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When food systems meet sustainability – Current narratives and implications for actions

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ABSTRACT

The concept of food system has gained prominence in recent years amongst both scholars and policy-makers. Experts from diverse disciplines and backgrounds have in particular discussed the nature and origin of the "unsustainability" of our modern food systems. These efforts tend, however, to be framed within distinctive disciplinary narratives. In this paper we propose to explore these narratives and to shed light on the explicit -or implicit- epistemological assumptions, mental models, and disciplinary paradigms that underpin those. The analysis indicates that different views and interpretations prevail amongst experts about the nature of the "crisis", and consequently about the research and priorities needed to "fix" the problem. We then explore how sustainability is included in these different narratives and the link to the question of healthy diets. The analysis reveals that the concept of sustainability, although widely used by all the different communities of practice, remains poorly defined, and applied in different ways and usually based on a relatively narrow interpretation. In so doing we argue that current attempts to equate or subsume healthy diets within sustainability in the context of food system may be misleading and need to be challenged. We stress that trade-offs between different dimensions of food system sustainability are unavoidable and need to be navigated in an explicit manner when developing or implementing sustainable food system initiatives. Building on this overall analysis, a framework structured around several entry points including outcomes, core activities, trade-offs and feedbacks is then proposed, which allows to identify key elements necessary to support the transition toward sustainable food systems.

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1. Introduction

The concept of food system goes back several decades (Kneen, 1989; Marion, 1986; Sobal, 1978), but has (re-)gained prominence in recent years and nowadays has become a substantive body of research and a subject of interest for policy-makers. Food systems are indeed identified as a central entry point for action in a growing number of high-profile reports on nutrition and food security (e.g. Global Panel, 2016; HLPE, 2017; IPES, 2016).

This emerging or renewed interest in food systems is the result of multiple concerns ranging from environmental, equity and power, trade, to dietary and health issues. It includes the realization that feeding the world today and in the future requires more than a simple 'more-food' approach and that particular attention is needed for diet quality and nutrition, the environmental 'food print' (i.e. the environmental impact) of production and distribution of food commodities, and the socioeconomic imprints of supply chains. In recent years, another major issue emerged as experts came to realize that even with a new focus on nutrition and diets, making food systems more nutrition-sensitive and sustainable will not be enough to address the triple burden of malnutrition (undernutrition, micro-nutrient deficiencies and overnutrition), and that, in the increasingly urbanized and globalized world in which we live, more attention needs to be paid to food system governance, actors and drivers (Tschirley, Haggblade, & Reardon, 2013).

In this context, a whole new set of questions is emerging around the roles and responsibilities of the different (formal and informal, public and private) actors to ensure that food remains available, affordable, accessible and acceptable to the different segments of the population living in both rural and urban areas. Very little is known, however, on how food systems work at different levels and only partial knowledge is available to help decision-makers influence the system and drive it towards more sustainable and higher diet quality outcomes.

Over the last decades, scholars from diverse disciplines and intellectual traditions have documented the critical threats to food system sustainability and attempted to define an appropriate agenda for action. These efforts tended, however, to be framed within distinctive disciplinary narratives (Eakin et al., 2016; Foran et al., 2014). In particular these narratives reflect underlying values which shape the way these experts view and interpret the world, and ultimately drive policy responses.

In this paper, we are interested in exploring these narratives more thoroughly, with the intention to unpack the different interpretation(s) of sustainability that are entailed when the different communities of experts and practitioners refer to the "sustainability of food systems". Relying on interpretive ontology, our objective is therefore to clarify the commonalities and divergences that exist between these different interpretations and to explore how this discussion can help inform food system transformation plans and actions. From a geographical perspective, our interest is essentially on low- and middle-income countries where food systems are both driving and driven by rapid transformations and where the prevalence of the triple burden of malnutrition is high.

The scope of the paper is on both the form and functions of food systems and food system narratives, especially relating to the sustainability thereof, with specific attention to the role of "healthy diets" being both an outcome (as dimension of sustainability) and a driver (through demands) of food systems in different contexts. Furthermore, the paper focuses on the 'upstream' part of the policy agenda setting, where policy narratives are constructed and debated, as this policy agenda setting represents the initial step within the policy process. As such we do not analyze (the content of) policies *per se*, nor do we engage and discuss how the different actors (public and private entities, civil society and consumers) interact with each other at the *policy implementation stage*.

This paper starts by presenting an overview of the narratives that dominate the current debates on food systems and their future. The analysis will reveal how different views and interpretations prevail amongst 'experts' about what the problems are, and consequently what the solutions addressing these problems should be. Next, we explore how sustainability is included (or not) in these different narratives and how this relates to the question of healthy diets. In doing so, we focus our analysis essentially on food systems and will not discuss in great depth other related themes such as e.g., sustainable agriculture, which are debated elsewhere -see e.g. Velten, Leventon, Jager, and Newig (2015). We conclude with a discussion of unavoidable trade-offs between different dimensions of food system sustainability and the need to navigate those trade-offs in an explicit manner when developing or implementing sustainable food system initiatives.

2. Methodology

The analysis builds on an in-depth review of the recent literature. More than seventy documents were identified on 'food system(s)', using two research engines: ScienceDirect and Google Scholar. The research scanning included academic research documents, journal articles, books and book chapters, government and international institution studies, reports, working papers, and other gray literature sources, published in English (language) between 2000 and 2017.

Adopting an interpretive analytic approach, we identified the narratives and story-lines (Gabriel, 2000; Roe, 1994) adopted by the authors of these documents in relation to food systems. The term 'narrative' here is used in a generic manner, to emphasize the constructed nature of the *framings* (in the van Hulst & Yanow, 2016 sense) of the 'stories' around food systems. 'Stories' are characterized by a beginning, middle and end (Roe, 1994; Yanow, 2000). In the context of our analysis, this meant we looked specifically at these different experts' story-lines around 'what the failure of food systems is about' (the origin of the problem = the beginning), 'what is threatened and needs to be fixed?' (the core

Table 1
Different narratives about the failure of food systems.

The state of play	What is the failure about?	What is threatened and needs to be fixed?	Where do the priorities for action stand?
"our food system is failing us"	Inability of the system to feed the future world population	Food security	Closing the yield gap
	Inability of the system to deliver a healthy diet	Nutrition security and health	Closing the nutrient gap and ensuring the quality of diet
	Inability of the system to produce equal and equitable benefits	Social justice, democratic process, small-scale actors	Decentralization, grass-roots autonomy
	Unsustainability of the system and its impact on the environment	Natural resources, agrobiodiversity, energy-water-carbon efficiency	Reducing the food-print of the system on the environment

issue = the middle), and finally 'where do the priorities for action stand?' (the way to fix the problem = the end).

In the next step of the analysis, we 'zoomed in' further into these narratives with the intention to unpack the different interpretation (s) of sustainability that are entailed when these different communities of experts and practitioners refer to the "sustainability of food systems". We looked in particular at how the sustainability of food systems is perceived or defined explicitly and/or implicitly, the associated socio-technical solutions, and the attachment of those narratives to certain groups of actors (specific communities of experts and spheres of disciplines). For this we adopted an interpretive ontology approach – but influenced by some element of epistemology (Easterby-Smith, Thorpe, & Lowe, 2002; Gray, 2014, chap.2), meaning that we were not simply interested in how these different groups of experts interpret sustainability in the context of food systems but also how this interpretation appears to be built and derived from their own mental models, and disciplinary paradigms (Carson, Gilmore, Perry, & Gronhaug, 2001; Carter & Little, 2007; Reiners, Lockwood, Prager, & Mulroy, 2015).

For this, a sub-group of representative articles were selected for their ontological foundations and for the renowned expertise of their authors, and a content analysis was conducted to identify systematically every occurrence of the words 'sustainable', 'sustainability', or 'sustainably' in these documents and interpret the way the word was used (holistic versus narrow definitions). The distinction between the more holistic definition of sustainability (acknowledging the multi-dimensionality of the concept) against a more narrow definition (focusing essentially on the environmental dimension of the concept) was *interpreted* (as in the interpretative approach[1]) on the basis of a careful examination of the evidence provided in the main body of text of these documents as well as in their recommendation section (when available).

3. Narratives about food systems

In this section, we present the results of the initial narrative analysis which was conducted on the food system documents identified through the literature search.

3.1. Our food system is failing us...

One overarching message that emerges from this literature is that food systems are not delivering what is expected or needed to ensure their contribution to full societal wellbeing. "The bottom line is that food systems are failing us" (Global Panel, 2016, p. 17). This term "failure" can be found in a large number of recent reports that touch upon food systems (e.g. Biel, 2016; de Schutter, 2014; FAO, 2016; Haddad & Hawkes, 2016; IPES, 2016, etc.). The WWF Living Planet report 2016 even refers to a "*systemic failure* inherent to the current systems of production, consumption, finance and governance" (Gladek et al., p.8 – our emphasis; see also Morley, Mcentee, & Marsden, 2014). The narrative is therefore one of a global "crisis" (Global Panel, 2016, p. 15) and the consensus is that something needs to be done. The UN Conference on Trade and Development (UNCTAD) talks about the need for "a paradigm shift", and the overall view is that we need to "change the current trajectory" of the food system(s) (UNEP, 2016, p. 24).

Yet, while there seems to be a clear agreement regarding the failure of the food systems and the need to do something about it, the nature of what that failure actually entails seems to differ considerably between perspectives. We identified four major narratives from the literature. These are presented in Table 1.

According to the first of these narratives (e.g. Foley et al., 2011; Tilman, Balzer, Hill, & Befort, 2011; West et al., 2014), the main challenge remains how to "close the yield gap", that is, to produce higher quantities to nourish the growing world population, or in West's and his colleagues' words, how to "provide enough new calories to meet the basic needs for more than 3 billion people [in addition to the 6 already on the planet]" (West et al., 2014, p. 325). Under this perspective, the main issue is therefore *still* the increase in crop production. We emphasize the word 'still' as this interpretation seems, at least at first glance, not very different from the framing by Malthusian and neo-Malthusian proponents over the last two centuries. It refers to the production element of the food security equation that humanity has been struggling with since its origin. Under this emerging *post*-Malthusian interpretation however, the threat is no longer just the growing population. It is rather the combined result of that population's growth, amplified by the multiplicative effect of raising incomes for the majority of this population – leading to an exploding increase and shift in food demand – while on the supply side the quantities of high quality land and water available for agriculture are diminishing and climate change is expected to further reduce the productivity of key crops in several regions of the world (Beddington et al., 2012; Challinor et al., 2014; HLPE, 2012; Tilman et al., 2011).

For others, however, the problem has shifted from quantity to quality. Remans (2016, p. 33), for instance, argues that "While much of the global discussion and agenda is on whether we can produce enough food for 9 billion people in 2050, [other analyses]

[1] Interpretivist looks for 'culturally derived and historically situated interpretations of the social life-world' (Crotty, 1998, p.67).

call for system changes, not so much on how to produce more with less (...) but more on how to change production systems for food availability to meet nutritional needs locally and globally". The narrative here is that *at the present time* the global food system is still able to provide enough caloric supply to feed the world population, but that this quantity is not adequate from a nutrient quality perspective with some serious implications for human health (Haddad & Hawkes, 2016; Popkin, 2009; Popkin & Reardon, 2018; Siegel, Ali, Srinivasiah, Nugent, & Venkat Narayan, 2014). Under this narrative, the framing of the food system failure revolves therefore not so much around closing the yield gap, but rather around closing the 'diet quality / nutrient gap', with a focus on (micro)nutrient intake and nutritional status of the world population. More recently this framing also started to draw attention to the foods that are important to prevent overweight/obesity and diet-related non-communicable diseases. This latest interpretation thus shifts the attention more towards how food systems can better deliver foods that are 'nutritious and healthy' and limit foods that are not leading to a healthy diet (Kuyper et al., 2017; Mozaffarian, 2016). Yet, even with the shift toward a narrative that includes healthy diets, there remains a substantial void in terms of unpacking the various linkages between healthy diets and the different dimensions of sustainability of the food system.

Closely related to this second interpretation, a third narrative insists on the distributional dimension of the equation. In that case the focus is on the apparent paradox that although, on aggregate, present food systems are producing enough food to feed the current world population, almost one billion people are still suffering from hunger (Dixon et al., 2007). The attention here is therefore placed on both the inequality and inequity[2] in the current food systems. This situation, however, does not only concern food access and the related global food security, it also refers to the economic and social inequalities and inequities that the food systems are generating, the increasing anonymity of food and their disconnect from local foodsheds, along with issues of food sovereignty (IPES, 2017; Sherwood, Arce, & Paredes, 2017). The increasing control of the chemical and seed sectors for instance, as well as the concentration of food distribution and marketing activities in the hands of a few large private corporations, is thus perceived as a major source of system failure. Essentially the concern here is that food systems, through self-organizing behavior seeking economies of scale, a) are heading towards more socially unjust structures, and b) are leaving the most vulnerable behind (Bailey, Benton, Challinor, Elliott, & Gustafson, 2015).

Finally the failure of the food system(s) can be interpreted along a fourth avenue where the main issue is not so much the yield gap, the nutrient gap or inequity/inequality of the food systems, but rather the negative impact that those modern food systems have on the environment and natural resources (Amundson et al., 2015; Frison, Cherfas, & Hodgkin, 2011; Gladek et al., 2016; IPES, 2016). According to this narrative the main challenge emerges from what we could term the 'food-print' of these systems, the fact that at all stages (production, distribution, retail, consumption and waste management) the food system activities have huge detrimental effects on the environment (Chaudhary & Kastner, 2016; de Schutter, 2014; FAO, 2013; UNEP, 2016). There is in particular a wide consensus in the literature that the degradation of soils and deforestation following the extension and intensification of agriculture (Amundson et al., 2015; Gladek et al., 2016), the depletion of freshwater resources through their use for irrigation (Frison et al., 2011; IPES, 2016), as well as the extinction of species and substantial erosion in the genetic diversity of domesticated plants and animals in agricultural systems (Fanzo, Cogill, & Mattei, 2012; FAO, 2010, 2015; Khoury et al., 2014), are some of the most severe impacts of the food systems. Again, the issues of healthy diets come into play here, as healthy diets may place additional demands on the food system that require explicit environmental considerations (van Dooren, Marinussen, Blonk, Aiking, & Vellinga, 2014) – see however Section 3.3 below.

3.2. Divergence of interpretations

In sum, starting from the same observation (the "food system is failing us and we need to do something about it") we see diverging interpretations emerging on what this failure is about, what is threatened and must be 'fixed' first -and therefore where the priorities for action sit.

Although we have simplified them somewhat in Table 1, we would argue that the divergences between those narratives as well as the potential tensions that they carry with them in terms of prioritization of actions are real and should not be under-played, especially in the context of low- and middle-income countries where resources and the ability of the relevant actors to embrace an inclusive approach may be highly variable. In particular, while synergies between heathy diets, equitable socioeconomic benefits, and environmental sustainability are potentially possible, closing yield gaps *and at the same* time addressing the food-print of food systems stands as a clear case where the tensions are palpable. The current heated debate around the concept of 'sustainable intensification' (see e.g. Garnett & Dodfray, 2012) is vivid evidence that such reconciliation is not perceived by everyone as being feasible. Yet, effects are not unidirectional and effective trade-offs, positive and negative feedback loops, and impacts at different system scales need to be contextualized (e.g., Dalin & Rodríguez-Iturbe, 2016; Zimmerer, 2013).

In this respect the optimistic discourses found in some reports highlighting the promises of win–win solutions resonate more like rhetoric than real opportunities. While for instance the at-that-time UN Rapporteur on Food Rights remarks that "certain types of agricultural development can combine increased production, a concern for sustainability, the adoption of robust measures to tackle unsustainable consumption patterns, and strong poverty-reducing impacts" (de Schutter, 2014, p. 13), the reality on the ground would force us to be more nuanced. For illustration, in their attempts to find "global leverage points" that offer the best opportunities to improve both global food security and environmental sustainability, West and his colleagues cautiously conclude: "The analyses here illustrate, *in principle*, what is possible and where to focus such possible actions" (West et al., 2014, p. 327, our emphasis). But they also recognize". The challenges and opportunities for improving global food security and the environment are not evenly distributed across the globe (...). There are many regional and global factors that would need to be included to address food security and environmental sustainability—and the tradeoffs among the many ecosystem services in agricultural landscapes — more holistically" (Ibid).

Besides the difficulties of finding technical solutions for win–win scenarios, the perhaps uncomfortable question regarding our (in)ability to challenge the status quo around food system regimes is also pertinent (Bernstein, 2016; McMichael, 2009; Pritchard, Dixon, Hull, & Choithani, 2016). Even when a concrete policy incoherence is identified, this does not mean that there is sufficient political will to redress it (Pingali, 2015). The paradox depicted by Siegel et al. (2014) and Murray (2014) illustrates this point:

[2] Equality refers to observable differences (for instance in the way different groups are treated, or in our case, in the way food is distributed or accessed by different individuals/groups/populations). In contrast equitability refers to 'just' or 'fair' outcomes (for instance a fair distribution of food according to specific needs –which implies that an equitable food system does not have to be equal). In that sense equity is a normative concept. In the current literature on food system, the distinction is not always clearly made, but evidence suggests that both inequality and inequity are observed (sometimes together) in the current food systems.

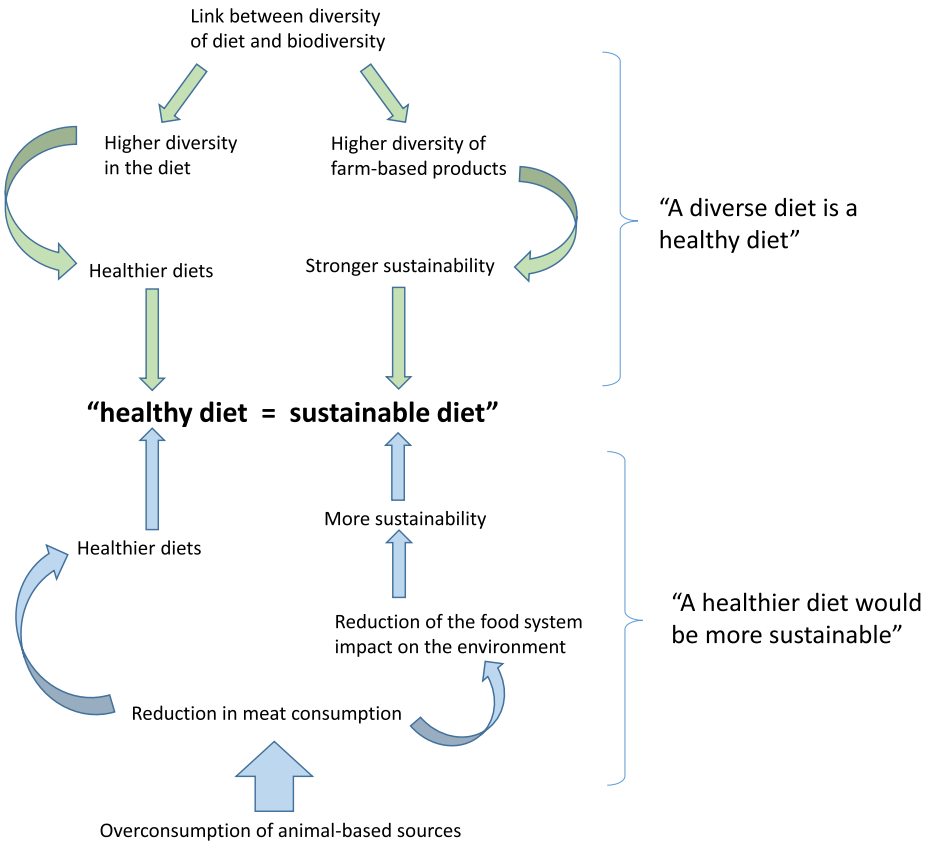

Fig. 1. Two causal pathways 'explaining' the equation "sustainability = health" based on the cases of agrobiodiversity use and meat overconsumption (source: Authors).

while the current supply of fruits and vegetables in most countries is known to be insufficient to meet the dietary needs of the population, most investment is spent on cereals, even if supply of cereals already exceeds the global need by 154 percent, and red meat is produced at 568 percent of the amount the global population would need for a healthy diet (reported in Remans, 2016). This latter point speaks to how the current institutional infrastructure may be tilted towards excessive production of cereals and animal-based products and, in doing so, may inherently create inequity in the distribution of access to adequate supplies of nutritious and sustainable foods.

3.3. Divergent but also confusing explanations

The current discussions on food systems are not simply characterized by divergent interpretations of where the fundamental issue lies and what needs to be done. The debate seems to be also impeded by confusing use of concepts. A case in point is the amalgam that is increasingly made in the literature between 'healthy diet' and 'sustainable diet'. For illustration, in their report, the members of the Global Panel (2016) recognize that "While there is no universal 'diet quality index', there is general agreement on what a healthy or high-quality diet should include", [that is] "a diversity of foods that are safe and provide levels of energy appropriate to age, sex, disease status and physical activity as well as essential micronutrients." (Ibid, p. 17).[3]

[3] This definition is in line with the WHO definition of healthy diet which emphasizes the importance of eating plenty of fruits and vegetables, whole grains, fibers, nuts and seeds, while limiting free sugars, sugary snacks and beverages, processed meats and salt, and replacing saturated and industrial trans fats with unsaturated fats.

Confusion however starts when later in the same report (p.32) high-quality diets are then re-defined as "those that eliminate hunger, are safe, reduce all forms of malnutrition, promote health, and are *produced sustainably, i.e. without undermining the environment basis* to generate high-quality diets for future generations" (our emphasis). This amalgam between 'healthy diet' and environmentally 'sustainable diet' is then continued throughout the rest of the report in the form of sentences or paragraphs that include a mix of references to "healthy" (from a nutritious and health point of view) and "sustainability" (from an environment perspective). For instance, box 2.3 "Elements of a high-quality diet" (p.41) explains that "to be accessible to future generations, high-quality diets need to be produced, processed, distributed and prepared *in ways that use natural sustainability* and mitigate the generation of GHG" (p.41, our emphasis).

We see the origin of this conceptual amalgam as being related to two causal pathways (represented in Fig.1). The first pathway (in blue) is derived from the recognition that some elements in the current diet transition (in particular the increase in protein consumption and, within it, the transition toward animal-based sources such as beef), are not only undesirable from a human health perspective (Global Burden of Disease Study, 2013; Nugent, 2011; Popkin, Adair, & Ng, 2012), but also from an environmental perspective (Herrero et al., 2014; Tilman & Clark, 2014; Ranganathan et al., 2016). Under this rationale, a shift away from a high meat-based towards a lower meat-based diet would not only be healthier, but also reduce the 'food-print' of the system and would as such contribute to environmental sustainability (van Dooren et al., 2014). A healthier diet would then effectively also mean a more sustainable diet (Tilman & Clark, 2014; Tom, Fischbeck, & Hendrickson, 2015; Westhoek et al., 2015).

The second causal pathways (in green in Fig.1) through which healthy diets can be seen closely correlated to environmental sustainability is based on the argument that dietary diversity is a key feature of healthy diets –captured in the motto "a diverse diet is an healthy diet" –consuming a variety of foods across and within food groups such as fruits, vegetables, nuts, fish, vegetable oils with high amounts of poly-unsaturated fatty acids, and modest amounts of dairy products, is recognized to ensure effective intake of essential nutrients (Nugent, 2011; Popkin et al., 2012). The theoretical link between the importance of diversity in what is grown and what is eaten (Fanzo et al., 2012; Jones, 2017) and the underlying assumption of the link between diversity of diet and (agro)biodiversity provides the basis for the second pathway through which the conceptual amalgam between heath and sustainability is made in the literature.

Yet, some would argue that this global equation "healthy diet = sustainable diet" is somewhat misleading and may potentially be doing a disservice to both concepts. Tilman and Clark, for instance, observe (2014, p. 520) "Minimizing environmental impacts doesn't necessarily maximize human health". We would add: and vice versa: a healthy diet is not necessarily sustainable. This point was made clear by Macdiarmid et al. (2013) in the context of the contribution of food systems to climate change through greenhouse gas emission (GHGE). Those authors remark: "A healthy diet is principally about the nutrient intakes, which can be achieved from many different combinations of foods. (...) In that sense, it cannot be assumed that a healthy diet meeting nutrients requirements will necessarily have low GHGE" (Macdiarmid et al., 2013, pp. 15–16). Even the authors of the Global Panel report acknowledge: "there is considerable debate around the relationship between high-quality diets from a nutritional perspective and from an environmental perspective. Are diets that are environmentally sustainable and efficiently use limited natural resources healthy for humans?" (Global Panel, 2016, p. 38). The answer is clearly: not necessarily. It is dangerous, therefore, to unconditionally associate a healthy diet with a sustainable diet and promoting too broadly win-win scenarios. While evidence suggests that synergies can, in principle, be identified (e.g., such as reducing animal protein in meat-based diets), these are often very difficult to achieve. On the other hand, completely decoupling healthy diets from the sustainability of value chains that deliver them would also not be desirable from a food system's, environmental and climate change perspective.

In sum while synergies are feasible if we capitalize on innovations, trade-offs and hard choices are more likely to characterize the near future of food systems and it is important to understand how diets (as proxy for health) and sustainability interactions play out at different scales and in different contexts.

4. Revisiting the meaning of sustainability in the context of food systems

In this section we aim at revealing the normative dimensions of 'sustainability' as used by the different communities of practitioners, scholars, and decision-makers engaging with the food system agenda; how these dimensions derive from underlying ontological assumptions or paradigms, and where potential biases exist. For this we start by identifying the different schools of thought and science, practitioner and civil society communities focusing on food systems. We then rely on a subset of the literature published in each of these communities to elaborate how they define and refer to the concept of sustainability with respect to food systems, based on a content analysis (see Methodology section). The result of the analysis is presented in Table 2**.** The text below provides the detail of this analysis.

4.1. Mapping the current communities engaging in the food system agenda

The three main communities of experts that have engaged with the agenda on food systems are those closely linked to the discipline of agriculture, nutrition, and ecology. Along with their 'disciplinary overlaps' (see below), these groups have and continue to shape the discussion on food systems.

4.1.1 Agriculture

Agriculture has always been closely related to food, but this relationship has historically been focusing on its productivist dimension and driven by an impetus that equated food security with food production. Today, although agriculture is producing enough food to feed the world's population (OECD-FAO, 2017), the agricultural community's engagement with food systems is to a large extent still shaped by the same priority: maintaining or restoring productivity. Along with other threats to food productivity, in particular the impact of climate change, today one of the major concerns within the agriculture community *in relation to food systems* is the impact that the 'modern' food system has on agriculture and its productivity.[4] Garnett, Godfray and the collective of experts that they invited to comment on the problem, for instance, argue that "while the stability and security of the food system is underpinned by its environmental resource base, the evidence overwhelmingly suggests that these resources are being depleted and damaged in ways that threaten food production in the long term (...). Much of this damage is caused by the food system itself - food is both agent and victim of environmental harms" (Garnett & Dodfray, 2012, p. 6).

Another important element in the discussion around the relation of agriculture with food systems is the applied research conducted around the concept of agricultural, or global, value chains (GVC). In development studies, GVC has been used to analyze trade and especially international trade, in relation, but not exclusively, to (high value) agricultural commodities such as coffee (Gereffi & Korzeniewicz, 1994). Two important points of attention in GVC approaches are governance and efficiency (Bush et al., 2013; Ponte & Gibbon, 2005). Governance can help elucidating the balance of power, decision-making and access to information among the different actors (from producers/farmers to consumers) in food systems; and efficiency can help identifying the market opportunities that would lead to increasing competitiveness of a value chain by moving towards, e.g., a specific market niche or by improving efficiency across the complete chain (Seuring & Müller, 2008; Webber & Labaste, 2010).

4.1.2. Nutrition

Nutritionists form the second community that has engaged with food systems. Originally, their interest was focused on addressing problems of poor diet quality and feeding practices resulting in micronutrient deficiencies and subsequent health implications. Typical engagement with the food system has been through direct interventions, including the promotion of supplementations, food fortification, behaviour change communication, universal iodization of salt, breastfeeding promotion, and developing specially formulated and fortified products for different vulnerable groups (Beal, Massiot, Arsenault, Smith, & Hijmans, 2017; Bhutta et al., 2008, 2013). Thinking has evolved, and arguments are emerging that suggest that while these direct interventions –

[4] We do recognize that agriculture as a key sector in the economy of low and middle countries is characterized by a much wider set of issues, covering poverty reduction, child labour, migration, aging, global economic growth, investment, trade and food prices, etc. (see e.g. FAO 2017). Our comments are limited in this analysis to the narratives around agriculture and food systems.

Table 2
The main communities of practices and their interpretations of sustainability in the context of food systems.

Communities of practice	What is the main issue?	Sustainability – what dimension(s) is/are emphasized?	Entry-points for actions/recommendations/solutions	Key references reviewed
Agriculture	Environmental resources underpinning the food system are depleted and damaged in ways that threaten food production in the long term. Much of this damage is caused by the food system itself	Defined through its ecological dimension (narrow definition of sustainability) –but with considerations for animal welfare and ethics, as well as for nutrition (e.g. in Garnett et al., 2014)	Sustainable intensification of agriculture, where sustainable intensification is understood as a "useful guiding principle" regarding the ways to achieve a union between sustainability on the one hand, and productivity on the other (Garnett, Godfray et al., 2012). Also improving natural capital (Pretty, 2008)	Pretty (1998, 2008); Thompson and Sconnes (2009); Garnett, Godfray et al., (2012); Dubé, Webb, Arora, & Pingali (2014)
Nutrition	The debate in nutrition has failed to recognize the very rapid changes that are taking place in the food system, and we lack a good understanding of the impact pathway of those changes on the nutrition of different groups	Very rarely mentioned or defined. If considered, focuses on the environmental dimension (narrow definition) and household capacity to sustain innovations (Combs, 2000)	Identify effective policies and programmes that shape food systems in order to contribute more effectively to improve nutrition and ensure the right to food for all in a sustainable way (HLPE report 2017). Adopt a more integrated framework that helps to gain a broader understanding (Qaim et al., 2014). No specific recommendation related to the sustainability of food system	Popkin (2014); Herforth and Ahmed (2015); Rosi et al. (2016); Ruel, Quisumbing, & Balagamwala (2018)
(Socio) Ecology	Global environmental change, in the context of social, political and economic changes, has brought unprecedented stresses on food systems and food security	Ecological, social and economic dimensions of sustainability (holistic definition)	A more comprehensive and holistic analysis of how the current organization of food production, processing, distribution and consumption contributes to food security is needed. This requires broadening the concept of a "food system" beyond just the activities, and considering the social, economic and ecological outcomes and feedbacks of the system	Ericksen (2008); EAT-Lancet commission (2017)
Value chain for nutrition	Efficiency should not simply be measured in term of income and finance, but also in term of nutrition	Sustainability generally implicitly defined (if at all) through its ecological dimension (narrow definition of sustainability)	Increase the supply of accessible (available and affordable) nutritious foods for the poor (and for different target groups). Increase the demand for and acceptability of nutritious foods for the poor. No clear recommendation related to (ecological) sustainability of food system	Hawkes & Ruel, 2011; Gelli et al., 2015
Agroecology	The crisis of modern, extractive (mainly mon-crop) agriculture where intensification has led to huge environmental degradation (loss of biodiversity, soil erosion, pollution), as well as marginalization of smallholders.	Important focus on the ecological dimension but with a growing attention to the social dimension, often with a local dimension attached to it; and (to a less extent) economic dimension. Closer to the holistic conceptualization of sustainability	Focus on the humans as part an essential part of agroecosystems and natural capital as essential element for sustaining agricultural production, and the compatibility of agriculture with other ecological processes and services. Emphasizes the role of food sovereignty, short value chains, the role of local knowledge in innovation, control over agricultural technology, and agrobiodiversity use	Wezel et al. (2009); Gliessman (2014); Power (2010); Eakin et al. (2016); IPES (2016)

which for the majority have a strong emphasis on the first 1000 days of a child's life- have the potential to improve micronutrient intake in the short-term, their longer-term effectiveness is questionable if they are implemented without simultaneously addressing the wider food environment and the underlying determinants of undernutrition (Bhutta et al., 2013; Leroy, Ruel, Verhofstadt, & Olney, 2008). Popkin (2014) for instance, argues that the diet transitions we observe around the world are partially the result of transformations in the food systems, and therefore that the agriculture and nutrition communities need to understand these changes and focus on their implications for diets and health. The rapidly evolving interactions between traditional-informal and modern-formal food value chains or the role of the private sector as a central driver of the 'missing middle' between production and consumption, are two examples of more comprehensive ways to link nutrition and food systems (Gómez & Rickett, 2013; RUAF, 2017). Yet, this literature also recognizes that very little is actually known about the links between nutrition and food systems (Gómez & Rickett, 2013; Qaim et al., 2014).

4.1.3. (Social)-Ecology

The third major community that has engaged with food systems is ecology and more specifically, scholars and practitioners engaged in deep, human, and social ecology. Part of the rationale for this engagement derives from the fact that food systems contain many of the basic characteristics of ecology – either food webs, energy flows or nutrient cycles – characterized by feedback loops, non-linearities, operating at multi-scales and at the interface between bio-physical and social dynamics- and that, as such, they both influence and are influenced by environmental outcomes and broader aspects of social welfare and livelihood security. For instance, Ericksen's (2008) framework for food system analysis incorporates not only the activities of food systems themselves, but also the interaction with their global bio-geophysical and

social drivers. ''A comprehensive and holistic analysis of how the current organization of food production, processing, distribution and consumption contributes to food security requires broadening the concept of a 'food system'" (Ericksen, 2008, p. 1). Some have thus been arguing that a host of economic, social, and environmental drivers affect food security, and that understanding the interactions among these drivers, activities and outcomes (in terms of food security, environmental security, and social welfare), although complex, is key.

Convergence between those three major communities has given rise to several 'disciplinary overlaps' which have also been instrumental in pushing the agenda of food systems. These include:

Value chains for nutrition – Building on the tools and approaches developed by the agriculture and nutrition communities, a hybrid approach called ''value chains for nutrition" or ''nutrition sensitive value chains" emerged recently in the literature on food systems (Allen & de Brauw, 2017; Gelli et al., 2015). The central argument is the recognition that while conventional agriculture value chains offer very useful tools to enhance the livelihoods and economic benefits of small-scale producers and other actors along supply chains, these tools have, to date, rarely been used to achieve nutrition-sensitive goals (Hawkes & Ruel, 2011). Classically food fortification, i.e. iodized salt and folic acid enriched flour, has taken effective advantage of the value chains of commonly consumed foods. Yet some experts would point out that improving the income and/or the degree of market integration of the poorest groups of actors engaged in a food supply chain is not enough, as evidenced by the negative health impacts that may result from this. The solution proposed by the proponents of the value chain for nutrition is thus to adapt value-chain tools and make them more nutrition-sensitive.[5]

Agro-ecology – This is another major school of thought that can be linked to the current discussion on food system. Agro-ecology lies at the intersection between ecology and agriculture, and in its origin basically guided the ecological basis for sustainable agriculture (Biel, 2016; Gliessman, 1989). Today, the term can mean a scientific discipline, the adoption of specific agricultural practices, or even refer to a social movement (Wezel et al., 2009). It emerges from the notion that the transition in agro-ecological production systems from diversified systems towards ecologically more simple cereal-based systems over the last 50 years (as illustrated in Khoury et al., 2014) has been accompanied by soil erosion, (ground)-water depletion, and natural resources over-exploitation, as well as a substantial reduction in agrobiodiversity at the species, varietal, and allelic levels (Fanzo et al., 2012). According to agro-ecological principles, the focus should therefore be on the sustainable use and management of natural resources, and on the compatibility of agriculture with other ecological processes and services (e.g., Altieri, 1995; Pretty, 2008). In international development contexts, the discourse on agroecology generally also explicitly includes social and ethical considerations, such as changes in diet, fairness and redistributive justice and a smallholder agrarian vision of agriculture (Garnett & Dodfray, 2012). In sum, agro-ecology has emerged as a narrative that in its widest interpretation provides the basic ecological principles for how to study, design and manage (alternative) food systems that address not just environmental/ecological aspects of the crisis of modern agriculture, but also the economic, social and cultural ones (Feenstra, 1997; Pretty, 1998; Rickerl & Francis, 2004).

From the more holistic perspective, however, agroecology and value chains for nutrition are emblematic of the approach that many researchers have taken in terms of creating a more tractable subset of overall food system sustainability in order to limit complexity and improve focus. Our approach that follows starts with sustainability, then identifies building blocks on top of the food system principles girding sustainability more generally.

4.2. Navigating the concept of sustainability

Several communities of practice have actively engaged with the food system agenda and thus privileged certain disciplinary perspectives in the overall food systems narrative. We now elaborate on how the concept of sustainability is defined and used in these different communities.

In the general literature a strong consensus seems to exist that sustainability, in its most universal sense, is a multi-dimensional concept that incorporates three fundamental elements: the pursuit of social equity, the creation of human welfare (often presented as an economic dimension), and the maintenance of the environmental integrity of the resource-base on which the economic and social dimensions are built (UN, 2005). A fourth dimension is often superimposed on these three, one that involves time and the idea that the sustainability of today should not be achieved at the cost of the sustainability of tomorrow (Brundtland, 1987). Together these four dimensions can be considered as the basis for an ''holistic" interpretation of sustainability. A close examination of the same literature reveals, however, that, despite this holistic interpretation, sustainability is frequently reduced to one single dimension: environmental integrity. When people talk for instance about the unsustainability of the current oil-energy system, they refer mostly to the environmental impact of that system, not its social or economic part. This ''narrower" definition of sustainability is relatively widespread in the literature.

As highlighted in Table 2, the five communities of experts we identified above define sustainability of food systems in different ways and pay attention to some dimensions while ignoring others. We reviewed their different positions on the basis of a content analysis of several representative documents selected for their ontological foundations and for the high profiles and renowned expertise of their authors.

Agriculture – Sustainability science in agriculture has been advancing since the late 1980s (see Brundtland, 1987). Sustainable agriculture involves production systems that protect the environment, public health, human communities, and animal welfare (Pretty, 2008; Velten et al., 2015). In this context, the detrimental impact of the food system is by now frequently emphasized (e.g. Dubé et al., 2014) and explicit references to (un)sustainability are being made in many key documents. These references however are for the most part limited to the environmental dimension (water depletion, soil degradation, agrobiodiversity loss, overexploitation of marine resources). In some documents considerations for animal welfare (livestock) and ethics, as well as for nutrition are discussed (e.g. in Garnett & Dodfray, 2012) as part of the debate on ''sustainable intensification", but no concrete attempts are made to embrace an holistic interpretation of sustainability. As a consequence, most of the recommendations found in this part of the literature do not include any major aspect of social or economic sustainability, thus frequently reducing the interpretation of sustainability to its narrower, environmental, element.

Nutrition – In the case of nutrition,[6] sustainability has frequently been linked to the 'beneficiaries' ability to independently sustain interventions, particularly through food-based approaches to nutrition (Combs, 2000). In this context, the analysis revealed an almost complete absence of any form of definition of sustainability in relation

[5] They could for instance be used to document if, where, and how the nutrient quality of the food changes along the chain and how loss of nutrient quality can be prevented (Gelli et al., 2015); but importantly also how nutritious foods can be delivered more effectively to the urban poor.

[6] We do recognize that nutrition as a science/discipline is characterized by a very large set of issues. Our comments are limited to those papers which discuss nutrition in the context of food systems.

to food systems (e.g. Herforth & Ahmed, 2015; Kuyper et al., 2017). In fact, with few exceptions, papers do not even mention the term sustainability. For those which mention or discuss food systems, they mainly consider the environmental dimension of sustainability especially in relation to meat consumption or vegan diets (Perignon, Vieux, Soler, Masset, & Darmon, 2016; Rosi et al., 2016; van Dooren et al., 2014). Subsequently, no specific recommendation was found in those papers in relation to sustainability of food systems. This is rather surprising since the new discourse on nutrition (which could possibly be symbolized by Popkin's recent work) insists on the need for the nutrition community to widen its perspective "beyond the first 1000 days [of a child's life]" (Popkin, 2014, p. 2) and start considering the larger environment, starting with food system transformations.

Social-ecological literature (SE) – by its very nature the SE literature has explicitly embraced a holistic, systemic understanding of the social, ecological and economic dimensions of the sustainability of food systems (see e.g. Ericksen, 2008). Most documents that discuss food systems and claim some epistemic link with the SE narrative emphasize the need to adopt a more comprehensive analysis of the current organization of food production, processing, distribution and consumption, stressing the continuous interactions and trade-offs between those different elements (e.g. Eakin et al., 2016), as well as limits to the earths carrying capacity (Ingram, 2011; Rockström et al., 2009).

Value chain for nutrition (VCN) – The content analysis reveals that the sustainability of food systems is rather implicitly defined in the literature on VCN (e.g. Hawkes & Ruel, 2011, Gelli et al., 2015) and, when considered, the interpretation generally refers to the 'narrow' definition of sustainability related to the ecological dimension only. Yet, among the recommendations (which generally insist on increasing simultaneously both the supply and the demand of accessible, available and affordable nutritious foods for the poor), no clear recommendation relating to the ecological sustainability of food systems was found.

Agro-ecology – Like the agriculture literature presented above, the narrative on agro-ecology often focuses on the ecological dimension of sustainability (e.g. Altieri, 1995; IPES, 2016). However, that specific literature also reveals a growing attention being paid to social and ethical objectives where issues such as changes in diet, fairness and redistributive justice are increasingly mentioned, underpinned by an agrarian smallholder vision attached to a 'local dimension' (Rosset & Martínez-Torres, 2012; Sherwood et al., 2017). The economics of agroecological production also frequently internalizes a cost-benefit analysis of the environmental and social components of farming systems and food supply chains (D'Annolfo, Gemmill-Herren, Graeub, & Garibaldi, 2017; Wojtkowski, 2007). Overall, this narrative explicitly embraces a holistic conceptualization of sustainability.

4.3. The messy "*culturally acceptable*" dimension of food system sustainability

In addition to the 'traditional' three dimensions of sustainability reviewed above (ecological, economic, and social dimensions), some would argue that in the case of food systems, another dimension needs to be added, that is, the "cultural" dimension of sustainability.

Having been mentioned in relation to food for the first time in 1948 by the UNHR in the sentence "everyone has the right to a standard of living *adequate* for the health and the well-being of himself and of his family, *including food* [...]" (quoted in Reynold & Mirosa, 2016, p. 391), "cultural food adequacy" is receiving increasing attention in the literature on food systems. Various international organizations have been presenting "cultural food adequacy" as a central component of what a 'proper' food system should be able to deliver. For instance, the 1996 FAO World Food Summit included the notion of "acceptability as a call for food that is *culturally acceptable*, produced and obtained in ways that do not compromise people's dignity, self-respect and human rights." (quoted in Hammelmann & Hayes-Conroy, 2015, p. 38 – our emphasis). More recently the cultural dimension has been mentioned in Eakin et al. (2016); Fanzo et al. (2012); FAO (2016); Herforth and Ahmed (2015); Kuyper et al. (2017); Global Panel (2016); or Bioversity (2017), among others. A dimension of sustainability associated with "cultural acceptability" in food systems thus seems to be emerging.

This dimension however introduces additional complexities – and possibly confusion- to the debate on food system sustainability. Sometimes referred to as "cultural acceptability" and some other times as "cultural adequacy", what is meant by this notion can be subject to different interpretations. Firstly, "acceptable" is more of a synonym for "tolerable" in a slightly subjective manner, whereas "adequate" is closer to "satisfactory" with a more objective meaning. Beyond this (semantic) distinction, with the introduction of this adequacy (or acceptability) dimension, new questions emerge: Is a "culturally adequate food" referring to diet or to the global food system? What are the criteria to qualify a food regime as "adequate" or "acceptable", or as more "culturally acceptable" than others? Would these criteria depend on whether we talk about adequacy or acceptability; and, who would be legitimate to decide on what is adequate or acceptable?

Following the 1996 FAO Summit what is "culturally acceptable" should refer to the production and supply of food "in ways that do not compromise people's dignity, self-respect and human rights". In that case, the "cultural acceptability" is clearly understood in a food system perspective. Yet, in more recent cases, "culturally acceptable food" mostly refers to food consumption (consumer acceptability) and is understood in a more "cultural food diet" sense – see e.g. Talsma et al. (2013), Oyeyinka, Pillay, and Siwela (2017), or Escobar et al. (2017).

Defining a culturally acceptable diet is already complicated because this depends on the individuals, families or communities concerned. However, when cultural acceptability is 'up-scaled' at the food system level, even more complications emerge. Being "culturally acceptable" at a food system level implies that all relevant activities, from production to consumption (and even food waste management) are expected to be done in a culturally acceptable way. Presently, however, the different documents that propose to include this cultural adequacy/acceptability dimension in their definition of food system sustainability are not fully clear on what they mean exactly by this concept and what the implications are.

Arguments are further compounded with consideration of healthy diets, as producing or consuming food that is culturally acceptable does not necessarily mean that it is healthy (or even sustainable). To illustrate this; while it is perfectly culturally acceptable (and in fact expected) to consume beef or other meat almost every day in some parts of the world (e.g. South America), it is also known that this diet is not necessarily healthy (Popkin, 2009), nor environmentally sustainable (Guyomard et al., 2012; Ranganathan et al., 2016; IPES, 2016). In other words, some diets may be perfectly culturally acceptable, yet unhealthy and unsustainable. Including the cultural dimension in our understanding of sustainability therefore complicates significantly the discussion, but it also underlines that food –and food systems- are not just about the production and consumption of calories and nutrients, but also about social and cultural values.

5. Discussion: from food systems to sustainable food systems

While we concur with Eakin et al. (2016, p. 3) that "Sustainability is inevitably a contested and political process" we also argue

that before a term can become contested it needs to be understood and appropriated. We would conclude that this is not yet the case for food system sustainability. While we observe some differences between the interpretations of sustainability as revealed by the review of the different discourses presented in Table 2, we would argue that those differences reflect more the lack of appropriation of the term by those communities than a real epistemological conflict.

In the paragraphs which follow, we build on the various points discussed in the previous sections to identify key elements that need to be considered when shifting from a food system to a sustainable food system approach. These elements are organized into a framework structured around four major entry points: outcomes, core activities, trade-offs and feedbacks. These four entry points reflect the overall system approach which is guiding our thinking on food system. The value of adopting a system approach to identify appropriate and relevant entries for interventions in food systems has been emphasized in several recent analyses (e.g. Ericksen, 2008; Grant, 2015; Ingram, 2011; McDermott, Johnson, Kadiyala, Kennedy, & Wyatt, 2015; Miller & Welch, 2013; Sundaram, 2014). A food systems approach recognizes activities and outcomes across the whole food system, and focuses on the full range of interactions, feedbacks and tradeoffs rather than on characteristics of separate pieces of the system (Chase & Grubinger, 2014; Grant, 2015; Pinstrup-Andersen & Watson, 2011).

These four entry points are summarized in Table 3 and presented below in greater detail. While discussing them, the following section also highlights some of the major roadblocks that need to be removed if we are to advance along this transformational path.

5.1. Expected outcomes of food systems

The first entry point relates to the expected outcomes of food systems (Table 3). There is wide agreement within and between the different communities that the main objective of a food system is to deliver food and nutrition security (Allen & Prosperi, 2016; Gillespie & van der Bold, 2017; Global Panel, 2016). Whereas the agenda was dominated by food security until probably a decade ago (Lang & Barling, 2012), the new consensus underlines the need "to shift the focus from feeding people to nourishing them" (Haddad & Hawkes, 2016, p. 30), and consequently that nutrition should be an integral part of food systems' global key outcomes. The first step toward a sustainable food system will therefore be to reconcile productivity and quality; food security and nutrition. Eventually this means that, through this focus on food security and nutrition, food systems may also contribute to improving human health, (although we recognize that health outcomes are broader and depend on several other mechanisms such as infrastructure, health and water and sanitation).

A second important outcome relates to the maximization of positive environmental and socioeconomic feedback loops. These need to be aligned with the earth's carrying capacity, population growth, urbanization, global migration and other megatrends. Part of this will also consist of transforming farming as an attractive and viable livelihood option for young people, along with a better integration of rural-urban linkages and inclusive and resource-efficient food supply chains. Such positive outcomes will be the result of environmental and socioeconomic couplings made possible by agents that facilitate the flows of material/energy and/or information among the systems (Liu et al., 2013).

Sustainable food systems will also need to be able to address *future* challenges. The new challenges that climate change will impose on our food security and nutrition priorities mean that in order to remain sustainable our future food systems will have to become resilient: resilient to the long-term productivity decline which is expected to affect several key crops in different regions of the world (Beddington et al., 2012; Schlenker & Lobell, 2010) and resilient to the short-term more acute shocks induced by the increased occurrence and intensity of adverse local events (droughts and floods) and their subsequent impacts (physical and economic disruptions of food supply; price peaks; social unrest, etc.). While a great deal of knowledge and information has been generated over the last 20 years about the impact of global environmental problems -in particular climate change- on agriculture (Battisti & Naylor, 2009; FAO, 2017), much less is known about

Table 3
Framework for achieving sustainable food system – drafting a plan for actions.

	(from) Food System	(to) Sustainable Food System
Outcomes	Desired outcomes: ▪ Food and nutrition security contributing to human health An "healthy diet" is not necessarily an "sustainable diet" ▪ Can be unhealthy/healthy (consumer's choices) ▪ Can be environmentally detrimental (as a result of the type of food preferably consumed)	Desired outcomes: ▪ Food and nutrition security contributing to human health ▪ Positive environmental and social feedback loops ▪ Resilience in light of trends and shocks Sustainable and healthy diets ▪ Diets aligned with national nutrition guidelines ▪ Diets based on food commodities which are produced and supplied through environmentally friendly processes ▪ Active search for diets which promote synergies between health and sustainability
Core activities	Unwanted impacts: ▪ Negative impacts on the environment ▪ Positive and/or negative socio-economic impacts on food system actors ▪ Very little (or no) consideration for the cultural adequacy/acceptability of food	Neutral or, where possible, positive impacts ▪ Conservation and reduction of the negative environmental impacts ▪ Shift towards more sustainable practices (e.g. systematic consideration for food wastes) ▪ Improving socio-economic welfare derived from food system activities ▪ Better consideration of the cultural adequacy/acceptability issue and recognition of its inherent coherency limitation
Trade-offs	▪ Not considered – tendency to overemphasize win–win solutions	▪ Fully considered – in essence should become central to the discourses on food system sustainability ▪ Goal : to balance trade-offs to reach a global maximum level of sustainability
Feedbacks	▪ Acknowledged but within a relatively linear conceptualization of food systems ▪ Emerged from the activities	▪ Feedbacks more central to the analysis, acknowledging complexity, multi-actors and unintended consequences ▪ Goal: Tightened feedback loops

the impacts of those global environmental changes on the other components of the food systems (Ericksen, 2008; Vermeulen, Campbell, & Ingram, 2012).

While food security and nutrition remain the central outcomes of sustainable food systems -with inherent environmental and social feedbacks (Da Silva et al., 2017; Millington, Xiong, Peterson, & Woods, 2017), a critical dimension of sustainable food systems outcomes relates to diets. Partly attributable to the rapidity in which they have occurred, recent transformations in food systems have led to the emergence of diets that are not healthy (Guyomard et al., 2012; Imamura et al., 2015; Lock et al., 2010). The consequence of these unanticipated transitions have been a population that is rapidly growing overweight, often obese, and has an increasing burden of diet-related non-communicable diseases (Lim, Vos, & Flaxman, 2012; Popkin, & Hawkes, 2016). Improving diet is a priority issue in the current global food system agenda, and should be part of the agenda on sustainable food system. However, because healthy diets are often implicitly associated with sustainable diets, there is a need to explore this further.

Shifting from food systems where diets are mainly culturally defined – and as such can be more or less healthy and more or less environmentally friendly – toward more sustainable food systems, would imply two transformations in diets: (i) transitioning towards more healthy diets, thus recognizing that some elements of particular national diets may have to be challenged and in that context that the criterion "culturally acceptable" is not always the recipe for healthy diets; and (ii) transitioning to more environmentally friendly diets where the consumption of particular types of foods may be discouraged (or their actual environmental costs properly internalized). In both cases some powerful lobbies will have to be aggressively challenged.

Finally, wherever the two transitions are achievable simultaneously through one particular change in diet, this synergy should be actively pursued. However, we need to keep in mind that "cultural factors are perhaps the most powerful determinants of which food we consume" (Prescott & Graham-Bell, 1995, p. 201) and therefore that changing diets or food habits to achieve sustainability is more easily said than done, given that culture is not something that can be changed overnight.

5.2. Food system core activities

The second entry point in our framework relates to the activities of food systems *per se*. Presently, the core activities of food systems (production, processing, transport, retail) generate some unwanted effects. First, food systems rely essentially on natural resources and the intensive use of conventional energy (fossil fuel and electricity). As such, food systems induce important impacts on the environment (soils, water, wild and domesticated crops, fish and other natural resources, etc.). Although these impacts are not negative by definition, in their current form most are considered to lead to detrimental externalities (HLPE, 2017; IPES, 2016; UNEP, 2016).

First a shift from a food system to a sustainable food system would therefore imply, transforming the negative environmental impacts of food systems' core activities into positive (or at lease neutral) outcomes and foster a shift towards more sustainable practices -such as a systematic consideration of food waste along the different steps of the value chain (Chaboud & Daviron, 2017) and a reduction of the 'homogenization' of food systems on the various forms of (agro)biodiversity (Bioversity International, 2017; IPES, 2016; Khoury et al., 2014; UNEP, 2016). Although to some extent this first element of the transformation is the most widely accepted one, it is still not acknowledged or discussed explicitly by all communities. More problematically, it still represents an extraordinary challenge both scientifically and technologically. None of the two main "solutions" generally considered relevant at the level of production (agroecology and sustainable intensification) offer clear and obvious avenues to move forward (Mahon, Croute, Simmons, & Islam, 2017; Struik, Kuyper, Brussaard, & Leeuwis, 2014). Some scholars suggest that these approaches should only provide "guiding principles", e.g. see Garnett and Dodfray (2012) on sustainable intensification[7]). More importantly, these approaches frequently represent opposite conceptualizations of what the solution could be. In fact, proponents of each approach are not just skeptical or unconvinced about the other approach, they even consider it part of the problem –see however Mockshell and Kamanda (2018). This is especially the case for the advocates of the agro-ecology approach who argue that "intensification is not that good" (Fanzo et al., 2012, p. 1) and therefore that no form of agricultural intensification can be part of a sustainable solution. Some even refer to sustainable intensification as an "oxymoron" (Lang & Barling, 2012, p. 413; Mahon et al., 2017). In contrast others insist that this conceptual gap is artificial and that intensification is in fact an inherent element of the agro-ecological approach under the concept of 'ecological intensification'.[8] In sum, while the need for a transformation is acknowledged, the path toward this transformation is not simply technologically challenging, it is also conceptually not yet clearly identified.

Secondly, inequity in access to food and in the distribution of the socio-economic benefits along the value chain is considered another major negative outcome of the current food systems' core activities (Bailey, 2011; de Schutter, 2014; Sherwood et al., 2017). The lack of equality in access to food has long received attention in the literature (e.g. Sen, 1982) but the food systems' perspective is broadening this issue (Caspi, Sorensen, Subramanian, & Kawachi, 2012; Lucan et al., 2015). In that regard, value chain literature has concerned itself with distribution issues and several donors and development agencies (e.g. GIZ, DFID, ILO, USAID) have invested substantial resources in supporting interventions that increase the "inclusiveness" of the food system (e.g. Springer-Heinze, 2007). Yet, as our review revealed, the social dimension of the sustainability of food system is not yet explicitly acknowledged in all narratives. In fact, with the exception of those who embrace a more holistic conception of sustainability, the social element of what should become a comprehensive agenda on sustainable food systems is still lacking in many narratives. It does not only involve how much value chain actors benefit (economically or socially), but importantly also who (i.e., family or corporate farms) and how (i.e. through long-anonymous or short-visible chains).

Finally, as highlighted in the previous section, we need to (re)-consider the cultural adequacy (or acceptability) of the system as we switch from food systems to sustainable food systems. Still more clarity is needed on this concept before it can effectively be used as an appropriate criterion for sustainability.

[7] The group of 26 experts invited to Oxford (UK) in 2012 to brainstorm about the concept of sustainable agriculture recognized that "the term denotes an aspiration of what needs to be achieved, rather than a description of existing production systems, whether this be conventional high input farming, or smallholder agriculture, or approaches based on organic methods… It is still not clear what sustainable intensification might look like on the ground, how it might differ amongst production systems, in different places, and given different demand trajectories" (Garnett and Godfray 2012, p.8).

[8] The concept of ecological intensification is embraced by the agroecological community as the means to make intensive and smart use of the natural functionalities of the (agro)ecosystem (through e.g. permaculture and biointensive gardening) to produce food and services in a sustainable way (Tittonell, 2014). The outcomes is not measures in yield per areas and time unit, but rather yield in combination with other factors; e.g. nitrogen fixation, carbon fixation, energy efficiency, land equivalent ratios.

5.3. Acknowledging trade-offs and the need to guide hard choices

An important step in the transition toward more sustainable systems would be a clearer and more explicit recognition of the multi-dimensional nature of the concept of sustainability. More importantly, as a multi-dimensional objective, sustainability is likely to be achieved only through trade-offs between these different dimensions (Liu et al., 2013). For instance, Mason and Lang (2017) in their reflection on what a sustainable diet is suggest that a multi-criteria approach should be adopted, giving equal weight to nutrition and public health, but also the environment, socio-cultural issues, diet quality, economics and governance.

While several documents already acknowledge this reality – the Global Panel report for instance emphasizes that "aligning high-nutrition, low resource footprints and low-carbon footprints will not be straightforward" (2016, p. 39)- many of the documents reviewed fail to acknowledge or even mention these trade-offs in their analysis, and remain silent about this critical point in their recommendations. Instead, a substantial number of these reports and analyses (e.g. Bajzelj et al., 2014; de Schutter, 2014; Tom et al., 2015) emphasize the existence of potential win-win 'solutions' which promise to make the original issue (usually the combination of environmental impacts with the occurrence of unhealthy diets) disappear. A more responsible and realistic approach would be to recognize that those win-win situations are relatively rare and/or difficult to implement and that a lot of the changes that need to be effected (and not just avoided) may be achievable only through difficult societal choices. More clarity and information are therefore necessary on these choices and more guidance needed on how those choices and trade-offs could be navigated by societies in a fair and equitable way. In fact, even where "obvious and simple" actions are universally accepted - such as for instance the reduction of food waste and losses-, those actions may imply some form of trade-offs. For example, setting up cold storage facilities for certain products in low income countries is often presented as one obvious way to improve product conservation and reduce food waste and losses (Parry, James, & LeRoux, 2015). Yet, such a solution has an environmental impact. Unfortunately, the systemic costs brought about by different alternatives (e.g., setting up cold storage vs. accepting a specific quantity of food waste and losses) are rarely fully considered (Chaboud & Daviron, 2017).

5.4. Feedbacks

The last entry point in the framework concerns feedbacks. The relevance of feedbacks (such as those between positive environmental and socioeconomic coupling) has been acknowledged in much of the literature on food systems. Ericksen was already discussing them in her 2008 seminal paper, noting that "the activities and outcomes [of food systems] are also drivers of global environmental change and create feedback loops" (Ericksen, 2008, p. 2). However, the general understanding of food systems is still relatively linear as the most conceptualizations are those which describe food systems as chains of activities spreading from production to consumption. Effectively, when referring to food system the value chain inspired expressions "from farm to fork" and "from field to table" are still prevalent in most of the literature (see e.g. Chicago Council, 2016; EEA, 2016; FAO, 2016; Fresco & Poppe, 2016; Global Panel, 2016, just for 2016).

The shift toward sustainable food systems should be accompanied by a more appropriate conceptualization, one that presents food system as complex, heterogeneous over space and time and replete with linear as well as non-linear feedbacks. This holistic conceptualization emphasizes the multi-causality of food systems resulting from interactions among interdependent components. In particular, information, communication, governance, cultural dynamics and transforming food politics, all interact with each other and have impacts on food systems' dynamics, leading to uncertainty and even unanticipated/unintended consequences as the long-term implications of choices and actions cannot always be foreseen. The possibility of those unintended consequences needs to be better acknowledged and taken into consideration when evaluating impacts.

6. Concluding remarks

In this paper we reviewed the different narratives proposed in the literature about sustainable food systems. This review revealed different ways in which the current food system crisis is understood and interpreted. The different communities of practice that have engaged in the food system debate diverge in their understanding of the actual nature of the problem and subsequently about what the potential solutions are and which one(s) should be given priority.

The paper then focused more specifically on the interpretation and use of the concept of sustainability in relation to food systems. We first showed how achieving sustainability and human health has been conveniently (or, rather, idealistically?) merged into the all-embracing concept of sustainable diet, thus eluding some important challenges and obscuring potential tensions between different objectives. The analysis also revealed how the concept of sustainability, although widely used by all communities, remains poorly understood and applied in different ways and in a relatively narrow understanding by most of them.

We argued that these findings have implications if one wants to shift from food systems to sustainable food systems. With the help of four key entry points we identified some key challenges for policy-making and research on sustainable food systems. These challenges can be summarized in the following three issues.

First there is a clear and urgent need to clarify more carefully what is precisely meant by a sustainable food system – in particular what dimensions of sustainability should be included in it and in what way. This clarification will have important implications for the identification of relevant dimensions and consensual indicators of sustainability. From the present analysis it seems that out of the conventional dimensions of sustainability the social (and in some cases economic) dimensions of food systems still receive insufficient attention.

Second, there is a need to acknowledge more explicitly the local-specific nature of food systems, not simply with respect to the geographical/spatial aspect that characterizes every activity included in the food systems and the implications that this local-specific nature induce for the more appropriate level of food system governance, but also because the recognition of this local-specific nature raises challenges on how to identify adequate indicators for the sustainability of food system; or, how to find indicators that can capture local-specificity and yet remain universal at the same time.

Local specificity plays another more fundamental role because our relation to food is primarily cultural. Since culture and identities are locally defined, local-specificity is central to food systems too. In that sense we challenge the relevance of the concept of a "global food system" as it seems that such a global food system tends to become too abstract and too much devoid of cultural and social dynamics to remain a useful concept. Instead we have in mind a multitude of different local food systems the outcomes of which can be aggregated and linked with each other to different degrees at higher levels (for instance through international trade). Still, this local-specific nature of food systems also raises issues at the conceptual level as it highlights the importance of including

the "cultural acceptability" dimension as a core element in discussions about food systems. As we saw however, the concept of cultural acceptability raises some serious questions with regard to its lack of systematic relation with sustainability: a food system that provides culturally acceptable food may not be sustainable. In sum, the cultural nature of food is clear but the cultural dimension of sustainability is not.

Finally, sustainable food system thinking should be cognizant of the presence of trade-offs, and these should be a central element in food system research. It is the (often competing or conflicting) interplay between food security, nutrition, health, income, environmental sustainability, culture, which makes food systems what they are and how they evolve. The fact that several recently published high-profile reports underplay those trade-offs and instead present the solution as being a search for win-win options is possibly pushing us in the opposite direction of where we need to go. While potential synergies should be looked for and built upon, our analysis suggests that the research agenda on sustainable food systems needs to focus on better understanding the trade-offs of food system sustainability and helping societies navigate these more efficiently and equitably.

With this last remark we reiterate that adopting a sustainable food system agenda implies fundamentally the recognition of its political economy dimension, acknowledging that multiple societal actors have roles to play at different levels in organizing food systems and making them more sustainable and more equitable. Not only local and national governments are to be involved but private sector actors and civil society organizations as well. However, in order to ensure a fruitful and effective dialogue between those different actors the complexity of sustainable food systems and the need for addressing trade-offs and interactions need to be clarified and acknowledged by all.

Conflict of interest statement

We, authors, declare that we do not have any conflict of interest of any sort in publishing this manuscript.

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