marketing

The entry of large international corporations in food retail changed the former dynamic of small markets, with concentrating agents and the exclusion of some players<sup>55</sup>. This is a hegemonic process with many barriers, but successful experiences valuing artisanal production and fair trade show it is possible to change this, benefiting producers and consumers<sup>56</sup>.

Local and regional food systems can foster sustainable food systems<sup>57</sup>. The concept of local food system has different interpretations and has been the topic of discussion. In broad terms, we try to integrate production, transportation, distribution and consumption to improve the economy, the environment and health of a specific location, creating self-sustainable food economies that are more locally based<sup>58</sup>. Lang<sup>59</sup> discusses the importance of local consumption to reintegrate older food habits, and value food and regional producers.

When discussing food marketing we should start out by prioritizing short marketing circuits, characterized by fewer intermediaries and geographic proximity<sup>60</sup>. In Brazil, government interventions show the potential of the State to reorganize the agro-food system and market

relationships, focusing on rural sustainable development<sup>61</sup>. The National School Meals Program [PNAE - *Programa Nacional de Alimentação Escolar*] and the Food Acquisition Program [PAA - *Programa de Aquisição de Alimentos*], especially as concerns institutional purchases, has already shown one can buy food locally and thus benefit producers and consumers<sup>61</sup>. To this end, given a system dominated by capitalistic change, public policies have been introducing a dimension of reciprocity and fairness to the relationships<sup>62</sup>. These reciprocity relationships reduce production and transaction costs, allowing family farmers or peasants to access markets, primarily institutional ones, despite competition from a capitalist system, which is generally unfavorable to their production systems<sup>62</sup>. This is normally done through networks, associations and alternative agro-food networks<sup>56</sup>, in addition to government programs.

At the individual level, direct purchases from family farmers is a strategy to bring people closer to food production. Public markets at ensured prices are a public policy tool to interface between systems or mercantile exchange and systems of reciprocity<sup>62</sup>. Short marketing circuits are seen in direct sales from farms, home delivery of produce baskets, specialized stores, cooperatives and restaurants that buy directly from the producer<sup>60</sup>. There are also community gardens, urban agriculture and the initiative entitled Community-supported agriculture (CSA)<sup>63</sup>. These methods to connect production and consumption bring consumers closer to the origin of their food. The authors realize this approximation is beneficial and is related to a differentiated pattern of perception of healthy diet, expanding the concept to issues of culture and sustainability<sup>63</sup>.

### Sustainable consumption

Food consumption has been changing, with a negative impact on health and the environment. Our current diet is based on high energy foods that are poor in diversity, supporting and encouraging agricultural intensity and worsening a global trend towards an obesity epidemic<sup>64</sup>. The authors also address excessive food consumption as being contrary to sustainability<sup>8,65</sup>, as it exceeds individual needs and becomes waste.

The cultural patrimony, the quality of foods and culinary skills are considered key elements for sustainable food patterns and food security<sup>66</sup>.

However, changes in patterns and the food choices made by the population are a major challenge for a sustainable diet. The social, economic and cultural transformations of society have had a major impact on diet<sup>55</sup>, thus this approach must include modern life-styles, cultural and social expectations, and the environments in which food choices are made<sup>16</sup>.

Brazil has 15 to 20% of the world's biodiversity<sup>67</sup>, however we find an actual reduction in the variety of foods consumed, which could compromise the assurance of food and nutritional security and food sovereignty<sup>68</sup>. Despite being aware of over seven thousand specie of edible plants, 30 crops provide 95% of the daily calories ingested by the population<sup>69</sup>. Conserving the diversity of edible vegetable species is key for food supply<sup>70</sup>. This leads to encouraging the use of Non-Conventional Food Plants (NCFP) and foods of socio-biodiversity, which if added to our daily diet could increase the variety and quality of the diet, as these plants are of superior nutritional quality than domesticated plants<sup>71</sup>. These plants have a major potential to increase the diversity of our diets, improving its nutritional quality and available to populations that are socially vulnerable<sup>72</sup>.

Individual diet changes have a major potential for influencing the demand for certain foods and reducing the pressure on the global food system. This requires providing consumers with tools and influence how they make choices<sup>73</sup>. Disclosure of information to the population is one of the goals of the nation's signing the UN 2030<sup>74</sup> Sustainable Development Goals. This stresses the need for diet guidelines that directly incorporate sustainability recommendations<sup>8,75</sup>.

For this, we must bear in mind modern lifestyles, cultural and social expectations, and the environment in which people make their food choices<sup>76</sup>. Food labeling that can help people choose a healthy and sustainable diet is required<sup>77</sup>. We also need a population that is informed of the food they buy in supermarkets or in restaurants, and that visits farms<sup>78</sup>. The Slow Food movement points to the political role of consumers in their choices, calling them co-producers or, in other words, players who are also responsible for how food is produced<sup>79</sup>.

Since 2006 the Brazilian Food Guide for the Brazilian Population has provided guidelines on sustainable diet. The Guide values regional foods and food culture, and encourages healthy eating by consuming foods that are produced

locally by family farming, and that they be eaten in their more natural form. The Guide also encourages a return to good eating habits. It recognizes that producing foods that foster and ensure food and nutritional security is a priority, using land and water in ecologically sustainable ways with positive social and environmental impact<sup>46</sup>. The Brazilian Diet Guide published in 2014<sup>45</sup> relates healthy diet to the possibility of approximating production and consumption by encouraging consumers to purchase food at open markets (*feiras*) and other institutional markets, as well as agro-ecological food practices, recovering traditional food production and processing knowledge thorough family farming<sup>80</sup>. It is considered one of the food guides with the most sustainability recommendations in its diet guidelines<sup>81</sup>. We reiterate that healthy food guidelines affect not only the health of the population, but also can impact farm production, trade and the economy in general<sup>82</sup>.

## Final considerations

As yet there is no consensus regarding the answer to the question "What are recommendations for a healthy and sustainable diet?" This requires a holistic, evidence-based approach for a deeper discussion that will benefit society, the economy and the environment. However, we realize there is a major challenge to understand the interaction between all of the players in a sustainable diet across the various socio-economic and environmental situations<sup>82</sup>.

To enable a more sustainable system, the population must have access to different forms of production, processing and marketing. We point out the importance of State intervention in food policies as key for consolidating a sustainable diet. Regarding consumption, we believe that the indissociability between promoting healthy and sustainable diet is fundamental, and that the premises of both must be articulated and considered when making diet recommendations.

We should point out that this article does not intend to address all possible aspects of diet and sustainability, but rather to initiate a reflective exercise and approximation. The approach to healthy and sustainable diet must bear in mind multidimensional interactions across the entire food system, and the need for greater reflection and engagement involving different areas and representatives of all steps in the food system.

## Collaborations

SS Martinelli helped design, structure and draft the article; SB Cavalli helped design, structure and critically review the article. Both authors approved the final version submitted.

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## References

1. Escudero P. *Alimentación*. Buenos Aires: Hachette; 1934.
2. World Health Organization (WHO). *Noncommunicable diseases progress monitor*, 2015. Geneva: WHO; 2015.
3. World Health Organization (WHO). *Global Strategy on Diet, Physical Activity and Health*. Geneva: WHO; 2004. [Eighth plenary meeting, Committee A, third report].
4. Sobal J, Kettel Khan L, Bisogni C. A conceptual model of the food and nutrition system. *Soc Sci Med* 1998; 47(7):853-863.
5. Oliveira SP, Thébaud-Mony A. Estudo do consumo alimentar: em busca de uma abordagem multidisciplinar. *Rev Saude Publica* 1997; 31(2):201-208.
6. Auestad N, Fulgoni VL, III. What current literature tells us about sustainable diets: Emerging research linking dietary patterns, environmental sustainability, and economics. *Advances in Nutrition* 2015; 6(1):19-36.
7. Gliessman SR. *Agroecologia: processos ecológicos em agricultura sustentável*. Porto Alegre: Ed. Univ. Federal do Rio Grande do Sul; 2001.
8. Gussow JD, Clancy KL. Dietary guidelines for sustainability. *J Nutr Educ* 1986; 18(1):1-5.
9. Burlingame BA, Dernini S. *Sustainable diets and biodiversity*. In: Food and Agriculture Organization of the United Nations, editor. *International Scientific Symposium Biodiversity and Sustainable Diets United against Hunger* (2010: Rome, Italy). Rome: *International Scientific Symposium Biodiversity and Sustainable Diets United against Hunger* (2010: Rome, Italy); 2012.
10. Nordic Council of Ministers. *Nordic Nutrition Recommendations 2012: Integrating nutrition and physical activity*. Copenhagen: Nordic Council of Ministers; 2014.
11. Calderón LA, Iglesias L, Laca A, Herrero M, Díaz M. The utility of Life Cycle Assessment in the ready meal food industry. *Resour Conserv Recycl* 2010; 54(12):1196-1207.
12. Del Borghi A, Gallo M, Strazza C, Del Borghi M. An evaluation of environmental sustainability in the food industry through Life Cycle Assessment: the case study of tomato products supply chain. *J Clean Prod* 2014; 78:121-130.
13. Cerutti AK, Contu S, Ardente F, Donno D, Beccaro GL. Carbon footprint in green public procurement: Policy evaluation from a case study in the food sector. *Food Policy* 2016; 58:82-93.
14. Baldwin C, Wilberforce N, Kapur A. Restaurant and food service life cycle assessment and development of a sustainability standard. *Int J Life Cycle Assess* 2011; 16(1):40-49.
15. Morgan K. Greening the realm: sustainable food chains and the public plate. *Regional Studies* 2008; 42(9):1237-1250.
16. Macdiarmid JI, Kyle J, Horgan GW, Loe J, Fyfe C, Johnstone A, McNeill G. Sustainable diets for the future: can we contribute to reducing greenhouse gas emissions by eating a healthy diet? *Am J Clin Nutr* 2012; 96(3):632-639.



17. Goggins G, Rau H. Beyond calorie counting: assessing the sustainability of food provided for public consumption. *J Clean Prod* 2016; 112(1):257-266.
18. Rother ET. Revisão sistemática X revisão narrativa. *Acta Paul Enferm* 2007; 20:v-vi.
19. Cordeiro AM, Oliveira GM, Rentería JM, Guimarães CA. Revisão sistemática: uma revisão narrativa. *Rev Col Bras Cir* 2007; 34:428-431.
20. Cavalli SB. Segurança alimentar: a abordagem dos alimentos transgênicos. *Rev Nutr* 2001; 14(Supl.):41-46.
21. Palmeira M. Modernização, Estado e questão agrária. *Estudos Avançados* 1989; 3:87-108.
22. Instituto Brasileiro de Geografia e Estatística (IBGE). *Censo Agropecuário. Brasil, grandes regiões e unidades da Federação*. Rio de Janeiro: IBGE; 2009.
23. Ruviano CF, Costa JS, Florindo TJ, Rodrigues W, Medeiros GIB, Vasconcelos PS. Economic and environmental feasibility of beef production in different feed management systems in the Pampa biome, southern Brazil. *Ecological Indicators* 2016; 60:930-939.
24. Machovina B, Feeley KJ, Ripple WJ. Biodiversity conservation: The key is reducing meat consumption. *Sci Total Environ* 2015; 536:419-431.
25. Hallström E, Carlsson-Kanyama A, Börjesson P. Environmental impact of dietary change: a systematic review. *J Clean Prod* 2015; 91:1-11.
26. Balbino LC, Barcellos AO, Stone LF. *Marco referencial integração lavoura-pecuária-floresta*. Brasília: Embrapa; 2011.
27. Bostock J, McAndrew B, Richards R, Jauncey K, Telfer T, Lorenzen K, Little D, Ross L, Handisyde N, Gatward I, Corner R. Aquaculture: global status and trends. *Philos Trans R Soc Lond B Biol Sci* 2010; 365(1554):2897-2912.
28. Baroni L, Cenci L, Tettamanti M, Berati M. Evaluating the environmental impact of various dietary patterns combined with different food production systems. *Eur J Clin Nutr* 2006; 61(2):279-286.
29. Bonny S. Genetically Modified Herbicide-Tolerant Crops, Weeds, and Herbicides: Overview and Impact. *J Environ Manage* 2016; 57(1):31-48.
30. Nodari RO, Guerra MP. Avaliação de riscos ambientais de plantas transgênicas. *Cadernos de Ciência & Tecnologia* 2001; 18(1):81-116.
31. Carneiro FF, Augusto LGS, Rigotto RM, Friedrich K, Búrigo AC. *Dossiê ABRASCO: um alerta sobre os impactos dos agrotóxicos na saúde*. Rio de Janeiro: EPSJV; 2015.
32. Friedrich K. *Parecer técnico: Avaliação dos efeitos tóxicos sobre o sistema reprodutivo, hormonal e câncer para seres humanos após o uso do herbicida 2,4-D*. Rio de Janeiro: Fiocruz; 2014.
33. Samsel A, Seneff S. Glyphosate, pathways to modern diseases II: Celiac sprue and gluten intolerance. *Interdiscip Toxicol* 2013; 6(4):159-184.
34. Alavanja MCR, Bonner MR. Occupational pesticide exposures and cancer risk: A review. *J toxicol environ health* 2012; 15(4):238-263.
35. Faria NMX, Facchini LA, Fassa AG, Tomasi E. Pesticides and respiratory symptoms among farmers. *Rev Saude Publica* 2005; 39(6):973-981.
36. Gangemi S, Miozzi E, Teodoro M, Briguglio G, De Luca A, Alibrando C, Polito I, Libra M. Occupational exposure to pesticides as a possible risk factor for the development of chronic diseases in humans (Review). *Mol Med Rep* 2016; 14(5):4475-4488.
37. Roberts JR, Karr CJ, Paulson JA, Brock-Utne AC, Brumberg HL, Campbell CC, Lanphear BP, Osterhoudt KC, Sandel MT, Trasande L, Wright RO. Pesticide exposure in children. *Pediatrics* 2012; 130(6):e1765-e88.
38. Oliveira NP, Moi GP, Atanaka-Santos M, Silva AMC, Pignati WA. Malformações congênitas em municípios de grande utilização de agrotóxicos em Mato Grosso, Brasil. *Cien Saude Colet* 2014; 19(10):4123-4130.
39. Hunter D, Foster M, McArthur JO, Ojha R, Petocz P, Samman S. Evaluation of the micronutrient composition of plant foods produced by organic and conventional agricultural methods. *Crit Rev Food Sci Nutr* 2011; 51(6):571-582.
40. Barański M, Średnicka-Tober D, Volakakis N, Seal C, Sanderson R, Stewart GB, Benbrook C, Biavati B, Markellou E, Giotis C, Gromadzka-Ostrowska J, Rembiałkowska E, Skwarło-Sońta K, Tahvonon R, Janovská D, Niggli U, Nicot P, Leifert C. Higher antioxidant and lower cadmium concentrations and lower incidence of pesticide residues in organically grown crops: a systematic literature review and meta-analyses. *Br J Nutr* 2014; 112(5):794-811.
41. Średnicka-Tober D, Baranski M, Seal C, Sanderson R, Benbrook C, Steinshamn H, Gromadzka-Ostrowska J, Rembiałkowska E, Skwarło-Sońta K, Eyre M, Cozzi G, Krogh Larsen M, Jordon T, Niggli U, Sakowski T, Calder PC, Burdge GC, Sotiraki S, Stefanakis A, Yolcu H, Stergiadis S, Chatzidimitriou E, Butler G, Stewart G, Leifert C. Composition differences between organic and conventional meat: a systematic literature review and meta-analysis. *Br J Nutr* 2016; 115(6):994-1011.
42. Palupi E, Jayanegara A, Ploeger A, Kahl J. Comparison of nutritional quality between conventional and organic dairy products: A meta-analysis. *J Sci Food Agric* 2012; 92(14):2774-2781.
43. Tuomisto HL, Hodge ID, Riordan P, Macdonald DW. Does organic farming reduce environmental impacts? - A meta-analysis of European research. *J Environ Manage* 2012; 112:309-320.
44. Carmo MS. A produção familiar como locus ideal da agricultura sustentável. *Agricultura em São Paulo* 1998; 45(1):1-15.
45. Brasil. Ministério da Saúde (MS). *Guia Alimentar para a população brasileira*. 2ª ed. Brasília: MS; 2014.
46. Brasil. Ministério da Saúde (MS). *Guia alimentar para a população brasileira: promovendo a alimentação saudável*. Brasília: MS; 2006.
47. Floros JD, Newsome R, Fisher W, Barbosa-Cánovas GV, Chen H, Dunne CP, German JB, Hall RL, Heldman DR, Karwe MV, Knabel SJ, Labuza TP, Lund D, Newell-McGloughlin M, Robinson JL, Sebranek JG, Shewfelt RL, Tracy WF, Weaver CM, Ziegler GR. Feeding the World Today and Tomorrow: The Importance of Food Science and Technology. *Compr Rev Food Sci Food Saf* 2010; 9(5):572-599.

48. Oghbaei M, Prakash J. Effect of primary processing of cereals and legumes on its nutritional quality: A comprehensive review. *Cogent Food & Agriculture* 2016; 2(1):1136015.
49. Louzada MLC, Baraldi LG, Steele EM, Martins APB, Canella DS, Moubarac JC, Levy RB, Cannon G, Afshin A, Imamura F, Mozaffarian D, Monteiro CA. Consumption of ultra-processed foods and obesity in Brazilian adolescents and adults. *Prev Med* 2015; 81:9-15.
50. Proença RPC. Alimentação e globalização: algumas reflexões. *Cie Cult* 2010; 62:43-47.
51. Monteiro CA, Cannon G. The Impact of Transnational “Big Food” Companies on the South: A View from Brazil. *PLOS Medicine* 2012; 9(7):e1001252.
52. Castro IRR. Challenges and perspectives for the promotion of adequate and healthy food in Brazil. *Cad Saude Publica* 2015; 31(1):7-9.
53. Schirnding YV, Yach D. Unhealthy consumption threatens sustainable development. *Rev Saude Publica* 2002; 36(4):379-382.
54. Henriques P, Dias PC, Burlandy L. A regulamentação da propaganda de alimentos no Brasil: convergências e conflitos de interesses. *Cad Saude Publica* 2014; 30(6):1219-1228.
55. Fonseca AB, Souza TSNd, Frozi DS, Pereira RA. Modernidade alimentar e consumo de alimentos: contribuições sócio-antropológicas para a pesquisa em nutrição. *Cien Saude Colet* 2011; 16(9):3853-3862.
56. Wilkinson J. A pequena produção e sua relação com os sistemas de distribuição. In: Wilkinson J, editor. *Mercados, redes e valores: O novo mundo da agricultura familiar*. Porto Alegre: EDUFGRS; 2008. p. 125-150.
57. Morley A, McEntee J, Marsden T. Food futures: Framing the crisis. In: Marsden T, Morley A, editors. *Sustainable food systems: building a new paradigm*. Abingdon: Routledge; 2014. p. 221.
58. Feenstra G. Creating space for sustainable food systems: Lessons from the field. *Agric Human Values* 2002; 19(2):99-106.
59. Lang T. Sustainable diets and biodiversity: The challenge for policy, evidence and behaviour change. In: Burlingame B, Dernini S, editors. *Sustainable Diets and Biodiversity*. Rome: FAO; 2012. p. 20-26.
60. Darolt MR, Lamine C, Brandenburg A. A diversidade dos circuitos curtos de alimentos ecológicos: ensinamentos do caso brasileiro e francês. *Agriculturas* 2013; 10(2):5.
61. Food and Agriculture Organization of the United Nations (FAO). *Superação da fome e da pobreza rural - Iniciativas brasileiras*. Brasília: FAO; 2016.
62. Sabourin E. Acesso aos mercados para a agricultura familiar: uma leitura pela reciprocidade e a economia solidária. *Rev Econ NE* 2014; 45:21-35.
63. O’Kane G. A moveable feast: Contemporary relational food cultures emerging from local food networks. *Appetite* 2016; 105:218-231.
64. Etiévant P. Dietary behaviours and practices: Determinants, action, outcomes. In: Burlingame B, Dernini S, editors. *Sustainable diets and biodiversity*. Rome: FAO; 2012. p. 102-107.
65. Macdiarmid JI. Is a healthy diet an environmentally sustainable diet? *The Proc Nutr Soc* 2013; 72(01):13-20.
66. Lairon D. Biodiversity and sustainable nutrition with a food-based approach. In: Burlingame B, Dernini S, editor. *Sustainable Diets and Biodiversity*. Rome: FAO; 2012. p. 30-35.
67. Coradin L, Siminski A, Reis A. *Espécies Nativas da Flora Brasileira de Valor Econômico Atual ou Potencial*. Brasília: Ministério do Meio Ambiente; 2011.
68. Allen T, Prosperi P, Cogill B, Flichman G. Agricultural biodiversity, social-ecological systems and sustainable diets. *Proc Nutr Soc* 2014; 73(4):498-508.
69. Food and Agriculture Organization of the United Nations (FAO). *Biodiversity: for a world without hunger*. FAO [cited 2017 Nov 10]. [Available from: <http://www.fao.org/biodiversity/components/plants/en/>]
70. Prescott-Allen R, Prescott-Allen C. How Many Plants Feed the World? *Conservation Biology* 1990; 4(4):365-374.
71. Kinupp VF, Barros IBI. Teores de proteína e minerais de espécies nativas, potenciais hortaliças e frutas. *Ciênc Tecnol Aliment* 2008; 28(4):846-857.
72. Termote C, Raneri J, Deptford A, Cogill B. Assessing the potential of wild foods to reduce the cost of a nutritionally adequate diet: An example from eastern Baringo District, Kenya. *Food Nutr Bull* 2014; 35(4):458-479.
73. Riley H, Buttriss JL. A UK public health perspective: what is a healthy sustainable diet? *Nutr Bull* 2011; 36(4):426-431.
74. Organização das Nações Unidas (ONU). *Transformando Nosso Mundo: a Agenda 2030 para o Desenvolvimento Sustentável*. Nova York: ONU; 2015.
75. Horgan GW, Perrin A, Whybrow S, Macdiarmid JI. Achieving dietary recommendations and reducing greenhouse gas emissions: modelling diets to minimise the change from current intakes. *Int J Behav Nutr Phys Act* 2016; 13(1):46.
76. Macdiarmid JI, Kyle J, Horgan GW, Loe J, Fyfe C, Johnstone A, McNeill G. Sustainable diets for the future: can we contribute to reducing greenhouse gas emissions by eating a healthy diet? *Am J Clin Nutr* 2012; 96(3):632-639.
77. Public Health Association of Australia (PHAA). *Ecologically Sustainable Diets*. Canberra: PHAA; 2015.
78. Sustainable Table. *What you can do*. Sustainable Table [cited 2017 Oct 7]. Available from: <https://sustainabletable.org.au/all-things-ethical-eating/what-you-can-do/>

79. Agrillo C, Milano S, Roveglia P, Scaffidi C. *Slow Food's Contribution to the Debate on the Sustainability of the Food System*. Wageningen: European Association of Agricultural Economists; 2015.
80. Oliveira NRF, Jaime PC. O encontro entre o desenvolvimento rural sustentável e a promoção da saúde no Guia Alimentar para a População Brasileira. *Saúde Soc* 2016; 25:1108-1121.
81. Food and Agriculture Organization of the United Nations (FAO). *Plates, pyramids, planet: Developments in national healthy and sustainable dietary guidelines: a state of play assessment*. Oxford: The Food Climate Research Network at The University of Oxford; 2016.
82. Lock K, Smith RD, Dangour AD, Keogh-Brown M, Pigatto G, Hawkes C, Fisberg RM, Chalabi Z. Health, agricultural, and economic effects of adoption of healthy diet recommendations. *Lancet* 2010; 376(9753):1699-1709.

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