


Review

Towards sustainable food systems: a review of governance models and an innovative conceptual framework

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Abstract

To accelerate the transition towards inclusive, ecological, just and economically viable food systems, insights into appropriate governance models and principles are needed. This article aims to understand how food system governance is linked to and can contribute to sustainability. A review of 34 articles addressed food system governance, sustainability, current barriers and potential solutions. Some authors propose new, participatory, collaborative and democratic governance models to achieve a sustainable food system transition. Other authors consider a lack of integrated policies across sectors and siloed governance major barriers to holistic sustainability agendas and food system approaches. Three main elements of governance emerged from the reviewed literature: (i) interactions between actors, (ii) control and power balances, and (iii) (in)formal rules. Our analysis provides a fourth element: the orchestration of (multiple) food systems and policies. These four elements are integrated into a novel conceptual framework for consistently researching food systems governance for sustainability. The latter is now defined as ‘the continuous process of orchestration of policies and (multiple) food systems consisting of diverse interacting actors, respecting (in)formal rules and striving to provide food for all, in equitable and environmentally-friendly ways, at any time and in any context’.

Keywords Food systems · Governance · Sustainability · Systematic review · Conceptual framework

1 Introduction

The planet Earth is confronted with shocks and crises becoming increasingly intensive, like wildfires, drought, heat waves, human conflicts and wars, and even potential biodiversity collapses [1], some of which can only be solved by concerted large-scale action [2]. The globalized agri-food system, consisting of many sub-systems, partly contributes to negative environmental impacts and social inequalities, but can also provide solutions via new agroecological, eco-friendly and participatory approaches and employment [3, 4]. Food systems have been conceptualised by Ericksen [5] and Ingram [6] and include biophysical and socio-economic drivers, food chain activities from production to consumption, and sustainable outcomes of the activities in terms of food security and environmental and social welfare. A sustainable food system is defined by the Food and Agricultural Organisation (FAO) as “one that delivers food security and nutrition for all in such

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Discover Sustainability

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a way that the economic, social and environmental bases to generate food security and nutrition for future generations is not compromised".¹ This is largely based on the initial definition of sustainability provided by the Brundtland Commission in 1987.² Sustainability in the context of food systems also refers to the 17 United Nations Sustainability Development Goals (SDG), which are all relevant to the food sector, but especially Zero Hunger (SDG 2), Reduced Inequalities (SDG 10), and Sustainable Production and Consumption (SDG 12).

More recently, new education, research and innovation agendas and strategies for food systems are emerging in Europe to encourage sustainable food system approaches [7]. One of the priority themes is '*Change the way we govern*' food systems to accelerate the transition towards sustainable outcomes [1]. The other three themes are: change the way we eat; change the way we process and supply, and change the way we connect to food systems. These themes are all addressed through a food systems lens and aim to contribute to sustainability. In this article, the theme of food system governance for sustainability is addressed by a systematic literature review.

Governance is defined as "the act or process of governing or overseeing the control and direction of something (such as a country or an organization)".³ However, governance is a broad and not consistently-defined concept, applied in political, management, economic, social and spatial sciences [8]. It has its roots in the management and business literature on corporate governance, where it has largely been studied [9, 10]. In practice, the word governance has become particularly popular since the 1980s. It then marked partly a shift from public sector activities to public-private or private contracts and partnerships, involving more diverse actors, and various types of organisations, and giving larger space to markets and networks [11]. 'New governance' processes "increasingly involve organizational hybrids that cross hierarchy, market, and network, and embrace multiple actors from the public, private, and voluntary sectors" [11].

Food governance refers to processes and actor configurations that frame decision-making and encompass food production, distribution and consumption activities [12]. A significant number of papers has been published, in particular addressing governance and food value chains [e.g., 13]. Food governance analyses have sometimes been aligned with an optimistic or problem-solving philosophy [14], while conflicts of interest, institutional deadlocks, and the existence of winners and losers in the governance arena predominate [15]. Governance is also strongly linked to the concept of change [8, 16]. In food systems, shifts from a neoliberal market to a more rights-based [17, 18], environmental-friendly [19, 20] and social [21, 22] food system governance are increasingly explored [23].

Governance of food systems in the context of sustainability is an interesting field of research but emerged only more recently [24]. Some earlier studies have reviewed the literature on food system governance for food security [14], food system resilience [12], and food system governance concepts [25]. Since then, publications on food system governance have significantly increased. More recently, other reviews have been carried out on food system governance, focused on sustainable diets [26], theoretical frameworks for food system governance [23], or good governance [18].

Our overall research aim and focus are, however, somewhat different from those publications, as our study was driven by the question of how food system governance is linked to and can contribute to sustainability, taking into account the complexity of food systems [1]. Sustainability in food systems is here considered as encompassing the three dimensions economic, environmental and social (the social dimension includes food and nutrition security for all). Our endeavour was also motivated by the observation that no definition and conceptualisation of 'food systems governance for sustainability' could be found in the existing literature. Accordingly, the article's contribution is to provide a synthesis of the current state-of-the-art research on food system governance for sustainability and to discuss which models and principles of food system governance exist that can contribute to sustainability. This article also presents an innovative conceptual framework for food system governance, by introducing a novel element: the orchestration of multiple food systems and policies to promote sustainability. Our research questions are:

- What has been researched so far regarding food system governance for sustainability?
- How is food system governance defined in existing literature?
- What are the current barriers in food system governance for sustainability?
- How is food system governance linked to sustainability and which food system governance models and principles can contribute to sustainable outcomes?

¹ <https://www.fao.org/food-systems/en/>.

² <https://www.un.org/en/academic-impact/sustainability>.

³ <https://www.merriam-webster.com/dictionary/governance>.

2 Methodology

To analyse the current state-of-the-art research on food system governance for sustainability and to understand which models and principles of food system governance can contribute to sustainability, a systematic literature review was carried out. A systematic literature review allows identifying and critically analysing research on a well-defined topic and answering research questions [27]. It is a thorough method to study what is currently known about a specific scientific field of knowledge [28].

2.1 The selection process for articles

Two important academic databases were used to find relevant articles for our research, Elsevier Scopus and the Web of Science Core Collection. To answer our research questions, the terms selected for the search were “food system* governance” AND “sustainab*”. For the query, ‘article title – abstract—keywords’ were used for Scopus, and ‘topic’ for the Web of Science. The key terms and exclusion/inclusion criteria were carefully discussed and defined by the authors, and they decided to follow the PRISMA flowchart for the selection process to ensure transparency of the review process. The search was conducted in January 2024. No restriction for the period of publication was defined.

Overall, 58 records were identified from Scopus and 54 from the Web of Science. After applying filters to keep only records in the English language and only peer-reviewed (original or review) articles, 51 articles remained from Scopus and 46 from the Web of Science. After removing duplicates from the two databases, 55 articles were left. Next, article titles, keywords and abstracts were screened by all authors to ensure adequacy with the research aim and quality. The following exclusion criteria were applied:

- references that did not present studies focused on food system governance (i.e., these articles included the terms food system and/or governance in their abstract, but their key theme was not about food system governance; for example, if their main focus was on nutrition, water governance, or data in food systems, then they were excluded)
- references that were not linked to one or more of the (economic, environmental, social) sustainability dimensions (i.e., these articles included the key search terms in their abstract but they used them only as problem statement or concluding remark. Hence, their focus was not on discussing food system governance linked to sustainability, but on e.g. resilience of food systems, food policies, or rural dynamics).

The number of articles retained from the screening was 37. After retrieving and reading the 37 full texts, 3 more articles were ruled out according to the exclusion criteria. The final number of articles included in the review was 34. These articles kept for study are listed in the Appendix.

The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) flowchart in Fig. 1 illustrates how the articles were selected.

2.2 Categories for the qualitative thematic analysis

Apart from a descriptive quantitative analysis, a qualitative thematic analysis of the 34 articles was done. Carrying out a qualitative analysis of the content is valuable for a literature review, as it allows for analysing a sample of articles in a structured and guided way and identifying specific patterns based on analytical categories [30]. The following categories were jointly defined for the data extraction and analysis of each article, according to the main research questions and themes to be explored, and to be able to draw reliable conclusions:

- Overall research topics and objectives of the articles
 - Methodology used / geographical scale
 - Summary of the results:
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- Food system governance definitions
 - Current barriers in food system governance for sustainability

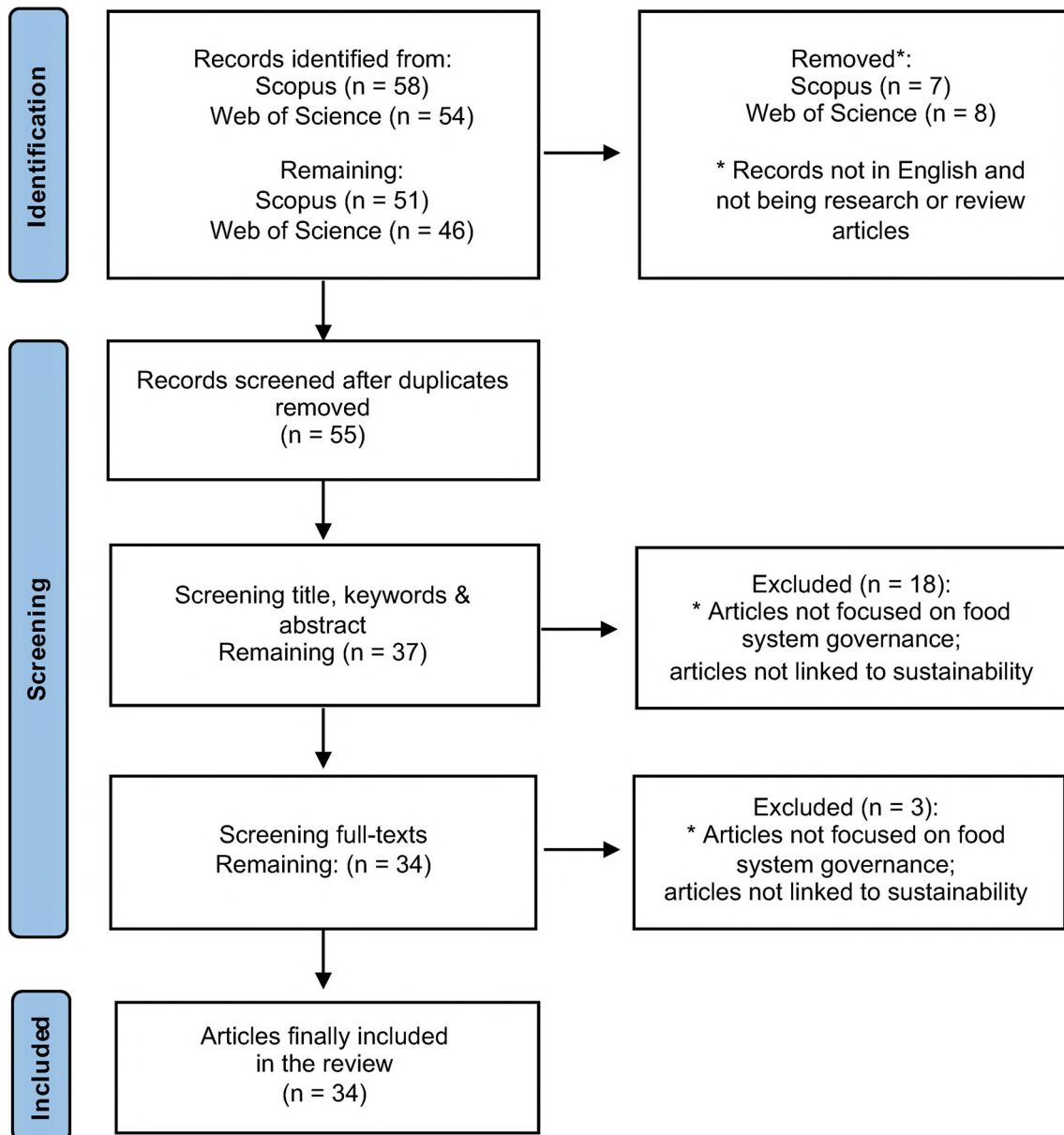


Fig. 1 The process of article selection (Source: based on [29])

- Proposed governance models and principles
- Links to sustainability

- Main conclusion
- Implications for future research or practice

To resume and display the findings from each article, the following analytical grid of Table 1 was used.

Table 1 Extract of analytical grid to resume and display the findings from the articles (full details for all included articles can be found in the supplementary data)

No	Authors	Overall research topic, objective	Methodology used, geographical scale	Summary of the results			Main conclusion	Implications for future research or practice
				FS governance definition	Current barriers	Proposed governance models, principles		
1	Arthur et al. (2022)	Review academic literature on how FS have been examined and how governance theories are explained	Literature review Rural–urban	Understanding FS governance requires “an analysis of actors, their relationships, and how they impact the food system.”	-	-	-	-

3 Results

3.1 Overview of the articles

For giving a general overview of the sample of articles studied, a descriptive quantitative analysis was carried out.

First, the dates of publications were analysed. Figure 2 shows the number of articles published per year, the first one in 2015, and the last from January 2024 when the search was conducted. One can note a strong increase in publications about food system governance for sustainability since 2021. Most of the articles appeared in 2022 (12 articles), probably due to the United Nations Food System Summit taking place in September 2021.

Next, articles were published in mostly thematic and interdisciplinary journals, as shown in Fig. 3. The majority of articles appeared in the *Journal of Agriculture, Food Systems and Community Development* (4 articles), followed by *Frontiers in Sustainable Food Systems and Sustainability* (each 3 articles), and *Ecology and Society*, *Cities, Environmental Science & Policy*, and *Nature Food* (each 2 articles).

3.2 Major research topics, methods and governance levels

Next, the articles were qualitatively analysed regarding their major research topics, methods used and governance levels. Three major topics could be identified by reviewing the existing literature.

The first, predominant topic includes governance studies of exemplary types of food system organizations such as Alternative Food Networks [23], Urban Living Labs [31], Civil Society Organisations [22, 32, 33], Food Policy Councils [20, 34–37], and Multiple Stakeholder Platforms [38, 39]. These examples represent mostly local, inclusive, multi-stakeholder, alternative or complementary approaches to governance, and seek to reduce power inequalities and sustainable solutions via co-governance.

A second major topic encompasses articles that discuss the articulation between global or national public policies and local food system governance, across different geographical levels [e.g., 40–45]. These contributions reflect how the interactions between various levels could be improved to achieve more collaborative and integrated food system governance. More democratic and dedicated policies are considered important for achieving more balanced system outcomes for all.

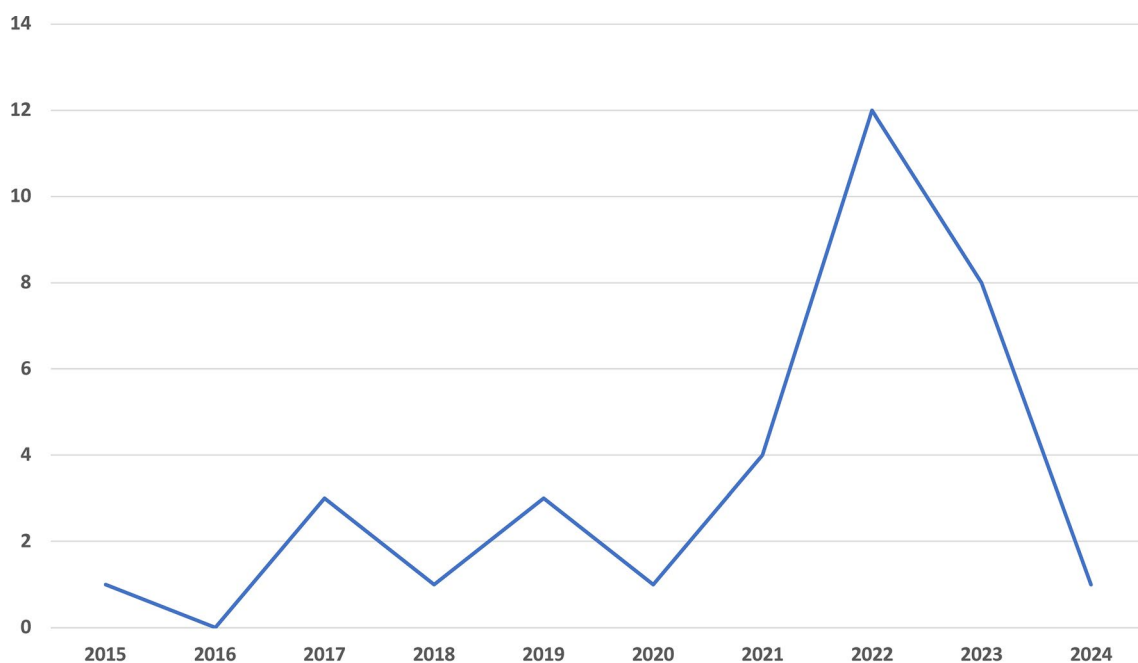


Fig. 2 Evolution in time of the number of publications on food system governance for sustainability until January 2024 (own illustration)

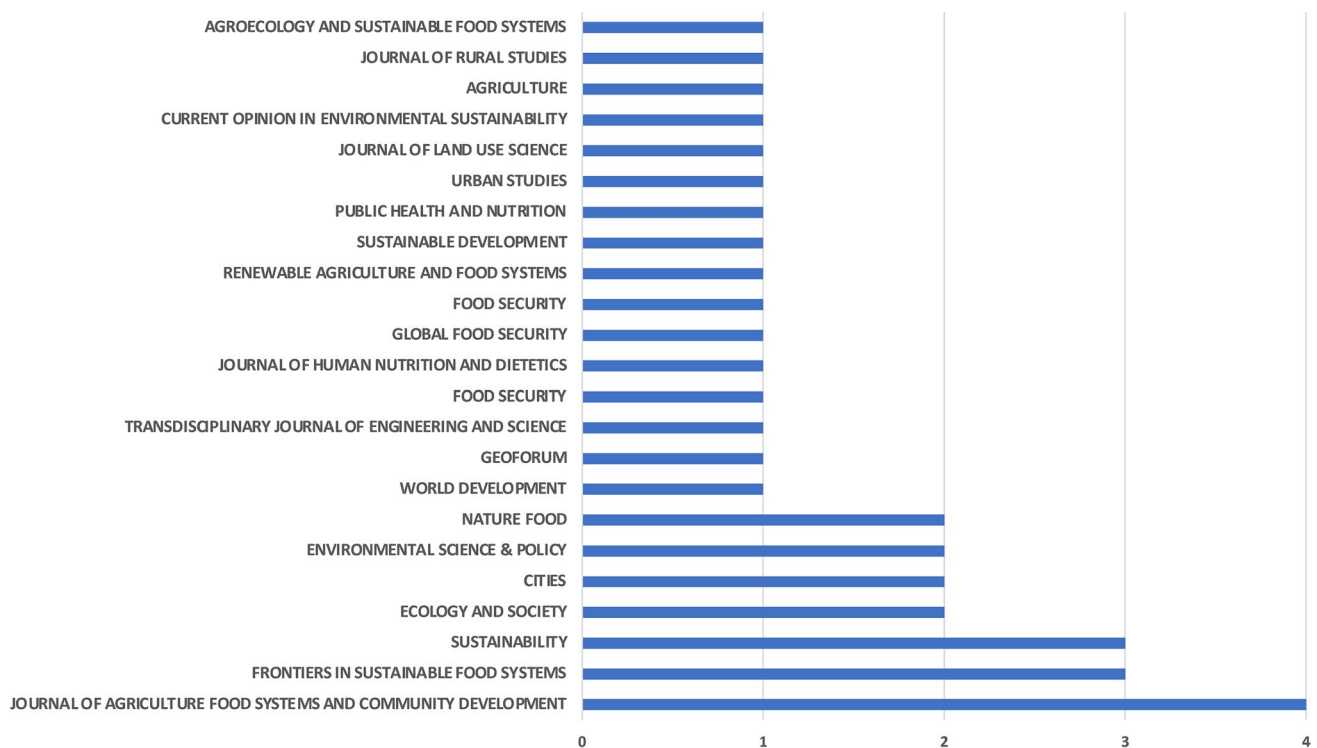


Fig. 3 Number of publications per journal (own illustration)

A third group of articles offers either assessment tools for food system governance performance [46, 47], or evaluates the transformative potential and barriers [15, 26], or environmental outcomes [18, 33] of agri-food system governance. A systemic view including boundary conditions, different actors and interactions is needed to identify barriers and evaluate outcomes.

Next, less represented topics are propositions of research agendas, based on summaries of earlier findings [24, 48, 49], analysis of institutional arrangements such as the European Union Protected Geographical Indication schemes [50] or other certifications [51], or the reflections on the power (in)balances and role of large corporates in food system governance [52, 53].

Most of the articles analysed are based on empirical research. The methodologies then used are case studies (nine of the 34 articles), mixed methods combining document analysis and interviews (eight articles), surveys (three), or participatory methods (one article). Apart from the empirical papers, a relatively large number consist of reflection, discussion or opinion papers. Several earlier literature reviews are also part of the sample, with other research questions than the ones posed here, but still offering relevant insights (five articles). Finally, one article is based on a discourse analysis of dialogues from Australia's National Food Systems Summit.

Concerning the different governance levels of analysis, they are various, from the local to the global (Fig. 4). About one-third of the papers (11 of the 34) focus on the local or urban level, often related to the first topic of alternative governance. Next, the rural–urban or rural–regional level is analysed by three, the national by four, the global/international also by four, a cross-scale by five, and the cross-regional by three articles. In four of the 34 articles, no level is defined.

3.3 Current barriers in food system governance for sustainability (in research or practice) and proposed solutions

Current barriers to food system governance for sustainability reported in the literature concerned different areas: in research, policies, corporations, and governance models (Fig. 5).

Concerning research, the following insufficiencies have been raised: a general underrepresentation of the governance topic within the food system domain [24], a lack of empirical backing within the debates on food system transformation [44], a focus on food system outcomes rather than on the causes of unsustainability [15], a gap of knowledge of multi-scale or networked governance forms [48], an absence of metrics for sustainable food system governance [47], research

Fig. 4 Number of articles per governance level (own illustration)

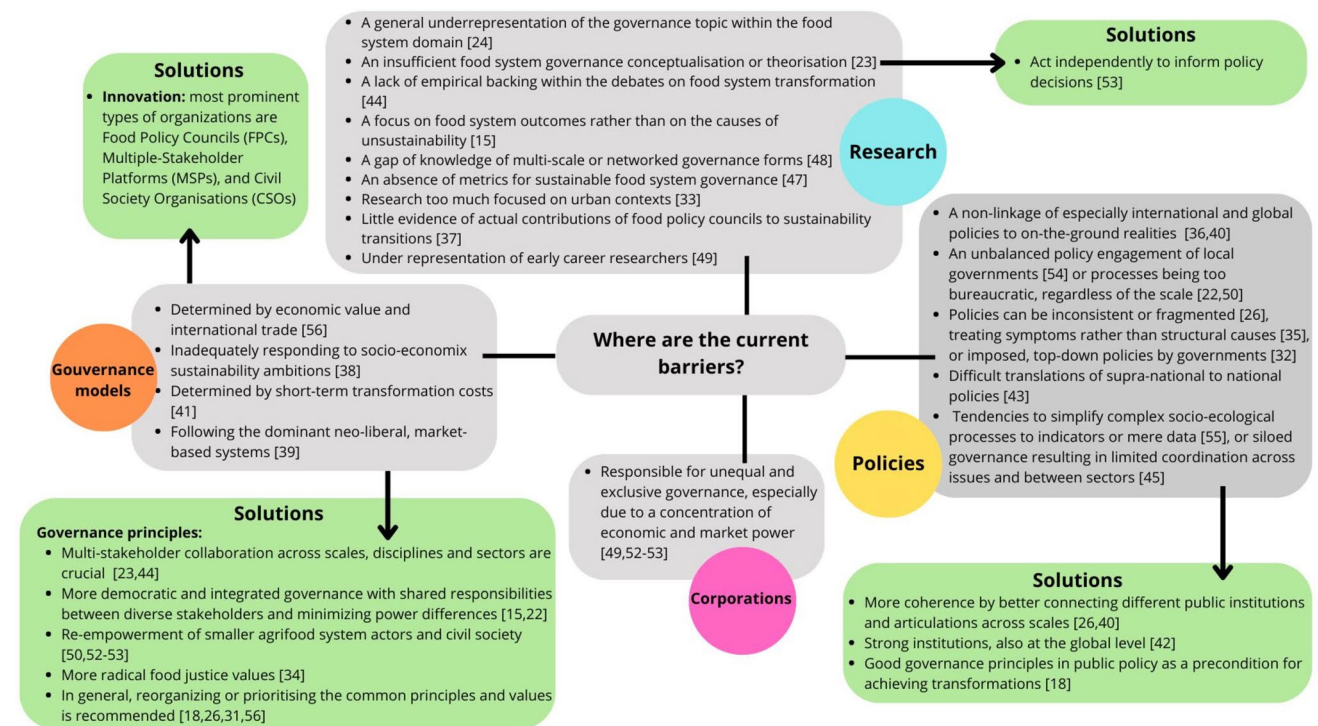
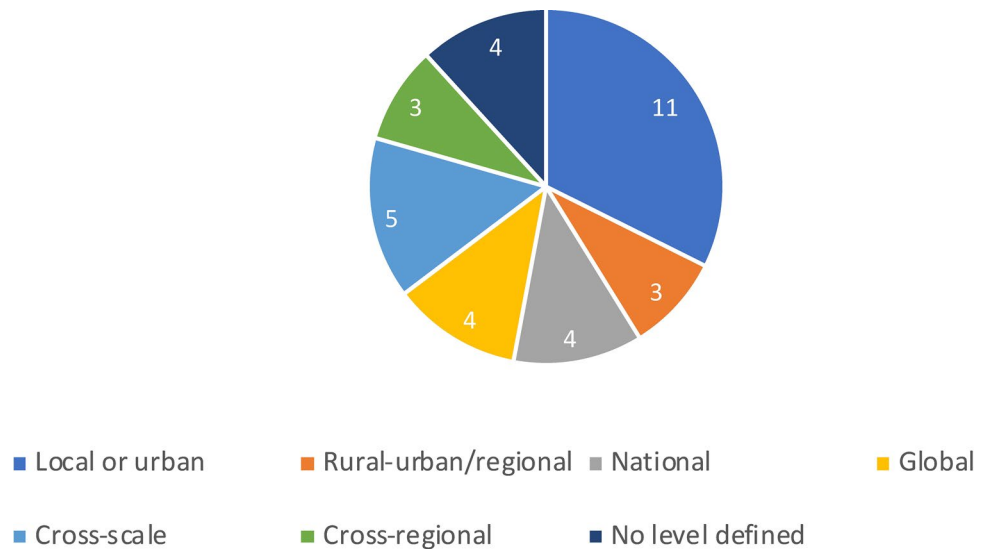


Fig. 5 Current barriers in food system governance for sustainability and proposed solutions (own illustration)

too much focused on urban contexts [33], little evidence of actual contributions of food policy councils to sustainability transitions [37], and underrepresentation of early career researchers [49]. Moreover, Arthur et al. point out that “No single conceptualization or theorization is enough to fully address the constantly evolving social, economic, and environmental challenges that emerge from the food system.” [23]. Still, they recognise the prominent amount of literature produced in the past years on this topic.

Policy problems are also often mentioned in the literature, especially regarding: a non-linkage of international and global policies to on-the-ground realities [36, 40], an unbalanced policy engagement of local governments [54], or processes being too bureaucratic, regardless of the scale [22, 50]. Next, policies can be inconsistent or fragmented [26], treating symptoms rather than structural causes [35], or imposed, top-down policies by governments [32]. Among the critical issues, there are difficult translations of supra-national to national policies [43], tendencies to

simplify complex socio-ecological processes to indicators or mere data [55], or siloed governance resulting in limited coordination across issues and between sectors [45]. Hence, although policy problems occur at different geographical scales, they are more likely associated with larger top-down, international or national levels.

Some authors consider that large corporations are responsible for unequal and exclusive governance, especially due to a concentration of economic and market power [49, 52, 53].

Other authors criticise current governance models as being determined by economic value and international trade [56], inadequately responding to socio-economic sustainability ambitions [38], determined by short-term transformation costs [41], and following the dominant neo-liberal, market-based systems [39].

Solutions for science and policy, and proposed governance models and principles are multiple.

From science, it is recommended to act independently to inform policy decisions [53]. From the policy side, requirements concern: more coherence by better connecting different public institutions and articulations across scales [26, 40], strong institutions, also at the global level [42], and good governance principles in public policy as a precondition for achieving transformations [18].

Regarding innovations in governance, the most prominent types of organizations are Food Policy Councils (FPCs), Multiple-Stakeholder Platforms (MSPs), and Civil Society Organisations (CSOs). FPCs are considered participatory, collaborative and democratic approaches [20, 41], as experiments for shaping new governance models based on food justice values [34]; and as being able to respond to food crises [35] or to scale up good practices ('seeds') [36]. MSPs can bring together multi-sector actors into shared spaces for joint decision-making [39] and shape new governance models responding to sustainability goals if supported in developing stronger capabilities [38]. CSOs are seen as being able to influence policy outcomes, contribute to more inclusive and democratic governance [54], link policy and people, include communities and vulnerable people, and foster collaborations across sectors [32].

To enhance governance principles, multi-actor collaboration and inclusion are considered crucial. More precisely, Arthur et al. [23] and Sonnino [44] propose multi-stakeholder collaboration across scales, disciplines and sectors, Moragues-Faus et al. [15] and Carrad et al. [22] more democratic and integrated governance with shared responsibilities between diverse stakeholders and minimizing power differences. Moreover, several authors [50, 52, 53] advocate for the re-empowerment of smaller agrifood system actors and civil society, and Davey & Davis [34] even call for "more radical food justice values". In general, reorganizing or prioritising the common principles and values is recommended [18, 26, 31, 56].

3.4 Food system governance definitions

Most importantly, half of the articles do not include any definition of what food system governance is.

When definitions are given, many are dealing with governance in general. Several authors [e.g., 26,48] fall back on earlier definitions, e.g., by referring to Candel [14]; however, his definition is not strictly about food system governance for sustainability but about food security governance, defined as "formal and informal interactions across scales between public and/or private entities ultimately aiming at the realisation of food availability, food access, and food utilisation, and their stability over time" [14]. The following Table 2 illustrates the explicit definitions of food system governance of the reviewed literature.

From these definitions, three recurrent key elements of food system governance can be identified, which will be discussed in Sect. 4.2.

- (i) The importance of actors, their relations and interactions (at a system level, horizontal and vertical),
- (ii) The control, power balances and decision-making,
- (iii) The formal and informal rules, norms and practices.

3.5 Links to sustainability

Links between food system governance and sustainability could be identified at several levels, concerning: (i) the drivers or objectives for sustainability, (ii) the conditions and needs for a sustainability transition, (iii) assessment frameworks and indicators, and (iv) expected outcomes and potential governance conflicts related to sustainability.

Table 2 Food system governance definitions

References	Definition Food System Governance
Arthur et al. [23]	"Understanding FS governance requires an analysis of actors, their relationships, and how they impact the food system."
Carrad et al. [54]	"formal and informal rules, norms and processes that shape policies and decisions that affect food systems (HLPE, 2020)." [57]
Chen et al. [46]	"the interplay between food system (or food chain) actors in decision-making processes that shape food systems and their development. Governance in this sense is the way rules, norms and actions are structured, sustained, regulated and implemented."
del Valle et al. [26]	"formal and informal interactions between institutions and people to enable the environment in which food systems perform (Candel, 2014; Kennedy et al., 2017; Béné et al., 2019)." [14, 58, 59]
Hammelman et al. [35]	"the establishment of rules, practices, and processes that structure the flows of power and control in the food system (Jessop, 1998; Kennedy & Liljeblad, 2016)." [60, 61]
Levkoe et al. [32]	"Governance involves both explicit rules and implicit practices, customs, and assumptions related to who and what is considered part of a food system, who should be included in governance decisions, and in what ways."
van Bers et al. [24]	"processes and actor constellations that shape decision-making and activities related to the production, distribution and consumption of food (van Bers et al., 2016)." [12]

3.5.1 The drivers or objectives for sustainability via food system governance models

For food system governance in general, the most important sustainability objective is considered food security, thus the UN Sustainable Development Goal 2 (zero hunger). However, Ballamingie et al. [40] point out that as more or less all 17 SDG goals are concerned with food systems, this offers an opportunity to connect different objectives and priorities. Arthur et al. [23] also confirm that new multi-actor food system governance models are driven by various reasons such as economic (local economic growth), social (food access and food security, human health and well-being), and environmental (circularity, low-carbon emissions). For Africa, Chen et al. [46] highlight mostly social objectives such as healthy and nutritious food products for all people, but also empowerment and inclusion of smallholders and rural livelihoods. Concerning specific arrangements, Protected Geographical Indications are generally considered tools to improve farmers' incomes and promote economic sustainability, especially in remote rural areas [50]; MSPs are driven by societal concerns such as food safety or malnutrition [38]; and CSOs seek to establish more democratic, accessible, and participatory governance models, rooted in social and environmental justice [32]. Hence, drivers are diverse and include all three (economic, environmental and social) sustainability dimensions, but mostly the social one.

3.5.2 The conditions and needs for achieving sustainability

Here, several authors reflect on a change in current values to enable sustainable food system governance. For example, governments should prioritise key goals such as the right to food and sustainability over corporate profits [53]; governance models should be established that allow people to govern their food based on their own principles and values [26]; and values, interests, and behaviours of many different food system actors need to be re-aligned [52]. Furthermore, for a sustainability transformation, the exertion (or not) of agency of a diversity of food system actors needs to be examined [24]. Participatory, inclusive and multi-actor governance models are a condition for ecological and social justice within food systems [35, 41]. Herein, as also emphasised by the UN New Urban Agenda, the role of cities in driving policy and action for sustainability via inclusive governance and growth is especially important [55].

3.5.3 Assessment frameworks and indicators

Landert et al. [47] developed a method for assessing the sustainability of urban food system governance, based on the FAO sustainability assessment framework of food and agricultural systems. It covers four dimensions: good governance, environmental integrity, economic resilience and social well-being, and 97 evaluation indicators in total. Chen et al. [46] propose a framework for assessing and improving urban food system governance for sustainability and resilience, adapted to Sub-Saharan Africa, with four dimensions directly linked to governance: enabling environment and institutions, governance structures, governance structure dynamics and determinants, and governance structure

and relationship strength. Thus, while the first is more oriented on the sustainability dimensions, the second targets governance itself.

3.5.4 Expected outcomes and potential conflicts

Here, while some authors stress the potential of new governance models for sustainability, others are more critical. For example, Brons et al. [31] state that urban living labs can engage citizens in co-creating healthy, inclusive and sustainable food systems; Carrad et al. [54] that dedicated food policies can strengthen the local food system and improve social and environmental outcomes; Zollet & Maharjan [33] that democratic and participatory processes are important strategies for fostering sustainability a territorial level. On the other side, Horton [62] warns that “not all food utopian narratives are necessarily aligned with principles of care, justice, and sustainability”, and Patay et al. [43] that tensions between the three sustainability dimensions can impede the adoption of shared food system agendas. Furthermore, Sonnino [44] and Thow et al. [45] estimate that the implementation of holistic sustainability agendas is still difficult because of a current lack of integrated policies across sectors and siloed governance; and Wilkes [18] that local and global policies are not substitutes, but complementary and interconnected. Overall, there seems to be consensus about reaching food system sustainability. However, answering the *how question* remains challenging, i.e., which governance models, principles and strategies are most adequate to conciliate the three sustainability dimensions. This question will be further discussed in Sect. 4.2. and 4.3.

4 Discussion

With the results from Chapter 3, four main points are here discussed, (4.1.) implications for novel sustainable governance models supported by public policy-makers (with results from 3.1. and 3.2.), (4.2.) a new definition and conceptualisation of food system governance for sustainability (mainly based on the results from Sects. 3.3. and 3.4.), (4.3.) the potential applications of the concept and definition, and (4.4) some future research avenues (integrally considering all results and discussion points from chapter 3 and 4, respectively).

4.1 Implications for new sustainable governance models

To achieve a transition to sustainability in food systems, governance models are to be reconsidered. These models should better articulate top-down and bottom-up approaches and be inclusive, to balance the distribution of power and the value created. Hence, there should be more consideration from the policy side on how co-governance can be developed [40]. Governments are asked to create ‘dedicated spaces’ that enable discussing problems of market concentration and power distribution in food systems [53]. In these discussions, the private food sector should not be excluded, because it is part of the solution as the largest employing sector in Europe. Furthermore, food systems should be based on multi-layered governance structures involving local organisations with more expertise, as in the case of Protected Geographical Indications [50], and move beyond singular topics as food is not only a material issue but includes other elements of life such as environment, health and well-being [32, 63]. This is also underlined by Jackson et al. [64], who consider food as a commodity, human right or common good. Here, we also argue that a stronger attention to the environmental sustainability dimension in food system governance is needed. E.g., Landert et al. [47], in their sustainability assessment framework, have proposed 14 indicators linked to the environmental integrity dimension, such as air, water and soil quality, energy use or waste reduction & disposal.

New governance models should also encompass multiple geographical levels and administrative boundaries. This would help improve local–regional and regional–national as well as international dialogues and provide better solutions for funding and capacity development [43]. Food system governance should avoid being siloed and be coupled with other sector policies; e.g., sustainability certification should be part of a policy mix supporting not just a single commodity but farming systems as a whole [51].

Finally, it is recommended that governance models are adaptive and coherent. In the case of the EU, Fesenfeld et al. [41] stress the need to develop a common definition of a sustainable European food system and a concrete food systems governance structure based on principles of adaptability and connectivity. In the next Sect. 4.2., a new conceptual framework and definition is therefore discussed.

4.2 A new definition and conceptualisation of food system governance for sustainability

Based on the review of 34 articles about food system governance for sustainability, three key elements were emerging (cf. Section 3.2, Table 2):

- (i) the importance of food system actors, their relations and interactions [23, 26, 46];
- (ii) the control, power balances and decision-making [35, 46, 54];
- (iii) the formal and informal rules, norms and practices [32, 35, 46, 54].

Another major, transversal element deals with the functioning of multiple food and other systems. For example, the European Commission expressed the need for an overarching partnership that develops the needed systemic and cross-sectoral EU research and innovation governance [1, 65]. We have translated this into:

- (iv) the need for an 'orchestrator' to steer policies and activities of food systems, and other systems, towards sustainable outcomes.

Since these elements are neither integrally conceptualised nor translated into a single definition of food systems governance for sustainability in earlier studies, this is here further discussed.

While reflecting on these elements, a new conceptual framework is developed, illustrated in Fig. 6.

About (i), the interactions between food system actors, their importance and their relations [23, 26, 46] can be graphically presented as a network of actors that are connected via dots. The ties between these actors can be of different strengths, schematically depicted as connection dots with different levels of thicknesses. If actors are collectively playing in a well-defined food system, they are members of a network or partnership, defined as "a relationship usually involving close cooperation between parties having specified and joint rights and responsibilities" (Merriam-Webster).

Concerning (ii), the control, power balances and decision-making [35, 46, 54] are generally discussed as relations between different actors. In literature, four different zones have been identified for a network of actors in food systems, namely the control, adaptation, co-creation and environment zones [66]; this has been based on initial work of Lewin on the circles of control, influence and concern [67] (Burnes, 2019). The control zone corresponds with the core business of an actor. The adaptation zone reflects the capacity of an actor to adapt to external changes. The co-creation zone presents the area in which different actors jointly strive to create (sustainable) value in a food system; this is also named the zone of (mutual) influence. Finally, the environment zone is the wider context around a food system in which external challenges and drivers are to be respected; these can be counteracted by strategies to jointly reach (sustainability) objectives.

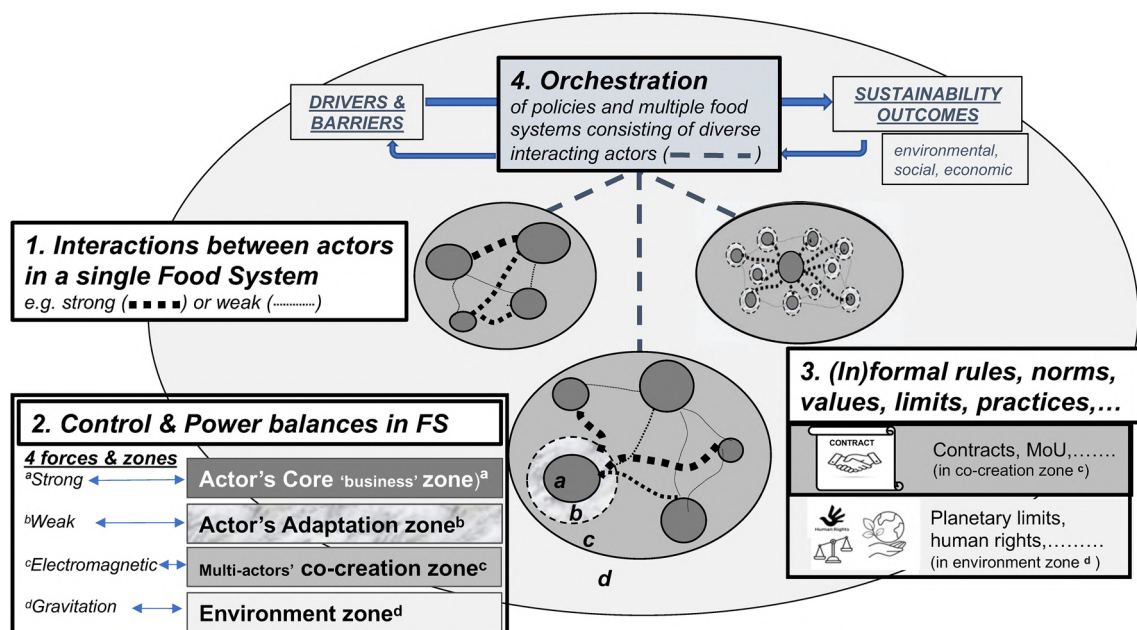


Fig. 6 Innovative conceptual framework for food system governance for sustainability (own illustration)

Remarkably, these four zones can also be described by a unique set of four forces [68]—referring to the unification theory in physics [69]. The first distinguishable force deals with keeping the key activities of an actor ongoing, hence a strong force maintaining core business. The second force allows a food system actor to respond to its context by slightly modifying its activities; this could be considered a weak(er) force. A third force addresses the interactions between food system actors, to enhance cooperation (attraction) or competition (repulsion), like an electromagnetic energy force. A fourth force refers to reaching joint goals—like sustainable value—of actors in a food system; this is a kind of gravitation force that all actors attract to a common point. The strong and weak forces concern an individual food system actor. The other two represent the interactions between actors with common objectives. Altogether, they enable the formation of an organisational and functional structure for a food system and its governance model. Here, we suggest that the overall balance between these four forces defines power balances, control and decision-making in a single food system.

Next (iii), the formal and informal rules, norms and practices [32, 35, 46, 54] are here also distinguished between internal ones—in a single food system—and external ones—in the environment zone outside a single food system. The internal ones are the agreements between food system actors (e.g., forming a partnership, their joint principles and their common ways of executing activities (co-creation)). These agreements are laid down in contracts, memorandums of understanding, charts, manifests, project work plans, etc. The external ‘Environment’ ones are defined by the planetary limits (in terms of temperatures, resources, biodiversity, etc.) and social and human values (equal rights, no child labor, ...). These set the boundaries in which food systems can sustainably operate.

Finally (iv), we here introduce an orchestrator who may help steering policies and joint activities in (multiple) food systems, and other systems, to jointly contribute to sustainability. In our conceptual framework, the interactions between three food systems are shown; each food system is presented as a circle englobing interacting food system actors. The role of the sustainable food system orchestrator – operating in the wider environment – is to align policies and multiple food systems along scales and within the planetary boundaries and societal and human values. If the overall output of all Food Systems should be sustainable (harmonic), then the individual food systems should also be sustainable (harmonic, not out-of-tune). This is either feasible by themselves, or via exchange mechanisms with other food systems as previously described in literature [68]. Consequently, the role of the orchestrator is overarching and positioned centrally in the conceptual framework.

While combining these insights, a new conceptual framework emerges as shown in Fig. 6. It also converges towards a single definition of food systems governance for sustainability.

‘Food system governance for sustainability is the continuous process of orchestration of policies and (multiple) food systems consisting of diverse interacting actors, respecting (in)formal rules and striving to provide food for all, in equitable and environmentally-friendly ways, at any time and in any context.’

4.3 The potential applications of a new conceptual framework and definition

The definition and conceptual framework are suggested as a basis for building new governance models in which interactions between actors, power balances, (in)formal rules and orchestration of food system activities and policies are integrally taken into account. The conceptual framework can be used by any governance model to visually clarify several points.

The framework can help to identify which interactions exist—or fail or are redundant—between actors; even more, it can elucidate what the strengths are, or preferably would be, of interactions (from weak to strong); this provides insights into the structure, functions and governance of organizations and options to change them.

The framework also sheds light on which control and power balances exist between actors or can be modified; this all depends on their individual roles and common objectives. If the intention is that all actors remain involved in an initiative, their core activities should be kept going (like a strong force), their capacity to adapt and reach objectives be optimized (a weak force), a balance between cooperation and competition be found (like an electromagnetic force), and a consensus about objectives be reached (a single gravitation force). The diverse actors in an organisational structure preferably develop a governance model in which an optimum in the set of four forces will be possible to reach.

Next, the framework can help analyse the relevant formal and informal rules, norms and practices in food systems, and their environment. Consensus should be reached about the most relevant (in)formal rules and values for their collaborations and contributions to sustainability, and what ways to respect them.

Finally, the framework allows visualising which orchestrations exist between interacting food systems and policies. As a network or partnership of actors in a single food system, it may be difficult to reach sustainability objectives. Hence, the

question is in what way joint activities and policies can be orchestrated that all benefit and jointly reach the preferred outcomes. It means finetuning of activities, but also governing new exchange mechanisms between food, and other, systems.

4.4 Future research avenues

The literature review also offers several future research avenues, to which our conceptual framework will be instrumental. The most important are here listed:

The first one concerns *scales and scaling*: The review has shown that much research has been dedicated until now to urban food systems (cf. Figure 4); consequently, it seems important to include larger (regional, national) governance levels in the future, and to get insights into the conditions that could enable the upscaling of successful local governance models and policies. It is also crucial to find out more about the interactions between different scales, i.e., between alternative and local, regional, national and large-scale global food system governance and policies, to reach better understanding of the different governance models [54]. Moreover, as proposed by Delaney et al. [48], exploring how governance at various scales impacts the diverse components of food systems seems necessary; the latter supports the introduction of the fourth element of the conceptual framework, named 'orchestration'.

Secondly, insights confirm a general need for a system-based approach, including an in-depth analysis of the *interactions and models of governance between different actors* (public policies/institutions; industrial actors, citizens, non-governmental organisations), to get insights into how to reach inclusivity and participation and how to balance equally the power and value created between actors; this refers to the second element (four forces). For example, analysing how Multi-Stakeholder Platforms organise their governance processes could allow understanding and monitoring of the complex relationships between societal problems and system change [38]. These interactions and power balances are two fundamental pillars of the conceptual framework of Fig. 6. The main aim of the orchestrator is to steer collective action via a system-based approach, that accelerates the transition towards sustainable outcomes and, thus, responds to societal and planetary challenges.

The third point is about *research methodologies*: Here, it seems increasingly important to apply existing or develop new participatory or mixed methodologies including citizens, non-governmental organisations and other actors for collecting diverse data, understanding multiple voices, and developing sound governance models and policy recommendations [55]. Also, it would be helpful to use more comparable research designs to disentangle complex governance networks [24]. Further developing and testing existing assessment frameworks [46, 47] for sustainable food system governance performance is recommended. Our integrative conceptual framework for sustainable food system governance may here be used to avoid overlooking crucial elements and being confronted with unforeseen trade-offs.

Fourth, *more interdisciplinary research* is required. Dealing with complex food systems, governance and sustainability issues need interdisciplinary approaches; therefore, we recommend building research teams from various disciplines. Even more, as also highlighted by Béné [52], different types of data and evidence, particularly at the frontiers between science, society and policy, are needed to understand the complexity of food system governance for sustainability. This is also strongly underlined in the European strategic research agenda for sustainable food systems [1]. Finally, including early career researchers to get a better representation and diversification is useful [49].

Finally, the literature review indicates that much research has been focused on the economic and social dimensions of sustainable governance, but the *environmental dimension* has been rather neglected, except in some studies [20, 33, 47, 51]. We strongly recommend taking more into account the environmental aspects in future research about food system governance for sustainability, potentially linked to circular bioeconomy, agroecological or biodiversity approaches. A common set of sustainability goals or gravitation forces is primordial for orchestrating multiple food systems, hence balanced attention to the environmental, social and economic dimensions of sustainability in governance models is needed. The new conceptual framework is then proposed to be utilized and validated in empirical studies.

5 Conclusion

This article aimed to understand how food system governance can contribute to sustainability, based on a systematic literature review. This has resulted in a new sustainable food system governance definition and conceptual framework.

Results from the review of 34 articles indicate that numerous barriers to food system governance for sustainability still exist in different areas: research, policies, and corporations. Several new, participatory, collaborative and democratic

governance models of exemplary types of food system organizations such as Food Policy Councils, Multiple-Stakeholder Platforms, and Civil Society Organisations, can potentially contribute to an inclusive, ecological and just food system transition. However, tensions between the three sustainability dimensions [43], a current lack of integrated policies across sectors, scales and siloed governance often still impede the implementation of holistic sustainability agendas and approaches [44, 45]. In research, more attention is needed especially on the (cross-)regional scale, the interactions between different geographical scales and various actors, and the environmental sustainability dimension of governance.

Insights have further inspired the development of a new definition and innovative conceptual framework. These make explicit that the outcomes of food system governance models with their dedicated principles are the result of (i) the strengths of interactions between food system actors, (ii) the sum of four (individual and joint) forces, (iii) the internal agreements between partners as well as appreciation of external planetary and societal-ethical boundaries, and (iv) the orchestration of policies and (multiple) food systems, operating at different scales, to reach overall harmonic (sustainable) outcomes in food systems.

Our main conclusion is that only by integrally considering the four elements presented in the conceptual framework, one can coherently govern food systems to contribute to sustainability. Food systems are highly complex; hence their governance is challenging, even more so since they are confronted with e.g., shocks, stressors, or unethical behaviour. This asks for in-depth knowledge of complex system theories and broad experiences with dynamic food systems via case studies and sharing new narratives. Since food and nutritional security need to be guaranteed for future generations in fair, just and environmentally friendly ways, one cannot wait any longer to unravel these complexities. The establishment of inclusive partnerships of diverse actors, with appropriate governance models and dedicated principles, like proposed in Europe today [1], is thus highly recommended.

6 Appendix

List of articles included in the review (alphabetical order).

Authors	Year	Reference number	DOI
Arthur et al.	2022	[23]	http://dx.doi.org/https://doi.org/10.1080/21683565.2022.2104422
Ballamingie et al.	2020	[40]	http://dx.doi.org/https://doi.org/10.5304/jafscd.2020.093.021
Béné	2022	[52]	http://dx.doi.org/https://doi.org/10.1016/j.worlddev.2022.105881
Brons et al.	2022	[31]	http://dx.doi.org/https://doi.org/10.1016/j.cities.2021.103552
Carrad et al.	2023	[22]	http://dx.doi.org/https://doi.org/10.1111/jhn.13195
Carrad et al.	2022	[54]	http://dx.doi.org/https://doi.org/10.5304/jafscd.2022.121.007
Chen et al.	2021	[46]	http://dx.doi.org/https://doi.org/10.3389/fsufs.2021.763352
Clapp	2021	[53]	http://dx.doi.org/https://doi.org/10.1038/s43016-021-00297-7
Conneely and Mahon	2015	[50]	http://dx.doi.org/https://doi.org/10.1016/j.geoforum.2015.01.004
Davey and Davis	2022	[34]	https://doi.org/https://doi.org/10.22545/2022/00204
del Valle et al.	2022	[26]	http://dx.doi.org/https://doi.org/10.3389/fsufs.2022.784264
Delaney et al.	2018	[48]	http://dx.doi.org/https://doi.org/10.1007/s12571-018-0770-y
Eakin et al.	2017	[56]	http://dx.doi.org/https://doi.org/10.5751/ES-09831-220432
Fesenfeld et al.	2023	[41]	http://dx.doi.org/https://doi.org/10.1038/s43016-023-00850-6
Hammelman et al.	2020	[35]	http://dx.doi.org/https://doi.org/10.5304/jafscd.2020.092.003
Herens et al.	2022	[38]	http://dx.doi.org/https://doi.org/10.1016/j.gfs.2021.100592
Horton	2024	[62]	http://dx.doi.org/https://doi.org/10.1016/j.envsci.2023.103605
Johnson et al.	2023	[42]	http://dx.doi.org/https://doi.org/10.1007/s12571-023-01377-1
Landert et al.	2017	[47]	http://dx.doi.org/https://doi.org/10.3390/su9040490
Levkoe et al.	2023	[32]	https://doi.org/https://doi.org/10.5304/jafscd.2023.122.005
Mangnus et al.	2019	[36]	http://dx.doi.org/https://doi.org/10.5751/ES-11014-240402
Michel et al.	2022	[37]	http://dx.doi.org/https://doi.org/10.3389/fsufs.2022.916178
Moragues-Faus et al.	2017	[15]	http://dx.doi.org/https://doi.org/10.1016/j.envsci.2017.05.015
Nadeau and Koebele	2023	[20]	http://dx.doi.org/https://doi.org/10.1017/S1742170523000285
Patay et al.	2023	[43]	https://doi.org/https://doi.org/10.1002/sd.2732

Authors	Year	Reference number	DOI
Pittore and Debons	2023	[39]	http://dx.doi.org/https://doi.org/10.3390/su15043527
Russell et al.	2022	[49]	https://doi.org/https://doi.org/10.1017/S1368980022001641
Sonnino	2023	[44]	http://dx.doi.org/https://doi.org/10.1016/j.cities.2022.104164
Sonnino and Coulson	2021	[55]	http://dx.doi.org/https://doi.org/10.1177/0042098020942036
Thompson et al.	2022	[51]	http://dx.doi.org/https://doi.org/10.1080/1747423X.2022.2097455
Thow et al.	2022	[45]	http://dx.doi.org/https://doi.org/10.3390/su141912700
van Bers et al.	2019	[20]	http://dx.doi.org/https://doi.org/10.1016/j.cosust.2019.08.003
Wilkes	2022	[18]	http://dx.doi.org/https://doi.org/10.3390/agriculture12030382
Zollet and Maharjan	2021	[33]	http://dx.doi.org/https://doi.org/10.1016/j.jrurstud.2021.06.020

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Declarations

Competing interests The authors declare no competing interests.

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