Global Food Security 26 (2020) 100398

Contents lists available at ScienceDirect

Global Food Security

journal homepage: www.elsevier.com/locate/gfs

Food systems everywhere: Improving relevance in practice

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ARTICLE INFO

Keywords:
Food system transformation
Systems analysis
Nutrition
Environment
Governance

ABSTRACT

Food systems approaches are increasingly used to better understand transitions in diets, sustainable resource use and social inclusion. Moreover, food systems frameworks are also widely used in many recent policy and foresight studies. We assess 32 highly-cited international studies, identifying and comparing differences in the frameworks used for food systems analysis, and discrepancies in the procedures to identify strategies for and performances of food system transformation. We show that the relevance of existing food systems analysis for identifying critical trade-offs and understanding relevant policies and practices for achieving synergies remains limited. While many studies are largely descriptive, some offer more practical insights into and evidence of entry points for food system transformation as well as opportunities for improving multiple food system outcomes (i.e. nutrition and health, environmental sustainability and resilience, social inclusion). We distinguish four different pathways for food system transformation and outline their analytical underpinnings, their views on multi-stakeholder governance, and how they deal with critical trade-offs between multiple food system objectives. We conclude that food systems approaches must be useful to decision makers and performance can only be improved if decision makers have a better understanding of these underlying interactions and dynamics of food systems change.

1. Introduction

Food systems approaches that assess linkages between all food activities; their market and institutional networks; and the nutrition, environment and socio-economic outcomes, have become very popular in debates on rural and human development. This popularity makes sense given their direct connection to processes of poverty reduction and strategies for improving nutrition, enhancing sustainability of agricultural production and mitigating climate change (FAO, 2014). These approaches are particularly relevant in low- and middle-income countries (LMICs), whose food systems are changing rapidly. Most LMIC recognize the importance of food system transformation as a pillar of economic development. However, few countries have food systems strategies and struggle with how to operationalize insights from food systems into transformative processes.

Interest in more systematic approaches to food system outcomes goes back some 20 years, in response to dissatisfaction with supply-focused development programs based on rather linear food security thinking. It became increasingly clear that intensification of food production alone would not be enough to accomplish the structural eradication of hunger (Koning et al., 2008). Innovation of production technologies could increase potential food supply, but uptake has been limited due to high risks and market constraints, whereas issues of diet diversity and micronutrient deficiencies were largely disregarded. This motivated an initial broadening of the analysis to 'food and nutrition security', including both supply and demand dimensions (Kracht and Schulz, 1999). In addition, more attention was given to rural-urban linkages and the management of agricultural connections to local and global markets through 'food supply chains and networks' (Gereffi and Korzeniewicz, 1994; Humphrey and Memedovic, 2016). Soon after, a more holistic food system framework was developed to capture the complex interactions and feedback between socio-economic and biophysical drivers, as well as to better understand the potential trade-offs and synergies between nutritional, environmental (sustainability and resilience) and distributional/equity outcomes (Ericksen, 2008). Less attention has been given, however, to evaluating the practical usefulness of food system approaches for identifying innovative solutions to support these outcomes and to identifying operational opportunities for engaging stakeholders in policies and practices to address these priority food system challenges.

Food systems frameworks are frequently used in political discourse to argue for particular approaches and reforms to reduce hunger and

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https://doi.org/10.1016/j.gfs.2020.100398
Received 31 March 2020; Received in revised form 9 June 2020; Accepted 12 June 2020

malnutrition or to advocate for more sustainable food system outcomes (IPES Food, 2019). Alarming statements that '*our food system is broken*' regularly appear in reports of international fora (Hawkes and Voegele, 2018), particularly from the perspective of unacceptable health, sustainability and inclusion outcomes. This sweeping representation of brokenness attracts attention, but begs the questions: where are the breaks, and who must be involved in repairing them? Some advocate for fundamental changes to governance, rights and power relationships (FOLU, 2019), while others promote public-private partnerships fixes (Polman, 2018; Schmidt-Traub et al., 2019). Most would agree that we need to search for system solutions beyond simple technical fixes (Ruben, 2019). This implies that instead of simple repair measures, attention should be given to changes in the interactions between food system stakeholders and adjustments in food systems dynamics (Fresco et al., 2017).

To achieve this, food systems analyses must provide key insights for a better understanding of the causes of dietary imbalances in different regions and for specific disadvantaged social groups; the environmental externalities of food production, processing and consumption; or the roles that producers, traders, processors, consumers and policy makers play in the production, distribution and consumption of food. Attention must be paid to the interlinkages within food systems and interactions between stakeholders, as well as the governance of the food environment that should guarantee strategic coordination between stakeholders and effective alignment of health, environment and equity goals (Ruben et al., 2018). There is no 'one size fits all' as individual countries are at different stages of economic and food system development, and this influences the available opportunities for transformative processes (Development Initiative, 2018; HLPE, 2017).

A key advantage of a food systems approach is that clear distinctions are made between causes (drivers) and outcomes (effects) of food system transformation, considering their interactions and competing interests and strategic leverage points to support food system innovations at policy and practice level (HLPE, 2017). Given inherent trade-offs and conflicts, negotiations between different actors are critical. Common conflicts arise around producer and consumer prices, market competition and inclusion, and how to manage trade-offs between poorly valued public goods such as reducing greenhouse gas emissions and how these are included in business investment strategies. Adequate understanding of interactions between formal and informal food arrangements, and insights into the exchange conditions between niche (alternative) and dominant food systems can be helpful to support adaptive change and overcome lock-in effects that hinder social change (Geels, 2002). In addition, food systems should be able to contribute to new and innovative practices to address societal problems in the domains of malnutrition, climate change and inclusion that require focussed practical actions through the consensus and engagement of multiple national and local stakeholders.

None of this can be done without first understanding the different components of food systems, to disentangle their interlinkages and feedback mechanisms, to identify the diversity in food system transformative pathways, and to outline their practical implications for policy makers. The purpose of this paper is to show that, for an adequate understanding of the governance of food system transformation processes, a clearly structured and consistent analytical framework is required to provide insights into stakeholder interests and interactions and their behavioural responses to incentives, innovations and uncertainties. This will be of critical importance to deliver 'value added' to different stakeholders and to guarantee their constructive engagement in food system transformative processes.

The remainder of this paper is structured as follows. We start with outlining the key dimensions of food systems analyses, derived from a review of some 32 highly cited international reports. This enables us to appreciate major similarities and differences in the description and characterization of food systems and to assess to what extent these studies provide insights into multiple dimensions of food system transformative processes. We then distinguish four different archetypes for the analysis of the structure and performance of food systems and indicate the implications thereof for global food policy and local practice. Finally, we conclude with suggestions for a more selective use of the food systems framework in order to guarantee better insights into the opportunities and constraints for promoting effective pathways to promote access to healthier and sustainable diets especially for poor people.

2. Framework

Currently, the frequently-used 'food systems' concept alludes to a wide variety of views about how interactions between food production and consumption are organised and shaped. Different definitions of food systems are, however, used, based on diverging views about the key components and dynamics of food systems. Hospes and Brons (2016) conducted a literature search and identified 55 international publications that refer to food systems, the great majority published after 2010 (Hospes and Brons, 2016). Some 11 different definitions of food systems are distinguished, ranging from the sequence and combination of different agri-food activities and disciplines (Hammond and Dubé, 2012; Vermeulen et al., 2012) to a more complex set of interrelated processes and relations between actors (Ericksen, 2008).

Definitions of food systems essentially differ with respect to their views on the constituting components, boundaries, and interactions within the systems. These differences have wide implications for the scope of food systems analyses for addressing global challenges in the fields of hunger, climate change and inequality. Moreover, these differences are likely to be based on diverging views regarding (1) the causes and consequences of food system performance and (2) the strategic and political opportunities for influencing and modifying food systems governance.

In recent years, a growing consensus has been reached about a more operational definition that covers both performance and governance. The High Level Panel of Experts (HLPE) - representing the science-policy interface of the UN Committee on World Food Security (CFS) - defines food systems as including all elements and activities related to the production, processing, distribution, preparation and consumption of food, the market and institutional networks for their governance, and the socio-economic and environmental outcomes of these activities (HLPE, 2017).

This framework is increasingly adopted as a pragmatic choice that contains the key components of food systems linked to diets and looks at how they are influenced by exogenous drivers and linked to health, sustainability and socio-economic outcomes. Given the importance of national food system policy and practice, this framework has been developed for and agreed upon by national governments who are members of the CFS. CFS also continues to advance this framework, currently with the development of voluntary guidelines for food system development in national and regional consultations.

The HLPE (2017) framework clearly distinguishes the linkages and feedbacks between three key components (Fig. 1):

- food system ***drivers*** (external factors), like urbanization, technology development, climate change and economic growth;
- food system ***components***, like food production, distribution (food value chains) and allocation (consumption) and the (public and private) food environment;
- food system ***outcomes***: (healthy) diets, sustainability (resilience) and equity or inclusiveness (distribution).

Whereas the key food systems components are widely accepted, major debates take place around their relationships and mutual interactions (Béné et al., 2019). Some approaches are based on rather linear supply-led thinking (from production to consumption) and devote much attention to the question 'how do we feed the growing world

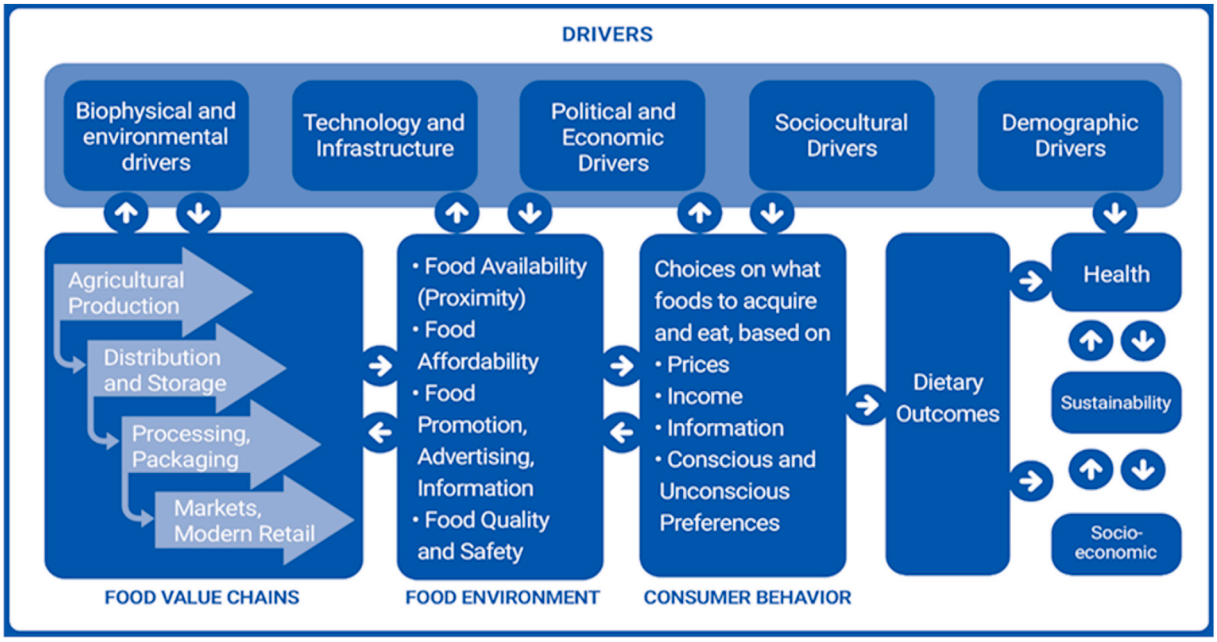

Fig. 1. Food system framework (from de Brauw et al., 2019; adapted from HLPE, 2017).

population?' (Van Ittersum et al., 2016). Other frameworks take a more circular view and consider agro-ecology principles for closing water and nutrient cycles, as well as loss reduction and waste recycling as major objectives (De Boer and Van Ittersum, 2018; Jurgilevich et al., 2016), addressing as their key concern "how do we reduce negative externalities from agricultural intensification?' There are also several approaches that extend the agri-food production framework with supply chain analysis, looking at the efficiency of the delivery networks and the role of (inter)national corporations, and how these influence access and affordability of food, thus focussing on the question 'how does food reach the population?' (Clapp and Fuchs, 2009; Gereffi et al., 2005).Whereas most agri-food analyses remain within the food value chain arena, there are also separate analyses that focus on the two other food system components: the food environment and consumer behaviour. The food environment includes both physical and communication infrastructures, the (public and private) institutional regimes that provide guidance to food production, market and distribution (like grades and standards), as well as the governance framework that guides the quality, safety and access of food through formal and informal markets (Caspi et al., 2012; Herforth and Ahmed, 2015; Turner et al., 2018). Large parts of the food policy literature focus on how different kind of decisions and types of incentives influence food activities in the production, distribution or consumption of food, frequently also considering the 'right to food' perspective (Henson, 2011).

Finally, contributions from the nutrition community focus on the drivers of food choices and the opportunities for nourishing people through healthy diets (Johnston et al., 2014). They consider different food choice motives (i.e. price, convenience, taste, etc.) and consumers' attitudes towards different food attributes. This also includes the appraisal of the role of certification for more sustainable and/or inclusive food products (Ruben, 2019). Key attention is given to the composition of diets (Trijsburg et al., 2019), the role of dietary guidelines for promoting healthy eating patterns (Bekele et al., 2019; Herforth et al., 2019), and the sustainability of different types of diets (Behrens et al., 2017; Van Dooren et al., 2014).

Based on these different insights and stimulated by international debates on policy coherence around the food-climate nexus (FAO, 2014; Laspidou et al., 2018), the development of more integral food systems thinking started with the recognition that different objectives are pursued (healthy diets, sustainable food production and inclusive demand) that require cooperation of different stakeholders. Food systems analyses then provide a useful framework for generating insights into the interlinkages between different system levels and the interactions between various stakeholders (Ruben et al., 2018). It identifies useful leverage points for improving food system outcomes and possible strategies for overcoming trade-offs between healthy, sustainable and inclusive diets.

Key characteristics of food systems analyses that can contribute to a better understanding of interlinkages, interactions and unintended consequences are:

- Food system performance needs to be understood based on the interaction between the (external) drivers and the (internal) system components;
- Technological innovations must be combined with behavioural incentives to guarantee sustainable adoption;
- Identification of appropriate interventions should be based on sound understanding of the interactions between different food system components;
- Activities and decisions of different (public, private and civic) stakeholders that are part of the food system need to be aligned;
- Different types of incentives can be combined to guarantee feasible pathways toward food system transformation;
- Changes in food systems interactions may generate unintended consequences and feedbacks with other components that may reinforce or weaken final outcomes.

Interestingly, the evolution of thinking around food systems is accompanied by a gradual shift in objectives and approaches. In early stages, the main focus was on food production through sustainable intensification, while the environmental discourse became increasingly embedded in strategies for addressing climate change. With the introduction of food value chains thinking, more attention was given to distribution issues and the inclusion of smallholders (as producers) and poor people (as consumers). Nutrition objectives and dietary concerns become subject to far more detailed analyses in integrated food system approaches that recognize malnutrition in all its forms (undernutrition, micronutrient deficiencies and overweight/obesity) and focuses on combined strategies to address the global syndemic of obesity, undernutrition, and climate change, as recently outlined by the EAT-Lancet

commission on food, planet and health (Swinburn et al., 2011).

Reliance on the food systems approach is believed to guarantee better understanding of the - sometimes complex - causalities between public policy interventions and private investment decisions and to enable insights into impact pathways that lead to multiple food systems outcomes for different stakeholders. The systems framework thus explicitly acknowledges the possible trade-offs and/or synergies between different competing goals. It is particularly useful to distinguish various opportunities for reconciling dilemmas between dietary transition and climate change (within planetary boundaries), either through adjusting diets within sustainability limits (demand-side solution), or by adapting food production procedures to environmental constraints (supply-side solution).

3. Appraisal of food systems studies and reports

We aimed to assess the implications of these different analytical frameworks for the way food systems are operationalized in recent studies and policy documents. To do so, we assessed 32 highly cited and influential international reports that used the food system concept as an analytical frame. For their comparison, we particularly looked at (1) which components of the food system are included in the analysis; (2) how these studies describe the interactions between these food system components; and (3) how processes of food system change are envisaged.

We selected reports and studies mainly published in recent years (2016–2019) that received considerable attention in science and/or policy circles (for a complete list of reports studied see complementary material). Several are published by international organizations (FAO, UNEP, EU, HLPE), think tank initiatives (WRI, EAT Forum, IISD, WWF), policy advocacy networks (GLOPAN, MaMo Panel, IAP, IPES Food) or research agencies (CIRAD, WUR, CCAFS). The reports are mostly based on substantive consultation processes with experts and/or practitioners in the field of food systems. Most devote considerable attention to describing the functioning of food systems in several parts of the world and the outcomes for specific groups of people. In addition, some reports also provide a forward-looking perspective and develop foresight scenarios with potential pathways for food system transformation in the near or distant future.

Most food systems studies have been published during the last decade, and different conceptualizations are used which ultimately relate to viewpoints regarding key system properties, their mutual relationships, and the role of governance. Studies focussing on food production and supply devote more attention to biophysical aspects toward sustainable and adaptive resource governance (food availability), whereas reports that focus on the food environment pay more attention to guaranteeing equitable food access and affordability through stakeholder alliances and reflective governance.

Table 1 provides an overview of the attention given to each food systems dimension (and the level of attention in the overall analysis) and indicates which core component(s) received the most attention as leverage forces for changing food systems behaviour and performance. We used the components outlined by the HLPE (2017) and focused on three outcome areas: nutrition and health, sustainability and resilience, and inclusion and equity.

Based on this overview, we can differentiate between four types of food system analyses that reflect different transition pathways (or archetypes) and are based on diverging assumptions regarding key system properties:

a) Supply-oriented analyses that mainly focus on sufficient long-term availability of food through greater food production efficiency under different conditions of population growth and climate stress;
b) Midstream-oriented analyses that consider the value chain as the link between food production and consumption, and mainly focus on better markets and institutions to reduce transaction costs and risks;
c) Demand-oriented analyses that place major emphasis on consumptive demand for food and the conditions for guaranteeing food access and ensuring appropriate diets; and
d) System-oriented analyses that focus on governance for a responsive and adaptive food environment as critical for overcoming conflicts and guaranteeing synergies.

The large majority of reports reviewed belong to the first two archetypes (13 and seven reports out of 32, respectively). Far fewer focus on consumer demand and nutrition outcomes (five out of 32). Seven reports take the food environment as an entry point for the analysis of the dynamics of food system change. Supply- and demand-oriented reports are more research-based and therefore focus on analytical diagnostics, whereas midstream- and system-oriented reports pay more attention to policy applications. Almost all reports pay due attention to sustainability outcomes (usually more related to the control of environmental externalities than to climate change adaptation or mitigation). Socioeconomic outcomes in terms of equity are addressed in half of the reports, and the same holds for reports reporting nutrition outcomes. Only two reports cover all outcome areas (HLPE, 2017; Willett et al., 2019), while three include attention to three outcome areas (AAH, 2017; IFPRI, 2019; IPES Food, 2019). It is noteworthy that only four reports explicitly address the linkages between nutrition and health.

Environmental sustainability outcomes are generally well analysed in supply- and midstream-oriented reports that explicitly consider natural resource use, climate change, and food loss and waste. Some reports that promote agroecology in food systems give significant attention to smallholder inclusion but tend to disregard consumer behaviour, dietary choice, and nutrition outcomes. Most recent food system analyses take a stronger environmental focus, given the growing international attention to addressing climate change challenges. They look at sustainability as the capacity over time to preserve the functions of food systems and their units at multiple levels to provide sufficient, adequate and accessible food to all, whereas resilience is understood as the capacity of a food system to regenerate in the face of unforeseen disturbances or shocks (Tendall et al., 2015). While these dynamic features are increasingly important, most empirical analyses rely on rather stylized systems modelling (Springmann et al., 2018) and only a few long-term reports on adaptation or mitigation at field level are available.

The assessment of equity and social inclusion outcomes is found in all food systems archetypes, although relatively less pronounced amongst the supply- and demand-oriented report categories. Roughly two-thirds of the midstream- and system-oriented reports give due attention to distributional implications of food system transformation for particular social groups (like smallholder farmers, women, youth, etc.). Inclusive development asks for partnerships that involve horizontal coordination between public, civic, and private agents, as well as vertical supply chain coordination among private sector producers and food processing industries (Fresco et al., 2017). Adequate upscaling of business innovations and tailoring public investments toward equity goals can be better guaranteed under conditions of equal access, broad and diverse stakeholder participation, and transparency of governance regimes (Wigboldus et al., 2016). Interestingly, almost no attention is given to backward linkages between healthier diets and the required adjustments in farm and production structure.

Generally, less attention is given to nutrition and diets, particularly in the supply-led and midstream-oriented reports. Most of these reports look at consumptive demand basically as an outlet for delivering food products and devote little attention to the composition of the food basket and outcomes in terms of dietary diversity or nutrient adequacy. About half of the system-oriented reports trace effects for nutrition by looking at the evolution of food distribution channels and the change in consumer food expenditures. Only four reports explicitly make linkages

Table 1
Mapping of food systems reports and studies.

Report	Reference	Food system drivers	Food System Components				Food System Outcomes			
			Food Production & Food	Value Chains & Food Markets	Food Environment	Consumptive Behaviour	Environ-ment & Climate	Equity & Inclusion	Nutrition & Diets	Health
FAO (2018)	(FAO, 2018)	XX								
CIRAD (2019)	(Dury et al., 2019)	XX								
AAH (2017)	(AAH, 2017)	XX								
WEF (2018)	(WEF, 2018)	XX								
GFS (2019)	(Global Food Security, 2018)	XX								
WRI (2019)	(Searchinger et al., 2019)		XX							
IPES (2019)	(IPES Food, 2019)		XX							
FOLU (2019)	(FOLU, 2019)		XX							
IAP (2019)	(Canales Holzeis et al., 2019)		XX							
ISPC (2018)	(Rachid; Serraj and Pingali, 2018)		XX							
CCAFS (2019)	(Rawe et al., 2019)		XX							
WWF (2017)	(Gladek et al., 2017)		XX							
UNEP (2016)	(UNEP, 2016)		XX							
TEEB (2018)	(TEEB, 2018)			XX						
EU (2018)	(Fabbri, 2017)			XX						
WBCSD (2017)	(WBCSD, 2018)			XX						
WEF (2017)	(WEF, 2017)			XX						
UNBSDC (2017)	(Business & Sustainable Development Commission, 2017)			XX						
FAO (2019)	(FAO, 2019)			XX						
IFPRI (2019)	(IFPRI, 2019)			XX						
WUR (2018)	(van Berkum et al., 2018)				XX					
IISD (2019)	(Laborde et al., 2019)				XX					
UNEP (2019)	(UNEP, 2019)				XX					
MaMo (2019)	(Malabo Montpellier Panel, 2017)				XX					
WBCSD (2019)	(WBCSD, 2019)				XX					
HLPE (2017)	(HLPE, 2017)				XX					
EAT (2019b)	(Willett et al., 2019)				XX					
EAT (2019a)	(The EAT-Lancet Commission, 2019)					XX				
SCAR (2018)	(Achterbosch et al., 2019)					XX				
FSIN (2019)	(Food Security Information Network, 2019)					XX				
GNR (2018)	(Development Initiative, 2018)					XX				
GLOPAN (2016)	(GLOPAN, 2016)					XX				

XX = Focus area (leverage force) High Some Low

between nutrition behaviour and health outcomes, thus seeking attention for the changes in the burden of diseases related to the shifts in nutrition patterns.

Overall, the food systems reports and reports reviewed differ in terms of their analytical approaches, diagnostic procedures, and policy outcomes. The frameworks used to assess system performance and the diagnostics applied for identifying system change lead to different strategies and policy proposals aiming to overcoming specific food systems failures (Eakin et al., 2017; Miller and Welch, 2013). Moreover, they reflect a variety of narratives, mental models and disciplinary paradigms that refer to different food system dimensions (Béné et al., 2019). The biggest risk to the usefulness of food systems analyses is that people focus on just one of the three major outcome areas and avoid assessing major trade-offs between them, thus neglecting important institutional issues and political dilemmas that need to be addressed to support food system transformation. We look at some of these typical differences to illustrate the practical contribution and relevance of more integrated food systems approaches.

First, major differences in analytical approaches can be registered between supply- and demand-oriented approaches that rely on forward and backward linkages, respectively, to guarantee that interventions involve and reach other stakeholders within the food system. Midstream-oriented reports use both types of linkages to influence input and output markets. System-oriented reports, however, devote significant attention to feedback mechanisms that result from large-scale adjustments in food systems relationships, as well as adjustments in supply- and demand-elasticities that result from spill-over effects to other stakeholders. In the former case, food system responsiveness may be dampened (due to general equilibrium effects), while in the latter case faster adaptations could take place.

Second, differences in diagnostic procedures are also likely to occur between supply and midstream-oriented approaches that tend to focus on food availability and access on the one hand and demand- and system-oriented approaches that pay more attention to food distribution, affordability and consumption on the other. This also implies that the former type of reports devote more attention to technical (and sometimes also agroecological) solutions that modify upstream relationships between input providers, producers and traders, while the latter look more at distribution networks, consumer awareness raising, and policy coordination as key areas for food system transformation.

Third, also in terms of major target areas for food system transformation, there are important differences between each of the frameworks. Supply- and demand-driven approaches basically intend to generate rather focussed stakeholder responses to price incentives either at the beginning or the end of the food supply chain, whereas midstream-oriented reports try to reach a balance between supply- and demand-side stakeholders. Consequently, long-term agreements and interlinked contracts play a key role for coordinating market transactions. In system-oriented reports, bargaining solutions between multiple stakeholders become the relevant framework for enhancing resilience and supporting innovations that explicitly address trade-offs between different objectives and interests.

Fourth, there are important differences between the frameworks in how gender is addressed. Gender is seen as central to food systems, where both men and women have (different) roles, responsibilities, power and preferences in production, markets and consumption and are differently affected by food system transformation (Ruel et al., 2018). Women's roles are often invisible or under-valued and are often performed with large economic and cultural constraints and limitations. Supply- and midstream reports basically focus on active participation and empowering of women in production and economic activities by improving their access to resources (knowledge, finances, inputs, time). Demand-oriented reports highlight the role of women as caregivers and food providers within their families and their reproductive role being mothers of the next generation. Focus is on improving women's decision making related to income allocation, food purchases and food allocation and on their own well-being in support of (future) pregnancies. While including gender-based differences in outcomes and improving women's empowerment, system-oriented reports explicitly address unintended consequences and trade-offs of food system transformation for women due to the existing norms and values concerning women and men's roles (Fofana et al., 2019).

In summary, while several archetypes for food system transformation may use similar concepts and distinguish comparable issues, they are essentially quite different in terms of their adjustment processes and the underlying assumptions for creating behavioural responses of food systems stakeholders to specific types of incentives. It is therefore important to clarify which framework is required to address typical food security and nutrition issues, and how different approaches could reinforce one another toward a more integrated and dynamic understanding of food systems transition pathways (Maye and Duncan, 2017).

4. Implications for policy and practice

A next step in the appraisal of different food systems frameworks is to assess their practical usefulness for the diverse set of public, private and civic stakeholders involved in decision making on food system innovations and transformation. Given the fact that conceptual models are only representations of more complex realities, we need to identify specific areas of action where the food system 'lens' leads to different types of solutions. This user perspective is also important to value the operational capacity of food systems analysis for mobilizing different key stakeholders to address common problems.

Using the four archetypes for food system transformation described above, we looked at some typical solutions and strategies proposed in the 32 reviewed reports and reports, focussing attention on the active engagement of different key stakeholders and the understanding of the steering principles and governance mechanisms for effective food systems change processes. Table 2 provides an overview of typical analytical methods and approaches used by each of the archetypes, and the implications for engaging relevant stakeholders in food systems governance (e.g. how to organize interactions between multiple agents), procedures for assessing trade-offs or synergies between food systems outcomes (e.g. how to deal with conflicts between multiple objectives), and food system transformative strategies (e.g. which practical interventions are proposed and how they consider interactions between different system levels).

These different traditions for food systems analyses are operationalized with specific analytical tools and methods and therefore also rely on other frameworks for engaging different types of stakeholders and for reconciling trade-offs between objectives. In practice, this means each food system archetype tends to be associated with specific views on the effectiveness of policies and incentives for improving system performance. We can illustrate the relevance of these differences in three particular areas critical for steering the process of food system transformation.

First, the food system archetypes maintain rather different views on the *governance of change* and the interaction of procedures between stakeholders. Supply-oriented approaches place high emphasis on the supply response of producers and input-providing agents that can contribute to sustainable resource intensification. Major challenges thus refer to understanding risks and information constraints that could explain (dis)adoption of technologies. Midstream approaches look at supply chain governance on the continuum between markets and contractual exchange (Williamson, 2000). This means that bargaining between supply chain agents is the most important governance interaction. Demand-led approaches start with consumers and their interactions with private food suppliers and public food regulators. Consequently, significant attention is given to the role of prices, information, and behaviour change communication for influencing decisions at household level. Finally, system-based approaches tend to rely

Table 2
Approaches, strategies and solutions in different food system archetypes.

Food system archetype	Reports/Reports	Analytical methods (toolbox & key concepts)	Governance systems (multiple stakeholders)	Trade-offs & synergies (Multiple goals)	Transformativepathways (multiple levels)
Supply-oriented	FAO (2018); CIRAD (2019); AAH (2017); WEF (2018); GFS (2019); WRI (2019); IPES (2019); FOLU (2019); IAP (2019); ISPC (2018); CCAFS (2019); WEF (2017); UNEP (2016)	Production systems; land use change; agro-ecology; biodiversity & forest cover climate stress adaptation & mitigation	Producers responses (adoption of good practices); sustainable intensification;	Income & Environment; Assets & Inclusion	Input supply & delivery; Rural finance & credit; Infrastructure; (sub)national & (sub)regional links; farmer organization (coops)
Midstream-oriented	TEEB (2018); EU (2018); WBCSD (2017); WEF (2017); UNBSDC (2017); FAO (2019); IFPRI (2019)	Supply chain analysis; life cycle analysis; business management; urban-rural linkages; transaction costs; risk analysis.	Market responses (prices & transaction costs); supply chain efficiency (FLW reduction)	Value added shares & margins; income & employment	Infrastructure & market information; price harmonization; delivery contracts
Demand-oriented	EAT (2019a); SCAR (2018); FSIN (2019); GNR (2018); GLOPAN (2016)	Diet quality; food expenditures; income elasticity; RCTs	(intra)household responses; living wage	Nutrition & Income/Assets	Food labelling; Asset Entitlements; Women empowerment
System-oriented	WUR (2018); IISD (2019); UNEP (2019); MaMo (2019); WBCSD (2019); HLPE (2017); EAT (2019b)	Response multipliers; multiple goals programming; feedbacks & interlinkages; gaming	Multiple agent coordination; transparency; public-private partnerships	Income – Nutrition – Environment – Health Nexus	Food-based dietary guidelines; food dialogues; food coalitions

on dialogue around public choice priorities that could lead to a gradual evolution of norms and values concerning healthy and sustainable diets and inclusive food systems.

Second, there are important differences in the procedures and mechanisms for *dealing with conflicting objectives*. Whereas supply-oriented approaches deal with trade-offs in a rather pragmatic way and focus mainly on sharing of information, midstream analyses pay most attention to bargaining processes, risk sharing, and contractual agreements on value added distribution as key mechanisms for reaching consensus. Demand-oriented frameworks search for reconciliation between nutrition and environmental objectives using a two-pronged approach that provides precise arrangements regarding the governance regulations for defining the rules of the game. Finally, system-oriented approaches are based on evolutionary changes that are embedded in continuous interactions and strong interlinkages and interfaces between sometimes-conflicting objectives for reaching solutions across sectors and at different scales.

Third, there are major differences in *leverage points* that are considered to support food system transformation. Supply-oriented approaches show great confidence in upgrading the (natural) resource base as a starting point for more sustainable production systems, thereby paying due attention to resource ownership patterns to guarantee inclusiveness. Midstream approaches focus more on spatial interlinkages and exchange rules to encourage adjustments at upstream (producer) or downstream (consumer) level. Demand-led analyses tend to consider consumer demand and women's empowerment as key mechanisms for changing food systems performance. Finally, systems-oriented approaches focus on spaces for adaptive behaviour and feedback between multiple stakeholders resulting from their mutual interactions as a major leverage point for driving food systems change. This implies that they search for engagement and realistic alignment as key mechanisms for self-enforcing food systems transformative strategies.

If food systems analyses is to move from concept to functional practice for specific countries or territories, the analytics must be simplified and streamlined, to focus on examples of effective interventions relevant to local and national stakeholders, and to enable active learning on the (un)intended positive and negative consequences of food systems change (Cistulli et al., 2014). Moreover, the food systems framework can be used to identify tensions between different outcomes and to enable societal debate and political bargaining about feasible instruments for overcoming these trade-offs. Steering such processes requires above all political engagement and sound public, private and civic partnerships.

5. Discussion and outlook

Food systems rhetoric has become very common in recent discussions on the linkages between agriculture, nutrition and health, and climate change. We have outlined several major differences in the definition of the components, boundaries and outcomes of food systems that give rise to diverging views on food systems responsiveness to incentives and innovations (Ruben et al., 2018). Given these discrepancies in analytical and conceptual frameworks, policy devices for food system transformation tend to vary as well.

Our overview of 32 recent policy reports based on food systems analysis indicates that general attention is given to the three core components of the food system: food production, agri-food supply chains, and the market and institutional food environment. Far less attention is generally devoted to the drivers of food systems change and the (social, economic, biological and psychological) determinants of food choice that explain differences in nutrition patterns and the composition of diets that people eat. Even fewer reports are available that trace nutrition to health results – only the reports by EAT-Lancet (2019a), HLPE (2017) and GNR (2018) (Development Initiative, 2018; HLPE, 2017; Willett et al., 2019) look at the implications of nutritional patterns for the burden of diseases - and address the convincing

rationale of investing in better diets that leads to substantial reductions in health costs. Less attention still is usually given to political economy and power struggles between organised and non-organised stakeholders, including gender differences (e.g. access to production assets, labour distribution, distribution of income etc.).

When we compare the underlying differences in food systems analyses, it becomes clear that most reports do distinguish between various food systems components but hardly engage in further analysis of the interactions between different stakeholders, and thus cannot identify policy incentives for aligning competing interests. In a similar vein, even while many reports consider multiple food systems outcomes, attention is mostly given to technological solutions while avoiding entering the bargaining arena where behaviour change interventions for overcoming trade-offs can be assessed. Consequently, proposals for food system transformation policies tend to be limited to particular levels and rarely create incentives toward dynamic and self-enforcing changes at scale.

In addition to this general conclusion, we can also register several more specific trends that warrant attention. First, most reports remain rather descriptive and provide scarce insights into the impact pathways for generating food system change and the potential effectiveness of different types of policy interventions. Consequently, entry points for food system transformation are difficult to identify and neither general equilibrium nor distributive effects (equity) are adequately addressed.

Second, the large majority of food systems reports are still based on a fairly linear and generic view of supply-demand networks ('from farm to fork') and pay most attention to incentives for supporting food producers (i.e. for adopting improved technologies or increasing the marketed surplus), while ignoring or underestimating the role of consumer choice motives as potential drivers for food systems change (Lusk and McCluskey, 2018). In a similar vein, sparse attention is given to more recent changes in food consumption habits, like the rise in out-of-home consumption, the emerging trends of home delivery (by fast-food chains) and the increased intake of ultra-processed foods, and the related implications for nutrition and health.

Third, most "food systems" reports still in effect focus on individual foods or food groups that are important in human diets (i.e. fruit and vegetables, pulses, animal-based products, whole cereals, etc.) or that may be potentially harmful (sweet soft drinks; ultra-processed foods, etc.) and are in fact value-chain reports. However, to address the complexity and connectiveness of food system outcomes, the focus should shift from single food (groups) to a whole diet approach. Promotion of healthier components AND mitigation of unhealthy components while taking into account possible substitutions and consequences for the environment are necessary to sustainably combat malnutrition in all its forms. Nationally endorsed food-based dietary guidelines that define a healthy diet within a country-specific context are urgently required (Gonzalez and Garnett, 2016; Herforth et al., 2019) not only to inform consumers about what to eat but to analyse in detail specific dietary gaps that particular categories of people (adolescents, pregnant women, young children, elderly and especially those being rural-urban poor, indigenous people, peasants, upland and remote communities, refugees and displaced people, etc), are facing. This will enable policy makers to better focus and target food policies (Clay et al., 1999; George and McKay, 2019).

Fourth, only a few food systems reports pay explicit attention to the bargaining relationships between different stakeholders and the feedback loops that may hinder or support food system transformation (Clancy, 2013; Kim, 2000; Sundkvist et al., 2005). This is mainly done when trade-offs between multiple food systems objectives are considered (e.g. consumption of healthier diets from a sustainable food environment). Overcoming such trade-offs requires deeper insights into behavioural relationships (guided by mutual trust, bargaining power, reputation, transparency, etc.) that are vital for long-term exchange networks and cooperation arrangements. Effective enforcement of shared pathways toward food system transformation can only be based on incentives that guarantee the involvement of all relevant public, private and civic partners.

Finally, but certainly not the least important, is the fact that few in-depth insights are provided in food systems governance mechanisms. It is of utmost importance to better understand the power (im)balances between food systems stakeholders, the (dis)connections between formal and informal systems, and the critical role of women, youth and marginalized groups in food systems. The opportunities and constraints of different food systems governance arrangements – like the role of public-private coordination (e.g. in the field of grades and standards) – are still poorly understood and need further study (Dunning et al., 2015; Mancini, 2019).

Our final outlook considers the challenges and requirements for relying on the food systems framework to provide guidance to countries to transform processes, practices and policies. The food systems approach needs to be grounded in an understanding of food systems dynamics, that identifies critical linkages and feedback between system components, and informs specific policy incentives to support priority food systems outcomes. Instead of designing new analytical frames, it would be most useful to harmonize existing tools under a commonly agreed systems approach. The relevance of food systems will benefit from practical approaches that deliver useful results to all stakeholders involved.

Declaration of competing interest

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

Annex: Overview of major food systems reports reviewed

Organization	Title of Report	Web link	Reference
FAO (2019)	State of food and agriculture (SOFA)	www.fao.org	FAO (2019)
EAT-Lancet (2019a)	Food, Planet, Health: Healthy Diets from Sustainable Food Systems/	www.eatforum.org	(The EAT-Lancet Commission, 2019)
EAT-Lancet (2019b)	Food in the Anthropocene	www.thelancet.com	Willett et al. (2019)
WRI (2019)	Creating a sustainable food future: a menu of solutions to feed nearly 10 billion people by 2050	www.wrr-food.wri.org	Searchinger et al. (2019)
IISD (2019)	Transforming agriculture in Africa and Asia	www.iisd.org	Laborde et al. (2019)
IFPRI (2019)	Global food policy report	www.ifpri.org	IFPRI (2019)
IPES (2019)	Towards a common food policy for the EU	www.ipes-food.org	(IPES Food, 2019)
UNEP (2019)	Collaborative Framework for Food Systems Transformation	www.oneplanetnetwork.org	UNEP (2019)
MaMo (2017)	Nourished: How Africa Can Build a Future Free from Hunger and Malnutrition	www.mamopanel.org	Malabo Montpellier Panel (2017)
FOLU (2019)	Growing Better: Ten critical transitions to transform food and land use	www.foodandlandusecoalition.org	FOLU (2019)
CCAFS (2019)	Transforming food systems under climate change: Local to global policy as a catalyst for change	www.ccafs.cgiar.org	Rawe et al. (2019)
		www.wbcsd.org	WBCSD (2019)

WBCSD (2019)	CEO Guide to food system transformation		
FSIN (2019)	Global report on food crises	www.fsinplatform.org	(Food Security Information Network, 2019)
CIRAD (2019)	Food systems at risk: trends and challenges	www.cirad.fr	Dury et al. (2019)
IAP (2019)	Food systems for delivering nutritious and sustainable diets	www.interacademies.org	Canales Holzeis et al. (2019)
FAO (2018)	The future of food and agriculture in 2050: alternative pathways to 2050	www.fao.org	FAO (2018)
WUR (2018)	The food systems approach: sustainable solutions for a sufficient supply of healthy food	www.wur.nl	van Berkum et al. (2018)
ISPC (2018)	Agriculture & Food systems to 2050: global trends, challenges and opportunities	www.ispc.cgiar.org	Serraj and Pingali, 2018(
TEEB (2018)	TEEB for agriculture & food: scientific and economic foundations	www.teebweb.org/agrifood	TEEB (2018)
GNR (2018)	Global nutrition report	www.globalnutritionreport.org	Development Initiative (2018)
EU (2018)	Food 2030: future proofing our food system through research and innovation	www.fit4food2030.eu/food2030platform	Fabbri (2017)
SCAR (2018)	Synthesis of existing Food Systems studies and research projects	www.scar-europe.org	Achterbosch et al. (2019)
WEF (2018)	Readiness for the future of production report	www.weforum.org	WEF (2018)
WBCSD (2017)	True cost of food: unpacking the value of the food system	www.wbcsd.org	WBCSD (2018)
UN-BSDC (2017)	Better Business, Better World Report	www.report.businesscommission.org	(Business & Sustainable Development Commission, 2017)
AAH (2017)	Outlook on hunger: scenario analysis on the drivers of hunger through 2030	www.actionagainsthunger.org	AAH (2017)
HLPE (2017)	Nutrition and Food Systems	www.fao.org/cfs/cfs-hlpe	HLPE (2017)
GFS (2019)	Game-changing developments in the context of food security and future research priorities	www.foodsecurity.ac.uk	Global Food Security (2018)
WEF (2017)	Shaping the future of global food systems: a scenario analysis	www.weforum.org	WEF (2017)
WEF (2017)	The global food system: an analysis	www.wwf.org.uk	Gladek et al. (2017)
UNEP (2016)	Food systems and natural resources	www.unenvironment.org	UNEP (2016)
GLOPAN (2016)	Food systems and diets: facing the challenges on the 21st century	www.glopan.org	GLOPAN (2016)

Acknowledgements

This work was undertaken as part of, and funded by, the CGIAR Research Program on Agriculture for Nutrition and Health (A4NH). Any opinions expressed here belong to the authors, and do not necessarily reflect those of A4NH or CGIAR.

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