



# Harvesting connections: the role of stakeholders' network structure, dynamics and actors' influence in shaping farmers' markets

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## Abstract

Farmers' markets (FMs) represent a crucial player in urban food systems, being the interconnection of local agricultural production and consumption, and serving as spaces for both economic exchange and community building. Despite their transformative potential, there is a scarcity of research that comprehensively investigates the dynamics of FMs network structure and the influence of the actors shaping FMs. The present article delves into the network of relationships within FMs in the Italian city of Bologna. This study adopts the Social Network Analysis (SNA) methodology applied with the Net-Map tool. The research objectives are to visualise the underlying network structure, map the dynamics, and identify the key actors who play pivotal roles in Bologna's FMs and their level of influence. The research carried out interviews with ten FMs stakeholders, revealing the network of relationships between 54 actors, divided into three categories—civil society, food economy and public administration. Actors were linked by a total of 428 relationships across three types of networks: support, economic, and hindering. Findings indicate a strong support network structure characterised by varying degrees of centrality among different actors. Farmers emerge as a central node due to their pivotal role in providing fresh, local produce. Additionally, local institutions contribute significantly to FMs resilience and growth. Our research demonstrates the importance of recognising the embeddedness of FMs within the local context. By understanding the network structure and influential actors in FMs, policymakers can devise more effective policies for promoting local agriculture, and enhancing the sustainability of urban–rural exchanges. In conclusion, the present study offers valuable insights into the network dynamics of FMs, highlighting their crucial role in the sustainable development of urban and local food systems.

**Keywords** Farmers' market · Alternative food network · Social Network Analysis · Agri-food system · Urban food policy

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## Introduction

The last century has been marked by the rise of a globalised industrial system of food provisioning based on transnational Long Food Supply Chains (LFSC) (Clapp 2020). The inherent complexity of the globalised economic model poses mounting challenges for small-scale farmers in sustaining their livelihoods (Khatri et al. 2023). Additionally, LFSC efficiency is recently being discussed due to their negative socio-environmental impacts and vulnerability to unexpected external shocks and risks (Khatri et al. 2023; Laborde et al. 2020; Husain 2022). As a result, there is growing interest in Alternative Food Systems (AFS) and especially on Short Food Supply Chain (SFSC) initiatives, such as Farmers' Markets (FMs), that aim to localise the production and services of the food system by operating within their territory (Connolly et al. 2022; Muchnik and de Sainte Marie 2010). This study analyses FMs by contextualising them within the frameworks of AFS and “food networks” (Liang and Plakias 2022). While the system conceptualisation primarily focuses on the activities and outcomes, “food networks” identifies the actors and relationships involved in the system (Liang and Plakias 2022). A “food network” is framed as a collaboration between actors, which can be formal or informal, aimed at addressing food-related issues and at reaching food systems goals (Liang and Plakias 2022).

At urban level, the development of strong and capable stakeholder networks represents one of the best strategies to support SFSCs (Schreiber et al. 2023). In particular, FMs are situated at the “meso level” of the urban food system, as they bridge the “macro level” of the urban governance with the “micro level” of farmers and consumers (Connolly et al. 2022). The network created around FMs and their stakeholders, especially farmers and citizens, builds the structure that enables them to address food system challenges, such as changes in consumer awareness and climate change related disruptions (Brinkley 2018; Schupp 2016). Despite the increasing global recognition of their role by scholars and governments (Figueroa-Rodríguez et al. 2019), FMs remain a fragile construction, characterised by the inclusion of a variety of food system actors which implies the need to merge and integrate a wide range of individual needs and motivations (Metz and Scherer 2022; Warsaw et al. 2021; Wentworth et al. 2023). While FMs networks are often portrayed as limited to consumers and farmers, various other actors contribute to the existence of FMs in different ways (Carson et al. 2016; Warsaw et al. 2021). However, the role of these actors and the relationships between them are understudied to date (Schreiber et al. 2023).

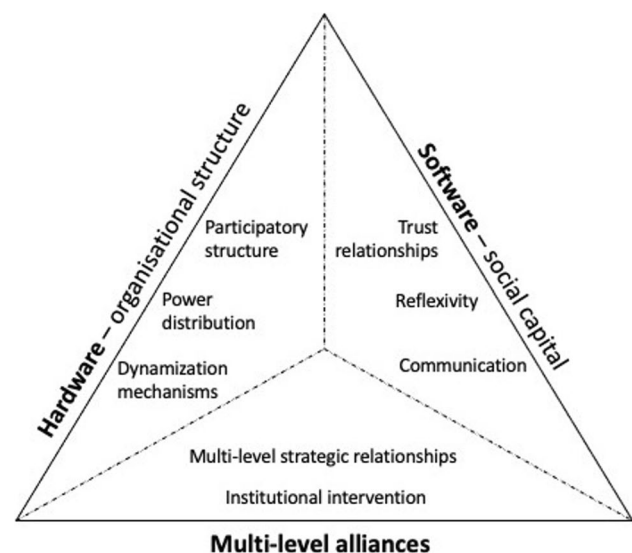
The existing literature lacks a comprehensive understanding of the involved stakeholders and their

relationships within FMs (Figueroa-Rodríguez et al. 2019). A research gap therefore exists in comprehending the roles of individuals, groups, and their connections at the network scale (Rocker et al. 2022). An integrated approach is necessary to contextualise FMs within a network framework (Figueroa-Rodríguez et al. 2019; Morales 2021). To support FMs, gaining insights into the dynamics of power and influence among actors within local food systems is crucial. This can help identify power dynamics, leverage points, and fragile connections at play in FMs (Fuchs-Chesney et al. 2023).

Using the city of Bologna (Italy) as a case study, this paper aims to fill this research gap by using Social Network Analysis (SNA) to understand FMs network structure, dynamics and the influence of the actors involved, through the mapping of stakeholders and their relationships. Specifically, the analysis will focus on the support, economic and hindering relationships that characterise the FMs. By analysing FMs through this new lens and emphasising the meso-level – comprising the FMs and the relationships of their actors – the paper will contribute to the existing literature and provide a holistic understanding of FMs as AFS (Figueroa-Rodríguez et al. 2019).

## Theoretical framework

The present research adopts the analytical framework of Alternative Food Networks (AFNs) theorised by Oñederra-Aramendi et al. (2023). Drawing on the results of their systematic literature review, they defined a new conceptual framework (Fig. 1) for the analysis of food governance processes, aimed to identify the factors ensuring



**Fig. 1** Three categories of food governance in AFS developed by Oñederra-Aramendi et al. (2023)

sustainable trajectories of AFNs. The framework is based on the theorisation of structural and relational embeddedness by Granovetter (1985). While the former captures the underlying organizational spaces structured for decision-making (“Hardware”), the latter focuses on social capital (“Software”) and the personal relationships between actors (Migliore et al. 2014; Oñederra-Aramendi et al. 2023). The “Hardware” focuses on participatory structures to decision-making and the relative “dynamisation” mechanisms that allow for the democratisation of governance processes and a fair power distribution. Through a reflexive perspective on food governance, the “Software” factor captures how relationships of trust and interdependence are developed within the networks. By contextualising food governance as socially embedded within multiple levels, Oñederra-Aramendi et al. (2023) added a third dimension, that of “Multi-level alliances” encompassing the collaboration across different levels of governance (horizontal and vertical collaborations). Multilevel strategic relationships are hereby analysed, as well as the role of institutional interventions. This third dimension is built on their previous works (Oñederra-Aramendi et al. 2018) emphasising the need for a new dimension of food governance. This new dimension should contextualise the various scales and levels characterising FMs.

This approach can lead to innovative strategies for addressing food system and governance challenges (Beckie et al. 2012; Oñederra-Aramendi et al. 2023). In order to conceptualise a new multilevel food governance approach, it is essential to recognise the role of different actors within the system and their relationships. These social interactions form the environment within which the economic activities of food systems and FMs are embedded. In this context, embeddedness conceptualises actor networks and relations as the social structure that connects economic, social, and other activities (Liang and Plakias 2022). FMs exemplify the embeddedness of localised agri-food systems as they are economically, socially and environmentally embedded in the local territories (World Farmers Markets Coalition 2021).

As mentioned above, the present research adopts Oñederra-Aramendi et al. (2023) framework to discuss the results against the background of these three dimensions (Fig. 1).

## Case study: the city of Bologna

Bologna is the capital of the Emilia-Romagna region, the second Italian region for income from agriculture (CREA 2021). It is a medium sized Italian city, with a population of approximately 400,000 people, and it has a high population density, with over 2,000 people per km<sup>2</sup>. It is a rather wealthy city, as in 2020 the average income per capita was 25,934€, which is 20% higher than the national average

(Comune di Bologna 2022). The agri-food sector in Bologna holds substantial economic influence due to its embeddedness in the city's culture and tradition, making the Metropolitan City of Bologna the eighth Italian city by value added in agriculture (ANCI 2023).

The FMs network is inserted in this favourable context, where governance also plays an important role. In Italy, the Ministerial Decree MIPAAF 20/11/2007 regulated FMs as a form of direct selling, specifying that FMs are characterised by the direct sales of agricultural products (mainly fruit and vegetables), cultivated and/or transformed by the farm. Direct selling of agricultural products needed formalising as it represents an increasingly important sales outlet for farmers in many Italian cities: in 2020, 21.7% of farmers chose to sell directly to consumers without intermediaries a percentage of their produce (ISMEA 2020). According to the Decree, FMs are short supply chains, as only farms based in the regional territory can sell there, unless differently specified by the local authority.

The national Decree was later implemented at urban level by Italian municipal authorities with ad hoc regulations, including the city of Bologna. Until November 2022, the operations of Bologna's FMs were governed by a Regulation (PG 58564/2009) that was no longer capable of managing their increasing complexity. Namely, such Regulation was deemed inadequate for several reasons. First, it allowed the allocation of areas to the FMs organisers only for short periods of time (three years), resulting in high precariousness. Second, it did not allow food serving on the FMs premises, contrary to Article 2135 of the Italian Civil Code where transforming agricultural raw materials is possible for agricultural entrepreneurs. Third, it considered agricultural producers as mere traders, needing an overall change of vision on the role of small-scale farmers in FMs.

To address these issues, the Bologna City Council approved a new Regulation called “Regulations for conducting direct sales markets of agricultural products” (DC/PRO/2022/76 of November 2022). It allows food service on the FMs premises, and it establishes a clear procedure for FMs implementation, aiming to provide the FMs organisers with defined, stable, and fair access to the spaces. More precisely, the Municipality issues a call for tender for FMs organisers, inviting all interested actors to participate. The final decision considers the actors' previous FMs history and is elaborated in agreement with the neighbourhood councils. Currently, Bologna FMs are overseen by various food-related associations, which act as FMs organisers. Once a FMs organiser is awarded a space, it is entrusted to manage it for a minimum of five years. The associations' variety enables them to pool resources and present a collective FMs proposal defined in advance and in agreement with all the actors participating in the specific market. Each FMs organiser has its own procedures for managing one

or more market areas, offering a variety of activities and experiences. For example, some FMs strictly deal with agricultural products, while others include street food vendors and children-friendly areas and activities. FMs diversity in terms of activities and management is underrepresented in the academic literature (Manser 2022).

The key innovation brought by the new Regulation lies in the recognition of the multifaceted values associated with FMs. FMs are acknowledged as promoters of social innovation through the activation of community ties. Simultaneously, they are recognised for fostering local and urban development by establishing trust-based relationships between consumers and producers, which also promote greater awareness of high-quality local products. Although the new Regulation was developed through a series of participatory meetings with stakeholders involved, it has been cautiously received by FMs organisers, and their opinion post-implementation was not collected by the Municipality.

Given such a fertile ground, the number of FMs in Bologna is consolidated, with 21 FMs operating during the week in 20 different market areas, run by 6 FMs organisers. The dimension of the FMs network and the relationships it develops provides a high potential case study to analyse the interplay of actors managing the city's FMs system.

## Methods

### Methodological framework

#### Social Network Analysis (SNA)

In recent years, the increasing recognition of the relevance of social relationships within local food systems have led to the adoption of the Social Network Analysis (SNA) method in studies concerning FMs and SFSCs (Rocker et al. 2022; Trivette 2019). By examining the connections between FMs stakeholders, this method enables the understanding and visualisation of the relational structure underpinning FMs, as well as the identification of strengths and weaknesses of the FMs network (Rocker et al. 2022). Moreover, SNA also helps defining the stakeholders' roles and level of influence in the network. The latter is commonly determined through the search of key players, those who occupy optimal positions to disseminate and receive flows of information and support (Borgatti 2006).

The fundamental components of SNA include *Nodes*, *Ties* and *Networks*. Nodes represent individual or collective actors involved in the system, while ties indicate the connections between these actors, and can be of various types – such as social relationships, material exchanges or information flows. The aggregation of nodes and ties forms the networks, which are comprehensive representations of the

systems studied (Borgatti et al. 2009). The network representations allow to encompass in the analysis of the individual stakeholder both its isolated attributes and its interactions with other actors (Bertoni et al. 2022).

#### Net-map tool

To apply SNA methodology to Bologna's FMs case study, the present research has adopted the Net-Map tool. The tool is useful in enabling the understanding of the network's complexity and structures, as well as in identifying conflicts and potentials for action within the network. It is an interview-based mapping tool that combines both qualitative and quantitative analysis to facilitate the development of strategies and concepts for network enhancement (Schiffer and Hauck 2010). The methodology follows a four-step process: data collection, data processing, network visualisation and data analysis. The first step consists of one-to-one interviews where individual Net-Maps are created together with each interviewee. The interviews address three key themes: the actors (*nodes*) included in the network, their connections (*ties*) and their level of influence within the network (Schiffer 2007). The individual Net-Map data is then transposed into matrices, processed, and visualised using a designated software. In the final step, the quantitative results and qualitative information obtained from the interviews are triangulated and analysed.

#### Data collection

As first step of the Net-Map tool, a total of ten individual interviews were conducted. Initial interviewees were selected based on past research and a comprehensive examination of the FMs network in Bologna. The adoption of snowballing technique ensured the full coverage of individuals with expertise on Bologna FMs, as each participant was asked to suggest other potential interviewees for the study. The search for new actors continued to reach saturation, ensuring a comprehensive coverage of the network. Each potential member identified was contacted and either interviewed or determined to be redundant due to a lack of specific knowledge regarding Bologna's FMs. The final set of interviewees encompasses a diverse range of stakeholders from the FMs in Bologna, each offering unique perspectives and insights. The ten interviewees included all the FMs organisers' representatives (7), one FMs organiser's consultant (1) and the urban level public administration officials (2). While FMs organisers are 6, one of them includes two associations running the markets together, and representatives from both associations were interviewed. The FMs organisers' representatives held various positions, including three FMs farmers and four FMs coordinators (volunteer or paid), while the public

administration actors represented both the municipal and the neighbourhood levels, the two main governance levels involved in FM regulations.

Adopting the Net-Map tool, each interview aimed to create one network map with all the FM stakeholders and their relationships, reflecting the interviewee's perception of the network. All interviews consisted of three main questions: "Who are the most influential actors in the FM network in Bologna?", "What relationships exist among the stakeholders in the FM network?", and "How influential is each actor present in the FM network?" (Schiffer 2007). These standardised questions were the basis for further discussing the structure and dynamics of the FM network. To facilitate the identification process, the researchers presented each interviewee with a pre-defined list of possible actors, compiled based on prior desk research. Actors were categorised into civil society, food economy, or public administration sectors to create homogeneous analysis. During the interview, participants were encouraged to determine whether each actor on the provided list is involved in the FM network. Moreover, interviewees could add further actors based on their own experiences. Interviewees were also asked about the kind of relationship that exists between actors in the FM network. They were specifically asked by the interviewers about three types of relationships: supportive, economic and hindering. Supportive relationships indicate a connection between actors based on help and assistance; economic relationships pertain to commercial exchanges between stakeholders; and hindering relationships include counteracting interactions. All the relationships were explored in terms of their directionality, meaning that both the source and the receiver of the relationship were identified. Bi-directionality was also an option. Finally, interviewees evaluated the level of influence in the local network dynamics attributed to each actor on a scale ranging from 0 to 5.

Such interview structure allowed the interviewees to reflect on the map they were creating, providing additional qualitative insights on the network structure and relationship types.

## Data processing and visualisation

In the data processing phase, the researchers extrapolated the relationships emerging from the ten interviewees' individual maps into three distinct matrices, visualised in three separate final maps. Each of the three maps illustrated the total relationships within the network, one for each type of relationship – supportive, economic and hindering.

All the elaborations have been conducted using the software UCINET.

## Data analysis

The Net-Map elaboration phase included two steps: Network Analysis and Actors influence.

The first phase encompasses a comprehensive exploration of the three different networks – supportive, economic and hindering – to determine their overall characteristics and their network dynamics. The analysis of the different types of relationships provided insights into which relational type is more prominent and influential in shaping the network.

Second, the research investigated the influence and importance of the network stakeholders. The findings showed the benefits of analysing FM as complex systems characterised by numerous stakeholders engaging in diverse interactions across various levels, ranging from the micro level of individual farmers to the macro level of the European Union.

### Data analysis – Network analysis

The three maps – supportive, economic and hindering – showed the structure of the FM network in Bologna. The network structure visualisation provides an overall understanding of key patterns and structures (Rocker et al. 2022). The further quantitative definition of the networks characteristics enabled a more precise understanding of the dynamics that govern both the network and its actors (Therrien et al. 2019).

Table 1 shows the indexes adopted to quantitatively characterise the three networks in the maps. These indexes were categorised into overarching themes used by the researchers to interpret specific network characteristics (Therrien et al. 2019). First, network centrality is investigated to gain insights into the distribution of power within the networks. Second, the network dimension is examined to understand information flow, namely how quickly information disseminates across different nodes in the networks. Third, modularity analysis shows the community structure of the networks. Fourth, the density and strength of actors' connections within the networks are explored to analyse cohesion.

Additionally, the research tested the ties between and within existing actors' categories for the network that resulted as most relevant based on the results of the previous indexes (the support one).

### Data analysis – Actors' influence

Several ways exist to conceptualise actors' importance and influence, but centrality measures, particularly in the context of local food systems, are commonly applied (Trivette 2019). Degree centrality, as mentioned in Table 1, measures a node's importance based on the number of ties it possesses. In the present case study, since the ties between actors are directed, degree centrality can be divided into two separate



**Table 1** Network indexes grouped according to network characteristics. Own elaboration based on Therrien et al. (2019)

Interpretation of network characteristics	Theme	Index	Description
Distribution of power	Centrality	Average degree	Mean of ties that each node has in the network
		Degree centrality (Out-degree, Indegree)	Degree of relational inequality between actors in the network, expressed as a percentage of a perfectly unequal star network of the same size (where the star network is 100% unequal). Out Degree measures inequality in outgoing relationships while in degree considers the incoming ones
		Betweenness centrality	How many times a node forms the shortest path between two or more other nodes
Information flow	Dimension	Average distance	Calculates the average length of all the shortest paths in the network
		Diameter	Maximum number of steps needed to connect any two nodes in the network
		Small World Index	How much the network follows a “Small World Structure”, characterised by a high local clustering and short distances between nodes
Community structure	Modularity	Coefficient of clustering	Tendency of the nodes to form groups, or “cluster” highly interconnected
Cohesion	Network Density	Density	Comparison of the number of actual ties with the number of possible ones among nodes
		Compactness	Measure of node’s cohesion

measures: outdegree and indegree. Outdegree centrality measures the node’s outgoing ties, while indegree centrality measures the incoming ones. Another important measure of actor’s centrality, as previously mentioned, is betweenness centrality. If the ties of a node are such to connect otherwise disconnected actors, or group of actors, the node has a considerable ability to control the flow of resources and support, thus gaining an important influence over other actors. The network centrality of an actor can be considered as a good predictor of its formal or informal power and influence on the whole network, as the high number of ties allows to quickly reach, connect and influence other networks players (Bertoni et al. 2022; Borgatti et al. 2009).

Also, the actors’ influence measured by the above mentioned indexes and the influence perceived by the interviewees were compared. This analysis aimed to identify any discrepancies between the network influence emerging from the indexes and the perceptions of the actors’ influence expressed during the interviews.

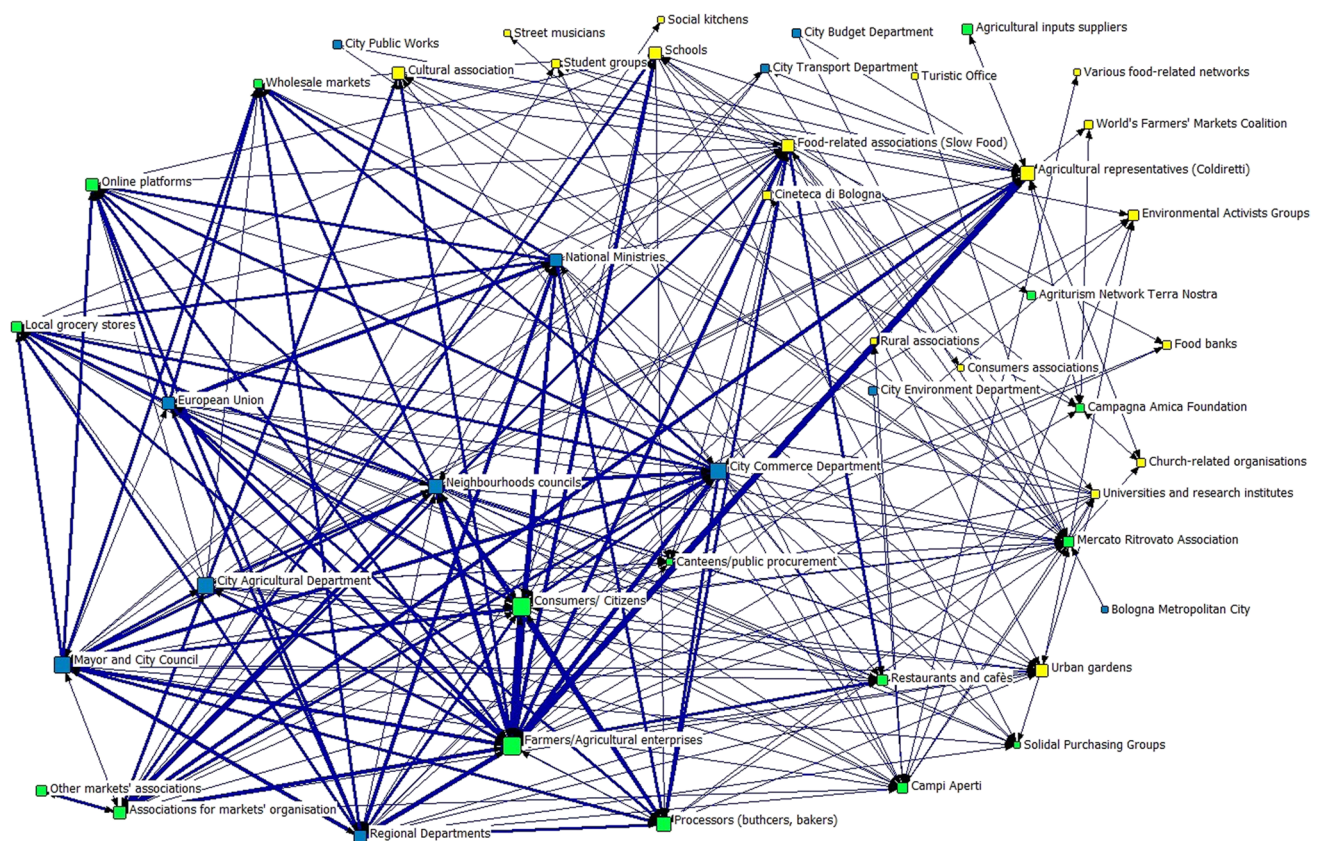
## Results

The interviews allowed the identification of 54 actors (*nodes*), linked by a total of 428 relationships (*ties*) across three networks: support, economic, and hindering. The findings emerge from both an exploration of the distinct characteristics of the three *networks*, and from a focus on the support network due to its heightened significance. Through an analysis of the support relationships, the study delves into the interactions both between and within groups of actors, and investigates the influence and role played by individual actors.

## Network analysis

### Network visualisations

Figure 2 shows the FM’s network created by support relationships, including help, cooperation, information exchange, and promotion. It shows a strong network of relationships, including 46 (85%) of the 54 actors identified in the interviews. The food economy (in green) and public administration (in blue) categories appear to have the strongest relationships. The varying sizes of these ties represent the number of times they have been mentioned as being present by the interviewees. Given that the relationship between farmers and consumers is the most frequently mentioned, the dyad can be regarded as the most important connection. A core group of actors surrounds these two stakeholders. Key actors in the food economy with numerous and strong ties include processors, local grocery stores, wholesale markets, online platforms, and FM’s organisers. Among these organisers, two associations, *Campi Aperti* and *Mercato Ritrovato*, particularly distinguish themselves. Their connections surpass those of other FM’s organisers in terms of quantity and diversity, justifying their recognition as distinct actors in the FM’s network. Administrative bodies also demonstrate a significant level of support and cooperation towards FM’s across various levels of governance, from the European Union to neighbourhood councils. Civil society actors (in yellow) are less clustered but form an outline around the key FM’s actors, with food-related associations and agricultural representatives having the highest number of ties. The different sizes of the nodes represent the influence that each actor has in the network dynamics, as perceived by



**Fig. 2** Network based on ten Net-Maps with stakeholders involved in FMs, support ties depicted. Node size according to the actors' influence as perceived by interviewees. Ties size based on strength of relationships. Node colours and shapes according to the actors' cat-

egories: green triangle=food economy, blue square=public administration, yellow circle=civil society. Source: Own elaboration with UCINET

the interviewees, and confirm the central role of farmers in the FMs network in Bologna.

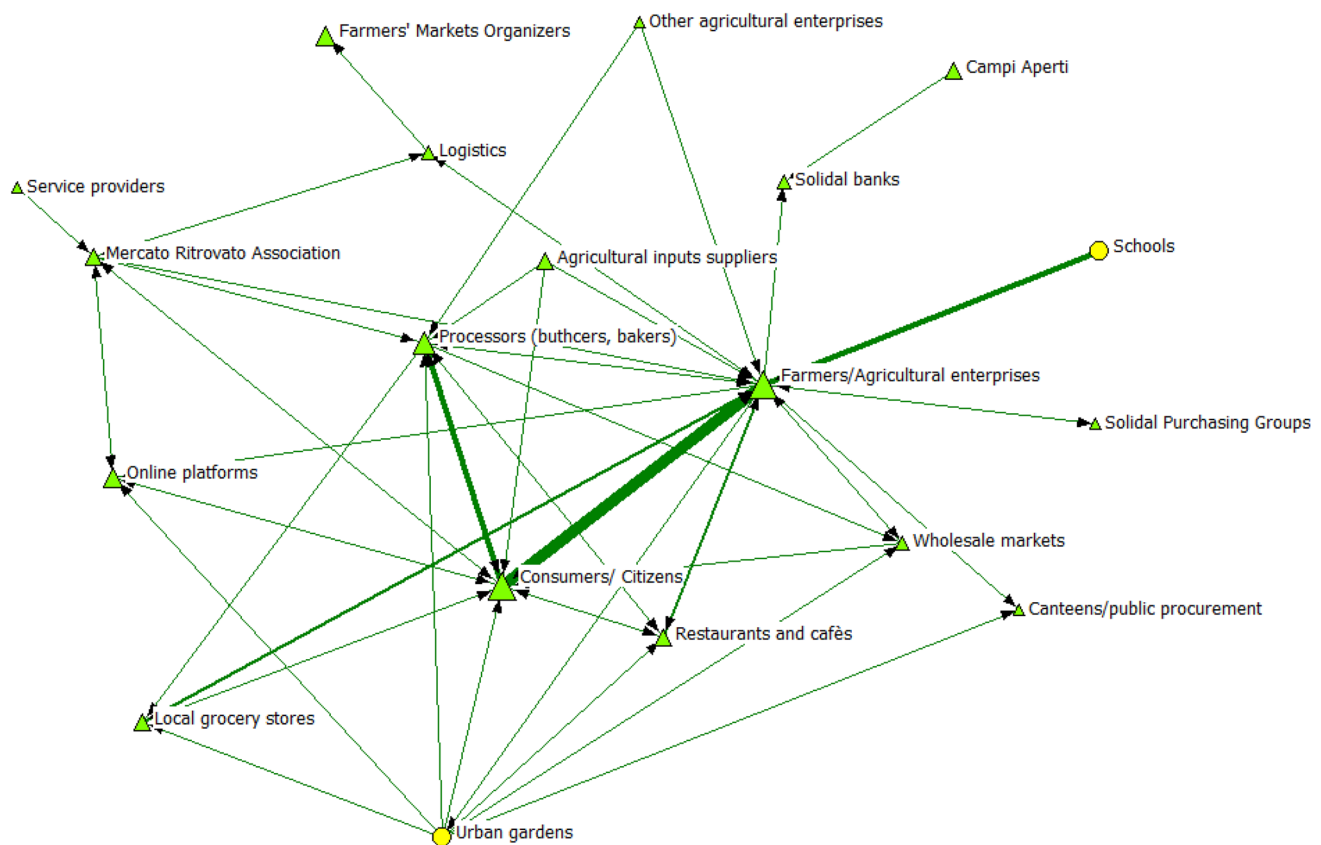
Figure 3 illustrates the network of Bologna's FMs commercial relationships, which includes fewer actors (28 actors, 51%) connected by fewer relationships compared to the previous map (Fig. 2). Farmers and consumers remain the key FMs actors with a strong connection. The map reflects the typical structure of the food supply chain, with agricultural suppliers providing inputs to farmers, who in turn produce food for citizens (together with processors). Local grocery stores, restaurants, and cafes have relationships with individual farmers, but they are usually not actively involved in the FMs. Wholesale markets play a secondary role, and their interactions are limited due to the specific nature of FMs. Public administration actors do not appear in this map, as their relationships with farmers is not commercial. Only two actors from civil society, i.e. urban gardens and schools, are included.

Figure 4 explores hindering connections, that is counteracting or obstructive relationships between actors that impact Bologna's FMs development. Hindering relationships are evenly distributed across the map, involving 28 actors (51%). The main conflicts are of a commercial nature, involving

farmers, local grocery shops, wholesale markets, one FMs organiser association (*Campi Aperti*) and a food-related association (*Slow Food*). FMs farmers face potential conflicts with local grocery stores and the wholesale market of Bologna due to competing interests and different food systems visions. FMs organisers may also experience competition among themselves when vying for the same space in public tenders. Another notable feature is a small group of hindering relationships involving *Mercato Ritrovato* association (one of the FMs organisers), Bologna's waste disposal company, and banks. Also this contrast is due to a discrepancy of values, with the latter guided by financial motivation rather than solidarity.

## Network indexes

Table 2 highlights the different characteristics of the networks by calculating several SNA indexes. From the number of ties, it is evident that the support network has the highest number of relationships, counting 309 ties with respect to 54 of the commercial network and 65 of the hindering one. The number of actors is also prominent in the support network, which includes 46 actors, while the commercial and



**Fig. 3** Network based on ten Net-Maps with stakeholders involved in FMs, economic ties depicted. Node size according to the actors' influence as perceived by interviewees. Ties size based on strength of relationships. Node colours and shapes according to the actors' cat-

egories: green triangle=food economy, blue square=public administration, yellow circle=civil society. Source: Own elaboration with UCINET

hindering one only 28. The table aims to better visualise networks' indexes, not necessarily to compare them given the different networks' sizes.

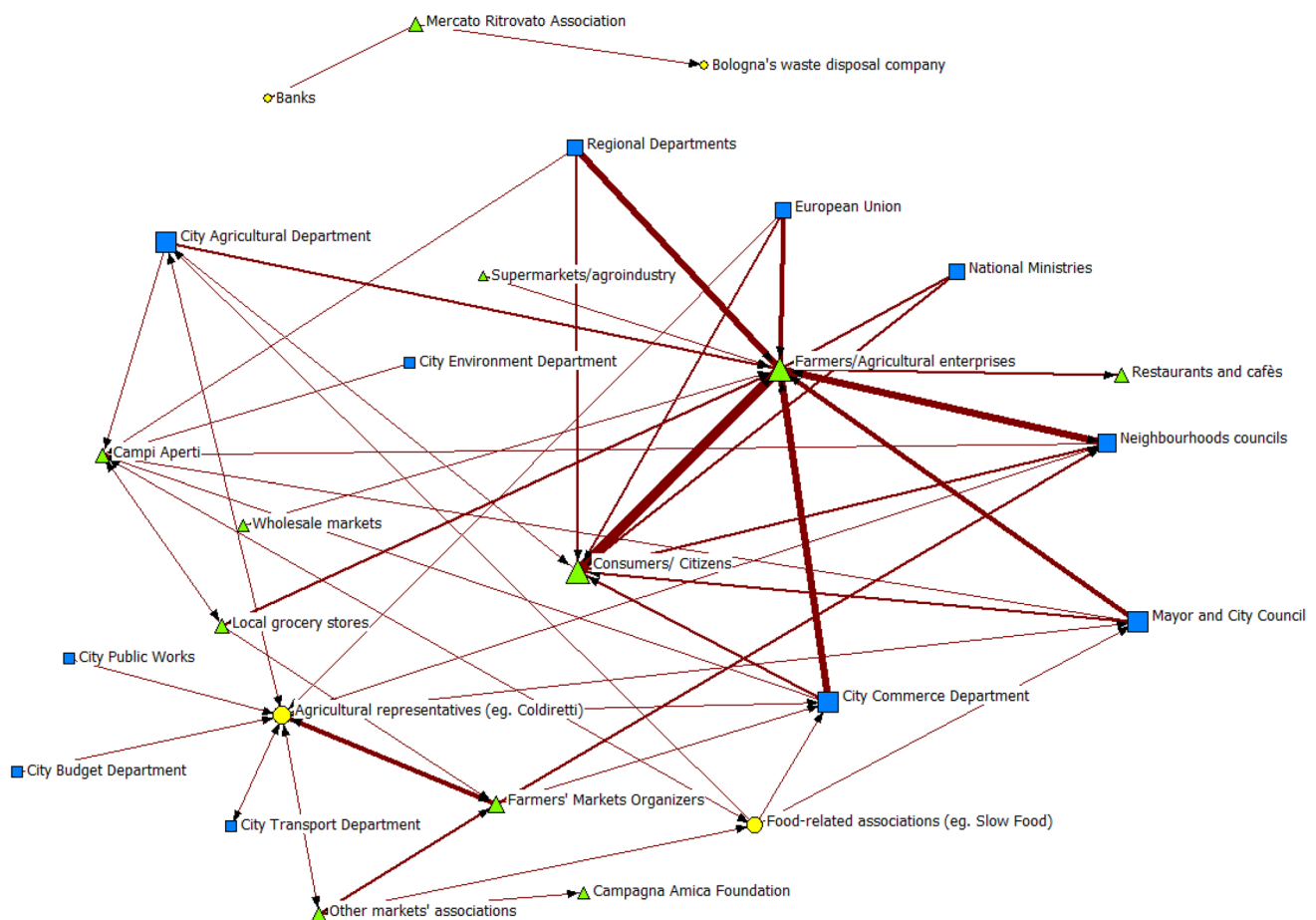
As for the centrality measures – showing power distribution –, the three networks exhibit similar behaviours. In all the three networks, both the outdegrees and indegrees are relatively modest and all well below 20%, indicating a low level of networks centralisation. This means that actors' power and importance vary, but not significantly, and are fairly distributed. The main difference can be observed in the indegree index, where the commercial network has a lower value as the commercial nature is perceived as less mutualistic. The overall Network Centralisation Index is relatively low for all networks ranging from 3.84% to 9.23%, indicating that there is considerable variation in actor betweenness across the networks. Most connections can therefore be made without the aid of an intermediary, which aligns with the other centrality measures, in showing a fair distribution of power.

In terms of dimension indexes – that represent the information flow –, the average path length is quite similar across

the three networks and relatively low, it does not surpass a mean of three connections for all the networks, indicating a compact and connected network. This finding is also confirmed by the diameter index, which indicates a very low maximum distance for all networks. This result is especially significant for the support network, which has almost twice as many actors as the other two networks. The high Small World Index, well above 1 (which is the reference point) as it ranges around 5 in all the networks, suggests that all networks exhibit characteristics of a small world structure. This characteristic implies that the FMs network structure consists of small, highly interconnected neighbourhoods connected by short paths, where information flows easily.

The clustering coefficient is an index of network modularity that represents the network community structure. Once again, the clustering index does not differ significantly between the three networks, indicating the presence of dense neighbourhoods in all of them. The networks are therefore characterised by high modularity, with a large number of interconnected FMs actors forming small dense groups that are also well connected to other groups.





**Fig. 4** Network based on ten Net-Maps with stakeholders involved in FMs, hindering ties depicted. Node size according to the actors' influence as perceived by interviewees. Ties size based on strength of relationships. Node colours and shapes according to the actors' cat-

egories: green triangle = food economy, blue square = public administration, yellow circle = civil society. Source: Own elaboration with UCINET

**Table 2** FMs network indexes grouped according to the types of relationship

Interpretation of network characteristics	Theme	Indexes	Support	Economic	Hindering
Distribution of power	Centrality	N° of ties	309	54	65
		N° of nodes	46	28	28
		Average degree	5.72	1	1.20
		Outdegree	9%	7%	6%
		Indegree	15%	4%	13%
		Betweenness Centrality			
		Mean	35.78	3.30	10.15
		St. Dev	76.95	14.95	27.67
Information flow	Dimension	Network Centralisation Index	9.23%	3.84%	4.80%
		Average distance	2.20	1.89	2.45
		Diameter	4	4	5
Community structure	Modularity	Small World Index	5.50	4.72	4.28
		Coefficient of clustering	0.60	0.65	0.59
		Density	0.15	0.03	0.27
Cohesion	Network Density	Compactness	0.30	0.04	0.07

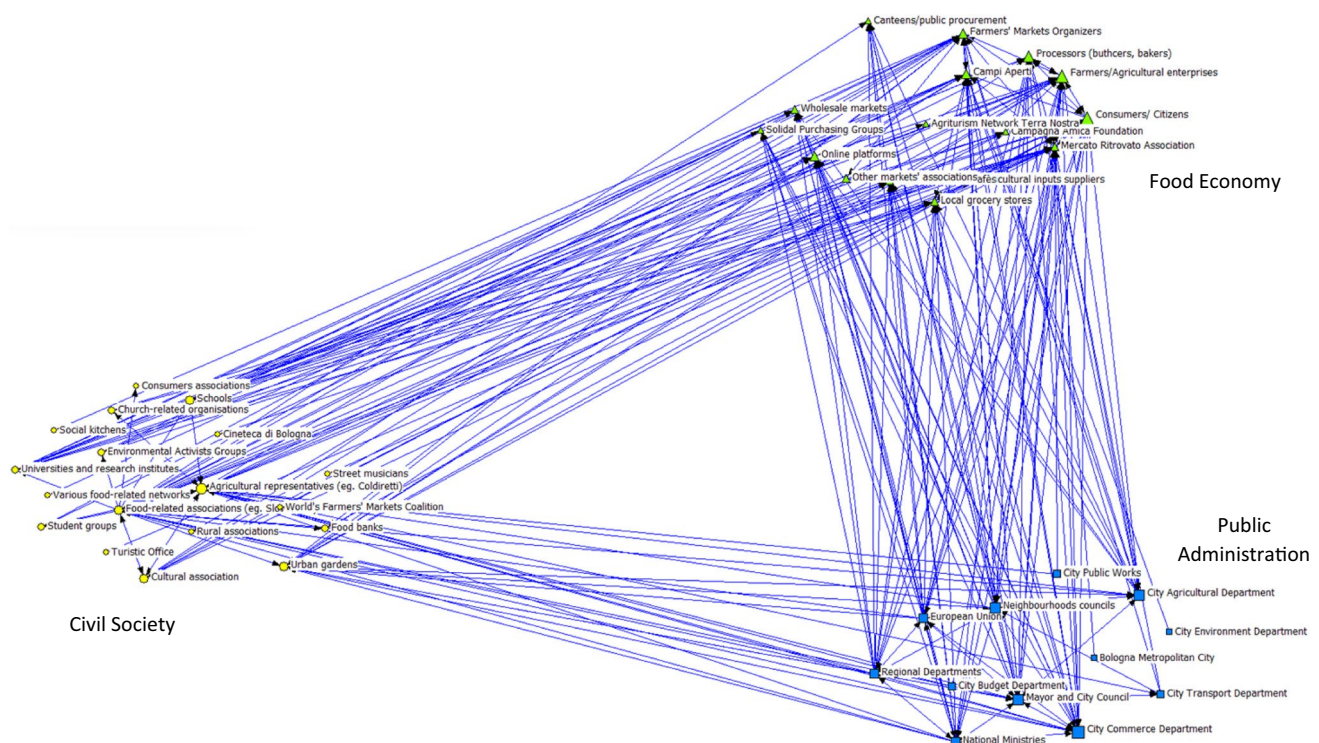
In terms of the network density, the index does not indicate high overall cohesion, and the results differ significantly among the networks, with the support network expressing 15% of the maximum possible connections between its actors. This result is likely due to the fact that not all actors are highly interconnected, and some only play marginal roles and are connected to specific individual actors. This result is confirmed in the graph visualisation and will be further explored in the core/periphery analysis presented in the Annex 1. The compactness index is not high enough to contradict the density index, indicating that the support network is more compact but still exhibits medium–low cohesion density.

To sum up, the centrality analysis results indicate that the three networks lack strong dominant roles that exert significant control over the entire network. While certain actors possess greater influence than others, overall power concentration in the networks is relatively low. Such fair power distribution is beneficial for the support and commercial networks, as it allows for the emergence of innovations and new ideas. Additionally, it is a positive outcome for the hindering network, as no actors have the ability to exert a high negative influence. The analysis of information flow reveals that the networks are characterised by short paths, facilitating the efficient dissemination of information and communication. The presence of high modularity within the

networks is also considered positive, as it allows for coordination among subgroups based on common themes or interests, promoting innovation. Although these results are positive for the FM's support and commercial networks, the characterisation of the FM's hindering network suggests the presence of multiple antagonistic actor subgroups. This finding is important as it may indicate shared causes of dissatisfaction among stakeholders, necessitating the identification and resolution of such issues. Finally, there is room for improvement in terms of information flow. Some actors remain disconnected from the network, and greater compactness could be achieved. However, it is important to strike a balance, as a highly interconnected network also runs the risk of uniformity. Overall, the findings are deemed positive for all the FM's networks.

### Ties between actors' categories in the support network

Figure 5 shows the FM's support relationships when stakeholders are grouped according to the categories they belong to. It is visually apparent that the FM's categories with the highest number of ties are Food Economy with Public administrations, followed by Food Economy with Civil Society. The relationships between Civil Society and Public administrations are fewer in number, but this



**Fig. 5** Network based on ten Net-Maps with stakeholders involved in FM's, support ties depicted and grouped by actors' categories. Node colours and shapes according to the actors' categories: green trian-

gle=food economy, blue square=public administration, yellow circle=civil society. Source: Own elaboration with UCINET

was expected as the main focus of the study is the FMs, whose main actors are in the Food Economy group.

In the context of FMs, the presence of high internal ties within the Food Economy category (see Table 5 in Annex 2) is a positive outcome, indicating that the relevant actors are interconnected and capable of sharing resources and support. Additionally, the relationships they have with the Public administrations category signify that the success and development of the FMs are not solely dependent on commercial relationships, but also rely on support from the public sphere. Moreover, the strong connections with civil society demonstrate that the role of FMs extends beyond being solely an economic entity, as it allows the exchange of support and benefits to a diverse range of actors beyond the economic transaction. This highlights the significant role of FMs in the community.

### Actors' influence

Individual centrality measures can also be calculated for each actor in the network. The study focuses on the support

network for this calculation as it is the most representative of network dynamics. Stakeholders listed in Table 3 represent the top ten with the highest scores for each measure. Farmers occupy the first position in both outdegree and indegree centrality, indicating that they both receive and provide the highest support from and to FMs. The following five actors with the most outgoing FMs support relationships are public administrations followed by FMs organisers and citizens. When considering incoming ties, the top ten actors change significantly. Citizens rank second, followed by FMs organisers and other food economy actors. Interestingly, neighbourhood councils are the only public administrations present. This result shows that there is a significant variety between the actors who support and the ones that are supported by the FMs networks. Regarding betweenness centrality, the FMs organisers occupy the top positions, with farmers in the fourth place. Some city-level public administrations also gain significant positions and, for the first time, civil society actors such as schools and cultural associations are included.

**Table 3** Actors' centrality measures in the FMs support network

	Perceived Influence	Outdegree		Indegree		Betweenness	
		Ranking	Value	Ranking	Value	Ranking	Value
Farmers/Agricultural enterprises	5	1st	(35)	1st	(56)	4th	(241.42)
Consumers/ Citizens	4.70	9th	(21)	2nd	(30)	6th	(139.80)
City Commerce Department	4.50	3rd	(32)	9th	(13)	10th	(40.22)
Mayor and City Council	4.28	2nd	(33)	9th	(13)	9th	(49.76)
City Agricultural Department	4		(19)		(7)		(21.54)
Neighbourhood councils	3.65	3rd	(32)	7th	(16)		(36.62)
Agricultural representatives (Coldiretti)	3.44	10th	(20)	4th	(20)	3rd	(271.46)
Processors (butchers, bakers)	3.40		(5)	3rd	(23)		(2.90)
Food-related associations (Slow Food)	2.81	8th	(22)	10th	(12)	7th	(103.71)
Regional Departments	2.78	4th	(28)		(10)		(9.26)
Cultural association	2.70		(7)		(9)		(31.85)
European Union	2.67	5th	(27)		(6)		(3)
Farmers' Markets Organisers	2.50	7th	(24)	3rd	(27)	2nd	(274.90)
National Ministries	2.33	6th	(25)		(8)		(3.10)
Schools	2.20		(15)		(8)	8th	(100.01)
Urban gardens	2.13		(6)	8th	(14)		(14.09)
Online platforms	2.13		(2)	6th	(17)		(0)
Campi Aperti Association	1.88		(9)	7th	(16)	5th	(225.51)
Restaurants and caf��s	1.83		(3)	10th	(12)		(0)
Local grocery stores	1.72		(4)	4th	(20)		(7.31)
Agricultural inputs suppliers	1.63		(1)		(1)		(0)
Other markets' associations	1.40		(2)		(2)		(0)
Environmental Activists Groups	1.30		(3)		(5)		(2.43)
Mercato Ritrovato Association	1.25		(13)	5th	(18)	1st	(285.40)

The table lists actors in descending order of perceived influence, that is with the most influential actors positioned at the top and the least influential at the bottom. Each actor's entry in the subsequent columns (Outdegree, Indegree, Betweenness) includes their ranking in that index, alongside the corresponding index value enclosed in parentheses.

The crucial role of farmers in FMs has been confirmed, and the outdegree index has highlighted the significant importance and central role of public administrations in supporting the network. The FMs organisers play a central role not only due to their numerous relationships but also because they often act as bridges between disconnected actors, as the betweenness index indicates. The Mayor and City Council, the City Commerce Department and the neighbourhood councils also serve as connection points, linking the policy level of the European Union to the city's FMs (the “meso level”). Notably, neighbourhood councils and citizens receive substantial support from the FMs, suggesting that FMs serve not only as a means of support for farmers and agricultural enterprises but also fulfil a political and social function within the local community.

The measurement of perceived influence scored during the interviews provides a deeper understanding of the role and power of each actor in the network. Both the outdegree and indegree centrality, as well as the perceived influence scores, identify farmers as the most influential actors in the networks. However, a difference arises when considering consumers. According to interviews scores, consumers are perceived as the second most influential actors, with a total score of 4.7 out of 5. However, this is not supported by the network indexes. This discrepancy also applies to most public administration actors. This result was expected since the influence measures study different aspects of power. The network influence derived from centrality measures analyses an actor's influence within the network by contextualising them and assessing their importance based on connections and relationships. On the contrary, perceived influence as scored by the interviewees, reflects an actor's actual role and legal importance. For instance, the City Commerce Department and the City Agricultural Department may not be in a central position, but they are responsible for developing new market regulations and must abide by the conditions imposed by the Mayor and other political bodies. Nevertheless, the centrality indexes still convey important information. They highlight that public administrations are not equally connected in a mutual relationship to all the other network actors, despite their role. This may imply that not all perspectives involved in the farmers market have been adequately heard, also in the recent process of co-designing the new regulations. Additionally, the high scores attained by agricultural representatives and FMs organisers in the network indexes emphasise their important unofficial role in the market, acting as connectors, support providers and receivers, and information carriers.

## Discussion

The present research aimed to analyse the social networks emerging from FMs in Bologna, in order to understand their structure, dynamics and influence of the actors involved.

The points of discussion emerging from the results are hereby presented following the theoretical framework classification in “Hardware”, “Software” and “Multilevel alliances” (Fig. 1).

### “Hardware”: the organisational structure

#### Participatory structure

The participatory food governance process that led to the writing of a new regulation on FMs was deemed satisfactory by most interviewees. The regular bilateral meetings held for the new regulation co-design allowed the Municipality to be more aware about the requests of the FMs organisers, albeit not all of them were addressed in the new regulation. A good level of actors' participation in decision-making processes was therefore granted, as perceived by most interviewees.

Data on Average Degree Centrality and information flow, both high in the support network, supported the importance of the connectivity of members theorised by Oñederra-Aramendi et al. (2023). Such measures show actors closely connected to each other, enabling efficient information sharing and therefore a higher stakeholder participation. On the contrary, Network Density measures are low, meaning limited over-connections among actors, avoiding information flow repetitions and homogenisation of ideas, as argued by Therrien et al. (2019).

#### Power distribution

In the FMs maps, a good representativeness and diversity of actors emerged: the three categories of stakeholders are almost equally present, with the food economy and civil society having the same number of actors. In comparison, the public administration has half of the actors, an imbalance compensated with greater influence and authority. Overall, interviewees indicated a good level of perceived power distribution in the FMs networks. On this, our findings do not align with Hinrichs (2000) who theorised unequal power relations among farmers and between farmers and consumers in direct selling, while in our maps and interviews the dyad farmers-consumers is perceived as central but overall equal.

Centrality measures support such perception, as for example Indegree and Outdegree centrality are relatively low, showing a scarce centralisation of power. Similarly, from the Network Centralisation Index emerge that most connections can be made without the aid of an intermediary, showing a horizontal type of governance, far from a hierarchical structure. The presence of a group of actors playing a more central role in the network shown by the individual centrality



analysis is typical of most networks (Fuchs-Chesney et al. 2023).

### **"Dynamisation" mechanisms**

The overall structure of Bologna FMs facilitates the dynamic process of sharing best practices and values. Small world networks are characterised by small, highly interconnected clusters composed of actors that share similar ideas and values. While the absence of subgroups is considered a sign of uniformity, the modular structure is usually connected with innovation, derived from the coordination by theme that the groups have and supported by the connection between the different groups, allowing them to share ideas and innovations as observed by Therrien et al. (2019).

Our results confirm past research that identified Small World structure and high modularity as resilient features allowing for the long-term survival of local food systems and networks (Brinkley 2018). Nevertheless, the presence of small and dense groups connected to each other may lead to difficulties in entering the network, and therefore the market access provided by the FMs. Indeed, FMs are seen by most interviewees (and by policymakers who wrote the new regulation) as a tool for facilitating the redistribution of value along the supply chain, as they provide an economically viable market outlet, alternative to retailers.

### **"Software": the social capital**

#### **Trust relationships**

Both maps and interviews show that the FMs network in Bologna is well developed in terms of connections and support. Several relationships exist between the different actor spheres and among the actors within the spheres. Overall, the number of conflicts is limited and there are no big hindrance factors that prevent FMs development, therefore making it easy to support them towards a common objective.

Mutual support between the actors involved is developed. These results are aligned with those of Schreiber et al. (2023), who considered the presence of a strong network of urban stakeholders as one of the best strategies to support Alternative Food Systems at local level. In particular, results from the interviews confirm the social capital structure built around FMs is the real strength of the network, enabling FMs to address the challenges posed by the present food system as addressed in literature (Brinkley 2018; Schupp 2016).

#### **Reflexivity**

As highlighted by Oñederra-Aramendi et al. (2018), FMs are characterised by a mix of values that blends the

economical dimension with social embeddedness. The presence of both types of relationships in the Bologna FMs network, with the support relationship being more prominent, reinforces the idea of FMs as a space where individual economical needs merge with common social and cultural values. Such shared understanding is also improved by the practice of reflexivity, which in turn helps information exchange, making AFS governance processes more socially sustainable. The interview process itself can be considered a moment of reflexivity, as thanks to the Net-map tool interviewees were allowed to reflect on the map they created to identify their own subjective points of view.

#### **Communication**

As for the organisational structure, the measures of centrality confirm the results of the interviews, where the high level of support among the actors also emerged. In particular, the Network Centralisation Index is low in the support map, meaning direct communication between actors is a common pattern in Bologna FMs. Such good level of communication allows for a better transparency and accessibility of the information flow. This is reflected in the Information Flow Indexes as well, as they show a network made of short paths between the actors, which improves the quality and quantity of communications. Such closeness between actors improves the network ability to build a common vision and identity, as well as shared values, as argued by Brinkley (2018). This clearly emerged from the interviews, where common values such as a strive for a fairer society were mentioned by most interviewees.

### **Multi-level alliances**

#### **Multilevel strategic relationships**

The FMs network in Bologna presented a horizontal type of governance where most actors at city level cooperate in a synergic way. Other levels of governance (i.e. national, EU) are of minor relevance, as their direct influence on FMs is limited. Our results confirm that FMs are located at the meso-level of governance, linking the macro level of the urban food system with the micro level made of farmers and consumers (Connolly et al. 2022).

The stakeholders' centrality measures highlighted the significant role of the FMs organisers as both a giver and receiver of support, and as an important link for other network actors. The capacity of the organisers to act as a bridge among actors enables farmers to come together, exchange ideas, and build capacity to strengthen their public relations, as argued by Schreiber et al. (2023).

## Institutional intervention

Within the urban governance, what is specific to Bologna is a strong and active municipal authority, well linked to both food economy and some civil society actors, as shown in the results on ties between the actors. Their relationship with FM organisations is not always straightforward and disagreements can happen, but such active institutional intervention from the municipal administration is a strength. Policymakers involved in the regulation process were perceived to have higher influence compared to most food economy actors. Additionally, centrality measures showed that the public administration's relationship with other actors was not mutual, placing the administration in a non-replaceable support role, crucial for the network stability (Brinkley et al. 2021).

Thus, local regulations strongly influence FM governance, but FM organisers are often at the forefront, anticipating issues and solutions, and providing advice to the public administration. The role of the organisers in supporting and influencing decision-making processes is confirmed in the literature (Schreiber et al. 2023) as it is the need for institutions that support both individual actors and the relationships between them (Beckie et al. 2012; Morales 2021).

## Strengths and limitations

The current research presents a comprehensive analysis of a case study, employing a theoretical framework to analyse AFNs through a holistic approach. This approach yields valuable insights into the structure, dynamics, and influence of actors within FMs in a real-world context. Adopting a mixed-methods approach with qualitative interviews and quantitative network analysis, the study captures diverse actor perspectives and reveals the underlying network structure, providing a more robust and nuanced understanding. Future research can build upon this case study to develop mixed methods research of local food systems, enabling a more comprehensive understanding of the actual study conditions. Moreover, it identifies key actors within the FMs network and explores multilevel alliances and relationships between actors at various governance levels. Policymakers and stakeholders can use this information to comprehend pivotal roles in supporting FMs and gain insights into collaboration and coordination between actors. As the network structure and dynamics may evolve over time, this study could serve as a future starting point for comparative analysis, in order to capture changes or developments that occurred after the data collection period. The study serves as a foundation for further research and provides guidance in supporting and enhancing localised agri-food systems like FMs.

Despite the findings' relevance, the study has three main limitations. First, as the case study focuses on Bologna (Italy), the applicability of the results to other cities or regions may be limited due to its context-specific nature. Second, the data collection process consisted of a limited number of interviews. While the mixed-methods approach enhances validity, the small number of interviews may restrict the complete representation of the entire FMs network. Nevertheless, the present study interviewed all the relevant actors with FM expertise in Bologna.

## Conclusion

The current research presents a comprehensive analysis of the FMs network of relationships, influences, and dynamics in the city of Bologna (Ity). Through the examination of this specific context, the study sheds light on the functioning of local food networks, community engagement, and the role of various actors involved. The study findings support that the *status quo* of the FMs network and its governance is overall satisfactory for most interviewees. Where needed, change is expected from an institutional level, especially through an increased awareness of the transformative potential of FMs in urban food systems and FM contribution to the local communities networking. The role of key actors, such as local authorities, FM organisers, and community leaders, who play pivotal roles in shaping FMs, extends beyond mere participation, as they often act as food system intermediaries, facilitators, or regulators, affecting the FMs structure and dynamics.

In conclusion, this study provides a valuable contribution to the understanding of FMs as complex socio-economic systems. By delving into the network structure, dynamics, and actors' influence within the context of Bologna, it not only advances academic knowledge but also offers practical insights that can inform policy and support the sustainability of FMs in other countries.

## Annex 1 Core periphery analysis

One of the measures that helps define the importance of the actors in the network is the core/periphery index. This index distinguishes actors in the core, which consists of highly connected nodes serving as centres for information and resource flow, from actors in the periphery, a collection of marginal actors typically characterized by limited ties and low influence. The index thus creates an initial division between more and less influential actors.

The core/periphery analysis (Table 4) revealed that the FM support network exhibits a highly interconnected core

While most policy-making entities, ranging from the European Union to neighbourhood councils, are part of the core, it is peculiar to find the City Agricultural Department assigned to the periphery. Considering its crucial role in the

## Annex 2 Ties between actors' categories

The results presented in Table 5 confirm the disparity in the number of ties between the categories. The table displays the numbers of each category and the observed frequencies of ties cross-classified between the categories. A Pearson Chi-square statistic is then calculated to compare the observed frequencies with those expected under random conditions. The  $p < 0.01$  value indicates that the deviation of ties from randomness is significant and

**Table 4** Core / Periphery analysis[illegible]

**Table 5** Observed frequency of support ties within and between categories

	N. of actors*		
Food Economy	21		
Public administration	12		
Civil Society	21		
Support ties**	From Food Economy	From Public Administration	From Civil Society
To Food Economy	40	15	40
To Public Administration	82	36	21
To Civil Society	54	4	17

\*The number of actors refers to the total number of actors identified during the interviews. However, not all of them have connections of support with other actors in the network

\*\*Observed Chi-square value = 177.556; Significance = 0.002100

would occur very rarely if the no-association model were true. Consequently, the differences observed in the number of ties can be attributed to the FM actors' affiliation in different categories. The table validates the results depicted in Fig. 2. As the relationships shown have a direction, the table is not diagonal. Instead, the number of relationships between two categories varies according to the reference one. Food Economy shares a total of 97 (82 + 15) ties with Public administrations and 94 (54 + 40) ties with Civil Society, whereas Civil Society and Public administrations share only 25 ties. Another noteworthy finding presented in the table are the diagonal numerosity, which represents the number of relations within each category. Food Economy has the highest number of internal ties, with 40, closely followed by Public administrations with 36. However, it is important to note that the number of actors within the Food Economy group is almost double that of the Public administrations, with 21 and 12 actors, respectively. Therefore, although the Public administrations group has fewer relationships, it exhibits a higher density of connections compared to the Food Economy group.

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