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RECEIVED 15 May 2024

ACCEPTED 07 August 2024

PUBLISHED 29 August 2024

CITATION

Sturla A, Viganò L, Vassallo M and Belliggiano A (2024) Mission, (self)-perception and role in localized food systems of Italian biodistricts: insights from a Delphi survey. *Front. Sustain. Food Syst.* 8:1433261. doi: 10.3389/fsufs.2024.1433261

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Mission, (self)-perception and role in localized food systems of Italian biodistricts: insights from a Delphi survey

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The spread of biodistricts (BDs) in Italy covers approximately 30% of the national territory. Their emergence is driven by specific local reasons and broader motivations, such as a favorable political climate and improved access to health and local food for all citizens. The rapid development of BDs has sparked significant interest from national and regional legislation, as well as from scientific and gray literature. However, there remain ongoing debates regarding the criteria for defining and identifying BD, the appropriate governance models to adopt, and the scope of their functions, particularly in relation to market and supply chain development. A three-round Delphi study was conducted to address these controversial issues and achieve expert consensus on the characteristics and potential direction for BDs as policy actors aligned with their mission. Beginning with a set of 12 open questions, the final round of the survey focused on the definition of BDs, their resilience in times of crisis, and their market strategies. According to the respondents, the specificity of BDs lies more in their functions than in their structural and organizational characteristics (such as the concentration of organic farming or the presence of a structured supply chain). Nevertheless, these structural elements must be pursued as objectives to enable meaningful territorial actions by leveraging local social capital. In this context, fostering interaction between producers and consumers and meeting local demand should be central to BD strategy. However, this does not preclude the possibility of entering national and international markets, especially when it supports the enhancement of local supply chains. Recent crises have served as a testing ground for BD governance, revealing that resilience is closely tied to the organizational maturity of the BDs.

KEYWORDS

organic agriculture and Agri-food systems, biodistricts, Delphi method, Territorial Governance, social innovation, market, local development

1 Introduction

The concept of establishing governance structures to promote rural development through a strategy focused on organic farming began to take root in the early 2000s, inspired by pioneering efforts in Austria with the creation of Bioregionen (Ecoregions) (Schermmer, 2005), in France with the Biovallée in the Drome River Valley (Schnyder, 2023), and in Italy with the

Cilento Biodistrict, which was formally institutionalized in 2009 (Pugliese et al., 2016). This idea has gained significant traction among local actors and practitioners, particularly in Italy, where BDs have flourished and currently encompass nearly 30% of the national territory (BD) (Sturla et al., 2023).

The spread of these initiatives has been driven by several factors, including the need to address specific local issues (Chaminade and Randelli, 2020), a growing awareness among consumers about food sustainability, increasing interest in sustainable food system design by public administrators, and, the heightened focus of the Common Agricultural Policy (CAP) on organic farming. This focus has opened up financing opportunities for the development of organic farming and has facilitated the activation of cooperation initiatives such as PEI-AGRI Operational Groups, supply chain initiatives, agreements for sustainable local development, and promotion and communication actions.

Consequently, BDs are now recognized entities for promoting and accelerating rural development processes. The European Commission's Communication on an action plan for the development of organic production [COM (2021), 141 final] mentions BDs as an effective tool for "integrating organic farming and other local activities in order to increase the attractiveness of tourism also in areas that are off the main tourist routes"; and states that: "The aim [of a Biodistrict] is to maximise the economic and sociocultural potential of the territory. Each biodistrict includes lifestyle, nutrition, human relations and nature considerations. This results in local agricultural production that is appreciated by consumers and hence has a higher market value." By virtue of this function, it commits the Commission to "encourage Member States to support the development and implementation of 'biodistricts' from 2023 onwards" (Action 14). The holistic approach to local development foreseen in the European Action Plan is reaffirmed by the Italian legislation on organic farming that disciplines also BDs (art. 13, Law 23/2022), to whom it assigns a role in promoting the integration of organic farming with the other economic activities present in the district area. Specifically, industrial activities must avoid pollution of natural resources (water, soil, air) to guarantee the environmental quality of organic products.

The legal acknowledgment has brought forward a rethinking of the BD as an institution, as it has moved from being a grassroots organization generating a novel approach to local development (Seyfang and Smith, 2007) to a political subject with precise function connected to the development of a specific area according to the principles of organic farming itself (IFOAM, 2020; Triantafyllidis, 2019). Consequently, questions arise about their capability as organizations to govern local processes, which could be very different. For instance, Italian legislation assigns tasks to BDs that are connected to territorial planning, marketing of organic products, organization of the supply chains, and management of natural resources.

It is now accepted that to have meaningful socio-economic and environmental impacts in a localized agrifood system, its governance must be participatory and inclusive, encompassing various structures such as mainstream supply chains, farmers' markets, and cooperatives. Moreover, knowledge exchange must be intensive (Kang et al., 2022; Janin et al., 2023). Nevertheless, different approaches to the food system require tailored governance that needs to be adapted to territorial needs and actors, especially when agroecology is taken as a guiding paradigm, as in BDs (González De Molina and Lopez-Garcia, 2021). Instead of relying on previous experiences or top-down experts'

recommendations, leveraging the expertise and insights of a diverse group of stakeholders appears to be a much more effective method for getting to the representation of lines of action and policy recommendations that could be meaningful at the local level (Frewer et al., 2011). Delphi methods are well-suited for describing localized agrifood systems, where a comprehensive understanding of diverse factors and stakeholders is essential for analysis and decision-making to effectively address future challenges (Settle et al., 2021), their needs for fostering innovation at the territorial level (Ramírez-Gómez and Turner, 2023), design policies and supporting measures (Partalidou, 2015), and explore their relationships with the market (Wittman et al., 2012).

These methods, moreover, by stimulating reflection and promoting discussion between scholars and practitioners, although anonymously and remotely, to avoid mutual biases, allow actors to build a knowledge base that integrates with existing analytical frameworks defined by experts (Zanasi et al., 2020; Pugliese et al., 2016). Such knowledge provides main elements to be discussed, adapted, or even rejected, aiming both at increasing the competitiveness of BDs and ensuring their sustainable development to design more mindful strategies and directions for policies.

By fitting into the same line of research, this study relies on a Delphi study to focus on BDs as institutions for local development, with the goal of identifying their peculiarities and possible value in relation to the governance of local processes, markets, and supply chains. The study seeks to answer the following research questions: *What is the experts' common vision on the role and definition of BD? How does its governance foster social innovation, its relationships with the market, and resilience to crises?*

This study is organized in the following sections. First, it discusses the results of a literature review conducted to identify key topics for submission to the expert panel. This review highlights the functional needs of BDs, existing shortcomings, and gaps in implementation that need to be addressed. Next, the methodology behind the Delphi study and its main findings are described. Finally, the results are analyzed to provide policy recommendations and suggest potential future research directions.

2 Materials and methods

2.1 Literature review

BDs are gaining increasing attention, first from practitioners and rural actors, as well as from the scientific community. This growing interest has led to a steady rise in studies focused on BDs, particularly in their role as governance structures capable of activating relationships within the supply chain (Poponi et al., 2021) and beyond it (Passaro and Randelli, 2022; Rico Mendez et al., 2021). Given their function in fostering local, territory-specific activities and engaging local communities, it is worth questioning whether their connection to the concept of the industrial district (Becattini, 2017) is merely semantic.

Focusing on the Italian context and theories related to industrial districts, some authors perceive BDs as entities that occupy a space between agrifood quality districts and rural districts, the two main territorial approaches to agriculture described by Italian legislation (L. D. 228/2001, amended by Law

205/2017) (Franco, 2015; Assiri et al., 2021; Poponi et al., 2021). Specifically, the first approach is closely linked to Marshall's concept of industrial districts, characterized by productive specialization, specialized labor, and knowledge spillover (Marshall, 1919). The second approach, on the other hand, is more centered on the territorial and cultural value of local agriculture.

Nevertheless, in identifying BDs, it is common opinion among scholars and practitioners that specific features (environmental concerns, community involvement, scaling up of sustainability values, etc.) must be considered (Monarca, 2009; Dias et al., 2021) in a manner that makes them a conceptual evolution of rural districts (Fiorentini et al., 2021), more sustainability centered. However, the fact that national legislation on BDs (art. 13, Law 23/2022) describes them as institutions for the involvement of local communities in sustainable development reinforces the perception that their concept could not overlap *as it is* with the Marshallian districts, although specialization is one of their features, but rather the BD definition contains elements transversal to the different district typologies that put them in a separate category, centered on relationship, sense of belonging and identity (Porter, 1998) and defined by the capacity of generating nested markets (Oostindië et al., 2010). Indeed, the nature of BDs somehow goes beyond the mere concentration of firms and the related activation of external economies of scale, consisting mainly of the ability to generate hybrid forms of governance of transactions on which both product/service ecological standards and equity in the distribution of the value created depend. This slow and progressive process leads territories to assume economic and organizational arrangements that are more efficient and accepted by all. Once the rules are defined and shared within the BDs (the "nests"), they can expand beyond their perimeter, attributing global values to local markets and using ICT (Milone and Ventura, 2018). Therefore, a specific question has been devoted to exploring to what extent and how important those elements are to define BDs since it is crucial for their definition and legal purposes.

BDs are expected to impact several aspects of the socio-economic context in which they operate, extending beyond the development of organic farming and agrifood supply chains (Dias et al., 2021). However, there is still a lack of a comprehensive and sound framework to fully capture its impacts (Packer and Zanasi, 2023). When placed within the broader framework of localized agrifood systems, defined as geographical concentrations of specialized farms, food-processing units, distribution networks, and both private and public entities in a specific area (Mantino and Vanni, 2018), literature has begun to explore the innovative potential of BDs as institutions capable of strengthening relationships among actors and fostering participation and bottom-up processes for local development (Favilli et al., 2018).

Poponi et al. (2021) view BDs as catalysts for inter-firm connections that can activate circular economy initiatives. Guareschi et al. (2020) highlight BD's ability to build organizational structures that link local farmers to other economic sectors while emphasizing the role of intermediate institutions in bringing together diverse stakeholders. Despite these potentials, BDs are often hindered by challenges typical of bottom-up initiatives in agriculture, such as limited consumer awareness, low collaboration propensity among small farmers, and technical difficulties related to agroecology and organic farming. These challenges are often not adequately addressed by qualified advisory services (Poças Ribeiro et al., 2021) and instead

rely heavily on empiricism and improvisation, further complicating the effective functioning of BDs (Poponi et al., 2021).

Moreover, the limited financial resources available to BDs often force them to rely on voluntary work to sustain their operations (Triantafyllidis, 2019). This dependence significantly hampers their ability to invest in costly and risky innovation processes (Hermans, 2021). Innovation is further constrained by a shortsighted strategic orientation (Porter, 1998 p. 10), which, due to the lack of systemic data collection on the structure and performance of BDs (Pugliese et al., 2016), fails to fully understand their economic and social impact (Zanasi et al., 2020; Packer and Zanasi, 2023). As a result, the operationalization of BD goals can sometimes be difficult (Rico Mendez et al., 2021), and their innovation potential remains underutilized. To better address these shortcomings, a focused inquiry into the specific areas where BDs could make an impact is essential.

As described in the literature and stated in Law 23/2022, BDs are tools for boosting local markets, as they support local supply chains by promoting direct selling and local processing, thus keeping value added in the territory and re-connecting consumers and agrifood actors through alternative food networks. Moreover, in the light of a renewed relationship between urban and rural areas, in BDs, urban-rural conflicts could be addressed using participatory planning (Poli, 2018; Colavitti et al., 2019; Dias et al., 2021; Fiorentini et al., 2021). However, from the results of some studies, issues emerge in supply chains and markets that concern the questions of who, where, and how. As regards the first, given the priority objective of a BD to develop organic agriculture and the related supply chains and to promote the interaction between local supply and demand, a fundamental role is played by both the BD, which should direct and coordinate interventions, and by institutions, which can enact specific policies to support the structuring of supply chains and marketing (Dias et al., 2021; Guareschi et al., 2020; Pugliese et al., 2015). The "where" concerns the localization of the BDs' organic product markets, which, alongside the local one and with a view to the revitalization of rural areas, could also extend abroad (Truant et al., 2019) through a process of internationalization (Dias et al., 2021). Finally, the "how" concerns the need to create new commercial channels or develop those that ensure direct interaction between producers and consumers so that benefits are shared between them (Dias et al., 2021; Guareschi et al., 2020) and reduce the substitutability of local organic products by aiming to strengthen their link with the cultural landscape (Schermer, 2005). There are, therefore, some conflicting issues in BDs' market strategies inherent to the question of how they should approach the market of organic products.

The pandemic breakdown has generated a substantial body of literature examining the impact of food systems (among these: Al-Saidi and Hussein, 2021; Altieri and Nicholls, 2020; Cesaro et al., 2022; Loker and Francis, 2020; Martey et al., 2022), revealing that local approaches have demonstrated greater resilience (Nemes et al., 2021; Tarra et al., 2021). Building on this consideration and considering that food-related disruptions are becoming more frequent due to factors such as geopolitical crises and health issues, it is essential to explore whether BDs and other localized agrifood systems are perceived as resilient and, if so, why. Rather than proposing a preconceived answer, this inquiry aims to interpret a diverse reality through various perspectives.

Studies conducted during periods of crisis (Altieri and Nicholls, 2020; Cesaro et al., 2022) have found that larger farms

tend to be less resilient due to higher levels of debt, advanced technological dependence, and specialization, and significant fixed costs, which limit their flexibility in reorganizing production. These farms also rely heavily on external inputs and broader markets to absorb their output. In contrast, smaller farms, which are the primary focus of BD initiatives, often demonstrate better response to crises. This resilience is attributed to their ability to reproduce essential resources within the farm, utilize specialized labor, maintain diversified production systems, embrace multifunctionality and self-financing, and show a greater propensity for cooperation. Additionally, these smaller farms often adopt agroecological practices and are more frequently managed by younger farmers. While local supply chains can, in theory, be designed to prioritize meeting local food demands, the actual outcomes of a crisis—whether positive or negative at a territorial level—depend on the capacity to effectively coordinate peasant businesses, movements advocating for food sovereignty, farmers' markets, and the spread of agroecology. Success also hinges on the enactment of policies aimed at bolstering these smaller, more adaptable farms rather than supporting larger, technologically advanced operations, which may appear economically and financially robust but are more vulnerable during crises (Van der Ploeg, 2020). The question of whether BDs possess the coordination capacity necessary to achieve this resilience is a focal point of inquiry in this study.

2.2 Methodology

A mixed-method approach, combining a classical Delphi survey with automatic textual analysis, was employed to assess the various facets of BDs. The Delphi method is a well-established and widely used decision-making process (Belton et al., 2019; Okoli and Pawlowski, 2004), particularly effective even in agricultural contexts (Badghan et al., 2020; Frewer et al., 2011; Rikkonen et al., 2019). It relies on iterative rounds of blind debates among a panel of experts, with responses being refined and reconsidered in each round until a substantial consensus or a significant dissensus is achieved (Belton et al., 2019).

In this study, automatic textual analysis was applied to the first round of Delphi, responses. This analysis involved two textual data mining techniques: Similarities analysis (SA) and text-mining clustering (TM-C). These methods are designed to identify patterns within textual data (Gupta and Lehal, 2009; Mandják et al., 2019; Younis, 2015), in this case focusing on the initial responses provided by the Delphi panelists. The automatic textual analyses were conducted using the IRaMuTeQ version 0.7 alpha 2 (Ratinaud, 2014), a tool specifically suited for handling and interpreting large volumes of textual data.

2.2.1 The Delphi method

According to Belton et al. (2019) review, a Delphi panel should be composed of a range of 5–60 experts, depending on the objective to be investigated, and it needs to be heterogeneous to better represent different perspectives on a topic and thus to obtain more accurate and reasonable judgments (Bolger and Wright, 2011; Spickermann et al., 2014). In this respect, the selected panel included experts engaged in agriculture policy and research (academics, staff scientists,

policymakers, and farmer associations) and BD representatives, as reported in Table 1.

The Delphi survey has been carried out from November 2021 to September 2023 within the activities of the National Rural Network 2014–2020 Project to understand how the specificities of BDs are being put into action for local development.

The first-round questionnaire was distributed to 58 experts, with 28 responses received. The second-round questionnaire was successively handed out to all the 28 respondents who replied to the previous round, and responses from 18 experts out of 28 were collected. In the third round, the panel of 18 participants dropped other four units for a total of 14 experts. In each round, questionnaires remained available for answers for roughly 1 month, and several gentle reminders were forwarded to ensure timely participation.

The first-round questionnaire consisted of an introductory part about the study's objective together with a brief description of the Delphi procedure and 12 open-ended questions to which the selected experts were asked to answer by writing down as much text as they wanted. The questionnaire was forwarded by single email to each expert. For this study, four out of the 12 questions were retained (Table 2) for three main reasons. First, they were considered to be more suitable for answering the research questions of this work. The second one concerned the significance of results regarding cooccurrences and clusters. Finally, the third reason is linked to the fact that the statements elaborated for the two successive rounds on the selected questions did not reach an agreement by the panelists.

The returned answers were elaborated with the support of textual analysis to discover potential further questions beyond the four selected. The textual analyses provided an initial potential consensus in the panel that was turned into new questions for further discussion during the second round. The resulting second round questionnaire consisted of 13 closed questions the panelists were asked to answer according to a 5-point Likert scale, where 1 = totally disagree and 5 = totally agree. Based on the results of the second round, a third round was performed to inform the panelists about the results of the

TABLE 1 Characteristics of the expert panelists for the Delphi survey.

Row labels	1st round	2nd round	3rd round
Biodistrict representative	13	12	9
Organic operator	6		
Advisor	2		
Public research	1	1	1
University	6	5	4
Grand Total	28	18	14

Source: Authors' elaboration.

TABLE 2 Selected question for the Delphi analysis.

Q1—What are the prerogatives of the biodistrict (BD) compared to other forms of districts (Rural Districts and Quality Agrifood Districts)?
Q4—Have the recent economic-financial, health, and energy crises favored or limited the development of BD?
Q5—What is the innovative potential of biodistricts?
Q7—What posture should the organic district take with respect to the market?

second round by summary statistics and provide an overview of the levels of consensus achieved. The questions where the consensus was not reached were reformulated by considering the comments provided by the panelists in the second round.

Due to the results of the three Delphi rounds, a potential fourth round was not considered essentially because the panelists have had enough opportunities to explain their points of view, thus preserving some dissensus. Moreover, forcing a fourth round would have caused a potential risk of increasing both the time requested to provide further answers and the drop-out rate. This circumstance is not new in Delphi applications (Rowe and Wright, 2001; Tomam and Picioareanu, 2016), and it especially happens in the so-called “policy Delphis,” where opinions on policy alternatives (Cuhls, 2015; De Loë et al., 2016; Franklin and Hart, 2007) are asked.

The classical Delphi approach aims to achieve experts' consensus if they rationally express their views and tend to converge on a reasonable agreement. However, this objective might not be considered achievable, especially in the context of policy issues. When policy decisions are solicited, a combination of “consensus and dissensus” among the panelists is desirable (Rikkonen et al., 2019). The data analysis of consensus was based on the measures of central tendency (modes, medians, percentages of agreement, and interquartile range for responses that consider variations in responses themselves and, thus, potential dissensus within the panel). The main limitation of a Delphi survey is expected to be due to the selection procedure of experts who can provide different views (Marbach, 1991, p. 97).

Moreover, the generalization of Delphi results is often risky since the selection of the participants is not randomly based (Belton et al., 2019). On the other hand, some authors (Anney, 2014; Kuper et al., 2008) stress the importance of the transferability of the Delphi results rather than their generalizability. In practice, this means that whenever Delphi results describe the phenomenon under investigation in a satisfactory manner so that conclusions can be applied to the present times, contexts, and people, they can also be considered effectively helpful in making substantial decisions on a not-so-distant future (Belton et al., 2019).

2.2.2 Textual data analyses

Statistical analyses were conducted on the responses to the four questions provided by the panelists after the first round (Table 2). The analyses utilized Similarity and TM-C automatic algorithms for textual data. Similarity analysis involves plotting a tree structure to visualize how frequently certain words co-occur in the text. In this tree plot, the thickness of the branches represents the frequency of co-occurrences between words, while the size of the words indicates the frequency of each word itself. By following the branch-led concatenation patterns, we can gain insight into how respondents articulated their shared opinions. Thus, the similarity graphs offer a descriptive representation of the common viewpoints among the experts. A more robust method was applied to further statistically validate these potential common views. Specifically, TM-C was performed using the ALCESTE method of estimation (Reinert, 2001), which is based on the hierarchical descending classification (HDC) algorithm, also known as co-occurrence statistical text analysis (Illia et al., 2014). In this analysis, the words that appear in decreasing order under each cluster are those that contribute

most significantly to the formation of that group, as indicated by the highest Chi-square values. These words were not only the most common but also the most strongly associated with others in forming each homogenous group.

This method tailors statistically independent word classes by maximizing the Chi-squared distance of matrices intersecting parts of texts and words. Each class is, therefore, composed of similar textual word segments because the internal vocabulary is similar. Conversely, different classes are distinct because each internal vocabulary is dissimilar. This splitting process ends until classes are no longer statistically significant (Illia et al., 2014). The final classes in this study represented the extent to which the panelists might have in common with each question.

3 Results

3.1 First round

As reported in Table 3, in the first round, 28 panelists answered four open questions: Q1, Q4, Q5, and Q7. In Table 3 the lexical statistics of the textual data responses are reported by each question.

The textual data of Q1 is composed of a higher number of lexical forms and occurrences than the other questions. Even the number of active forms and the ones with frequency > 3 was the highest for Q1. The two indexes of lexical extension, the number of type-tokens and the type-hapax ratio were, respectively, found within the cut-off criteria for all the questions (i.e., values under 20% for the former and under 50% for the latter are considered satisfactory values for conducting a textual analysis; Bolasco, 1999). The lowest values of these two indexes belonged to Q1. On the other hand, the occurrence means did not meet the suggested cut-off values of over 5 (Tuzzi, 2003), whereas the Giraud indexes were all found within the cut-off values of under 22 (Giuliano and La Rocca, 2008). Questions Q1 and Q5 were those with more lexical extensions and, therefore, with the most occurring forms. This means the panelists expressed wider opinions on the topics proposed in Q1 and Q5 than those in questions Q4 and Q7. Particularly for Q7, the cluster analysis did not achieve a convergence: the lexical extensions and the relative word occurrence, together with the capacity of each other concatenation, were not statistically sufficient to reach a solution.

Specifically, with reference to question Q1, the results of the textual analysis are illustrated in Figures 1, 2, where the similarities and the dendrogram of the cluster analysis are, respectively, depicted. The cooccurrences tree (Figure 1) clearly shows the expected link between “Biodistrict” (ITA: *Biodistretto*) and “organic” (*biologico*), showing three main interpretative tendencies: the food market [production (*produzione*) – consumption (*consumo*)-supply chain (*filiera*) associated with rural (*rurale*), agrifood (*agroalimentare*), quality (*qualità*) at SE]; the territory (*territorio*) community (*comunità*) combined with company-association-subject-to-involve (*azienda – associazione - soggetto coinvolgere* at SW); the peculiarity of the reticular structure [different-network-actor (*differente – rete - attore*) at East].

The dendrogram elicits a five-cluster solution with 65.5% of the textual segments correctly classified (see Figure 7), and it supports the initial descriptive explanations of the cooccurrences tree. Specifically, class 3, containing 21.8% of the segments, attributes to the organic

TABLE 3 Lexical statistics of the 1st round questions.

	Questions			
	Q1	Q4	Q5	Q7
Common descriptives				
Number of texts	28	28	28	28
Number of occurrences (O)	2,847	1,690	1,971	1,698
Number of forms (F)	860	611	721	596
Number of Hapax (H)	525	416	463	392
Occurrences mean (O/F)	3.31	2.77	2.73	2.85
Guiraud index (F/ \sqrt{O})	16.12	14.86	16.24	14.46
% Type/Token ratio (F/O)	30.21	36.15	36.58	35.10
% Type/Hapax ratio (H/O)	18.44	24.61	23.49	23.09
ALCESTE results				
Number of active forms (AF)	680	467	566	–
Number of AF with freq >3	119	63	82	–
Active occurrences mean (O/AF)	4.19	3.62	3.48	–
Active Guiraud index (AF/ \sqrt{O})	12.74	11.36	12.75	–
% Active type/Token ratio (AF/O)	30.21	27.63	28.72	–
Number of text segments	84	57	63	–
Number of clusters	5	4	4	–
% of classified text segments	65.48	57.89	58.73	–

Source: Authors' elaboration.

district a connotation explicitly linked to food production; here, the superior quality food (*qualità, agroalimentare*) would derive from the practices promoted by the biodistrict in its territory.

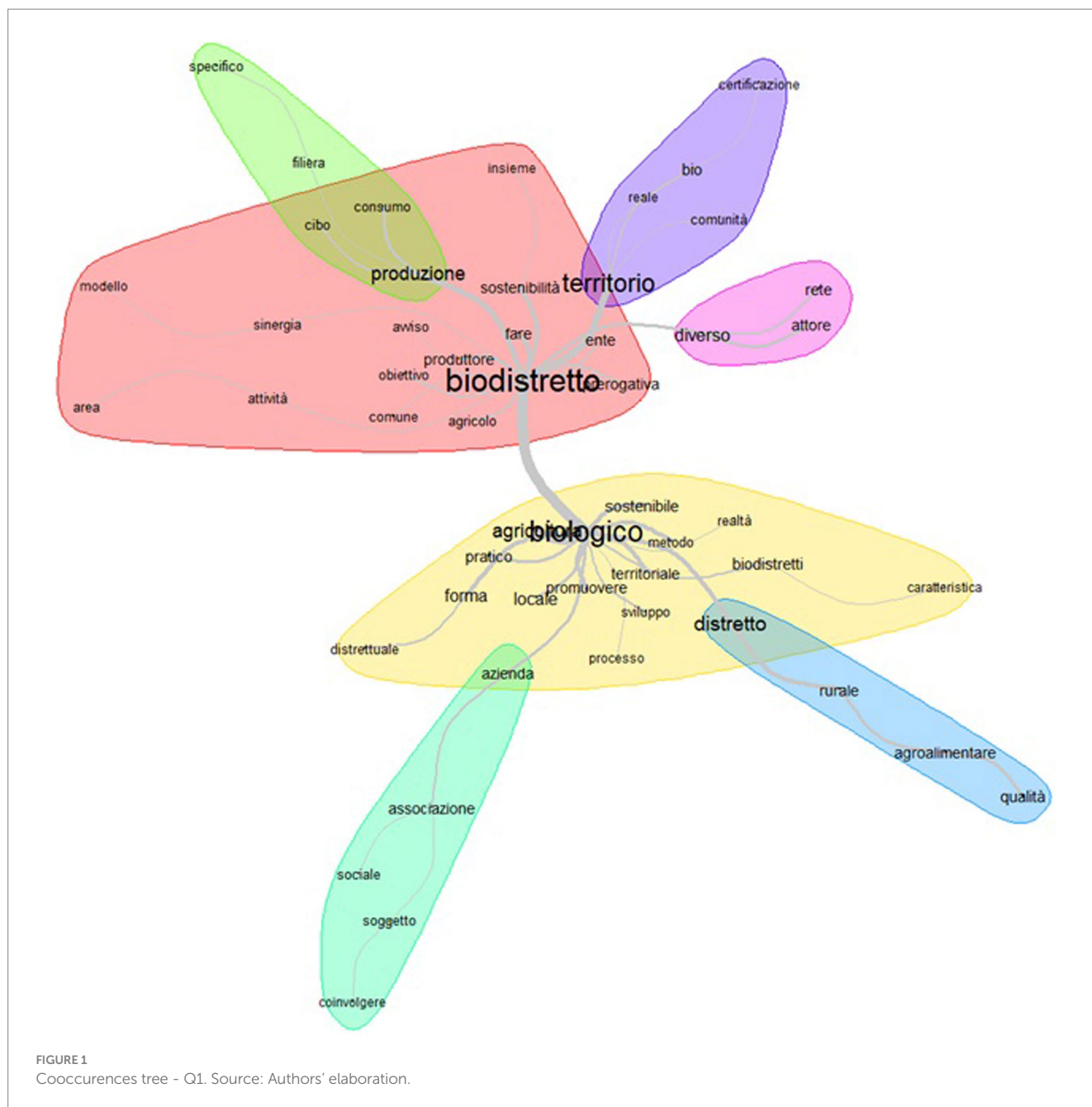
The first group of clusters (*classe 2 and 5 in Figure 2*), containing a total of 40% of the text segments, are very close to each other and describe biodistricts as institutions for local development (*sviluppo*) and sustainability (*sostenibilità*) and connect them to networking (*rete, relazione*), synergy and systems (*sinergia and sistema*). On the other hand, certification (*certificazione*) and “*bio*” (= Italian for organic) share the same node in the cluster (*classe 1 e 4*) as two undetachable concepts connected to the biodistrict and basis for their acknowledgment and associate the productive dimension of the organic district with the institutional (class 1–16.4% of the segments) and social (class 4–21.8% of the segments) ones. “*For biodistricts (or biological districts), the territorial transposition should be linked to the presence of organic farming. This aspect gives greater ‘scientific’ robustness to the actual existence of a district and limits the discretion with which an area can actually qualify as a biodistrict*” [AP1].

Q4 is one of the two questions where the shortness of the answers allowed for poor recurrence and linking of the words, so they are not statistically significant; therefore, the interpretative capacity of the cooccurrences tree is very limited (*Figure 3*). The experience gained by individual respondents certainly influenced their answers. These, therefore, have been clustered between those who believe that the crises have favored the development of the BDs through an expansion of the market and those who think the opposite (*Figure 4*). In the first case, two clusters highlight that development depends, respectively, on the higher quality of organic products [*classe 3* contains 30% of the words related to concepts such as organic (*biologico*), quality (*qualità*), trade (*commerciale*)] and on the ability of the BD to foster new relationships, cooperation,

networking, and supporting new commercial relationships [*classe 4: incontro, rete, and cooperazione*]. The difference between the two clusters (*classe 1 and 2*) relating to the responses of those less confident in the BDs' ability to develop in times of crisis is less incisive. The reasons cited by the respondents concern the isolation of farmers and the subsequent difficulty in cooperating, the economic losses suffered by farms in times of crisis, the lower political representation of small companies, the limited political weight of BDs, and the slackening to the processes of community involvement in the BD's activities. One respondent, however, is aware that BD could be the answer to the crisis itself.

Regarding question Q5 (*Figure 5*), the interviewees think that the innovation of the BD is, above all, inherent to governance. They perceive it as a tool capable of giving “*a new collective meaning to rural communities*” (EP1). So, the innovation brought about is organizational, as the BD can encourage cooperation between very different subjects for a newfound protagonism of the local communities who can autonomously decide the most suitable development trajectories: [“*The District is an endogenous development tool because it is the local actors themselves who decide the strategy to be pursued. The heterogeneity of the actors (producers, consumers, local authorities, technicians) guarantees synergistic and effective work from an integrated perspective*” [AP2]. This vision of the bio-district is captured by the cooccurrence tree and by the clusters.

As for the first, the word “innovative” [*innovative*] is strongly connected with local development concepts [Territory (*territorio*); cooperation (*cooperazione*) and development (*sviluppo*), for instance] at SE and with socio-economic sustainability at SW [Social (*sociale*), environmental (*ambientale*) cultural (*culturale*), model (*modello*)]; while Northern commonalities are split between quality and food-related concepts (*qualità, cibo*) and

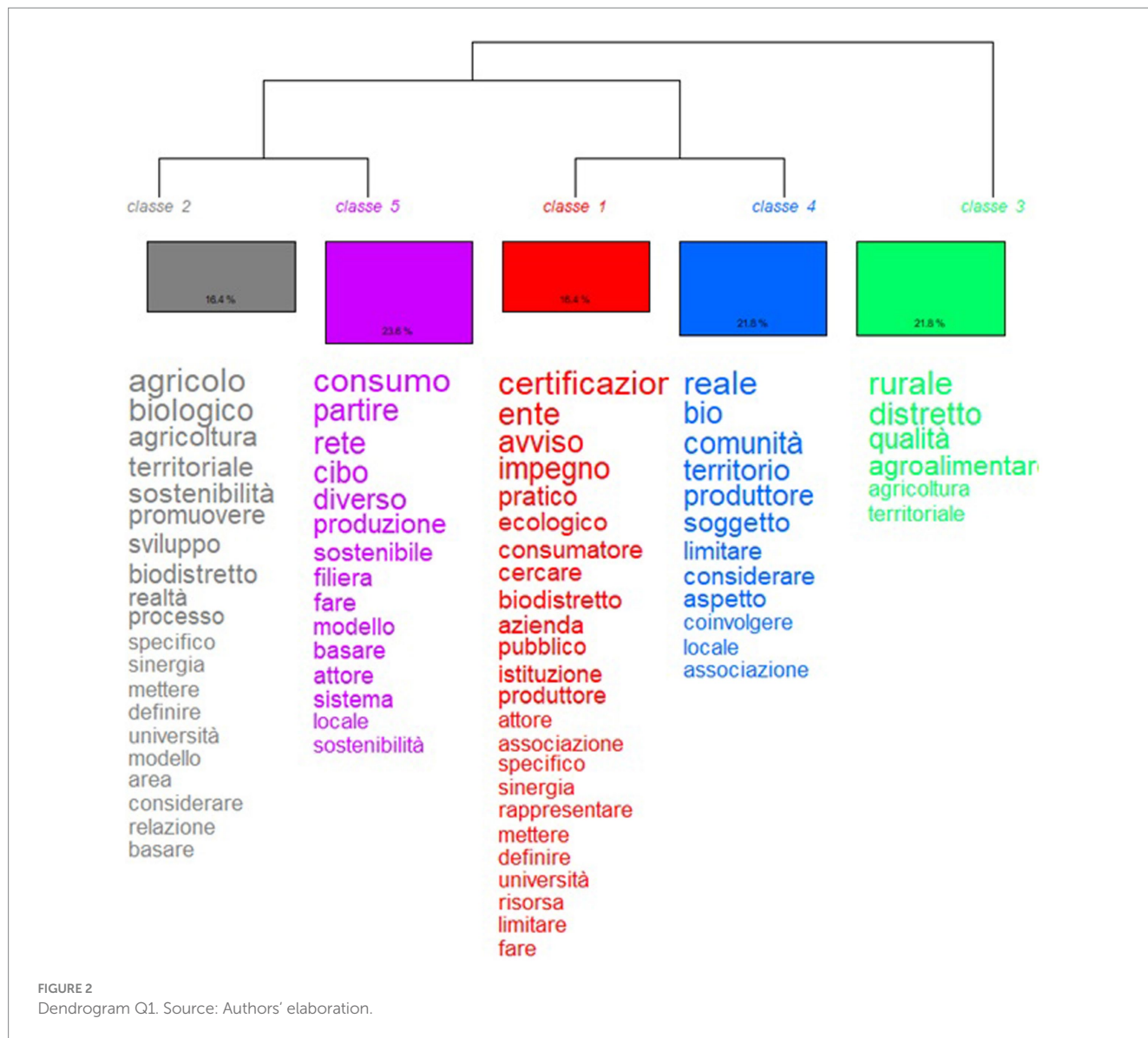


innovation (*innovazione*) for (*consentire*) local communities (*locale, comunità*).

Clusters 1, 2, and 3 (Figure 6), which together collect 72% of the occurrences analyzed, are grouped in a single node, which brings together the concepts of community (*comunità*), territory (*territorio*), and network (*rete*), as to describe the district as a container that brings together different experiences of organic and agroecological production and consumption present in an area.

The shortness of the answers to question Q7 did not allow the clustering of the lemmas. Nevertheless, the analysis of the cooccurrences (Figure 7) shows a direct and “thick” connection between BD, market (*mercato*), and local (*locale*) that summarizes the view of the respondents on the topic. The word local is connected with supply chain (*filiera*) related concepts [(e.g., quality (*qualità*); supply (*offerta*); platform (*piattaforma*); producers (*produttore*)], and its

commonalities are connected with the development of the territory (*sviluppo, territorio*), as to show that the local market and the viability of local supply chains are perceived within a perspective for local development. Participatory Guarantee Systems (PGS) and local brands are crucial in achieving such an objective. “Being certified with a local brand or with a PGS based on trust between producers and consumers, BD products are designed more for a local market. It is not just a matter of promoting the sale of products but of involving citizens within a project and an idea of sustainable territorial development with economic and social dimensions as well” [AP3]. Despite this strong focus on local, “maintaining openness to external markets and institutions outside the BD encourages the exchange of knowledge and awareness, also on the part of external actors, of the relevance of the biodistrict experience. In this context, sustainable tourism, presence in international organizations, visits, exchanges, and conferences present



an important element in consolidating the BD experience” [AP4]. On the other hand, the halo of commonalities around “BD” contains words such as consumers (*consumatore*), actors (*attore*), and tourism (*turismo*), and it is connected with “network” (*rete*) and “promotion” (*promozione*), so to state once again that the approach to the local market of the BDs should happen by involving consumers and integrating with other supply chains.

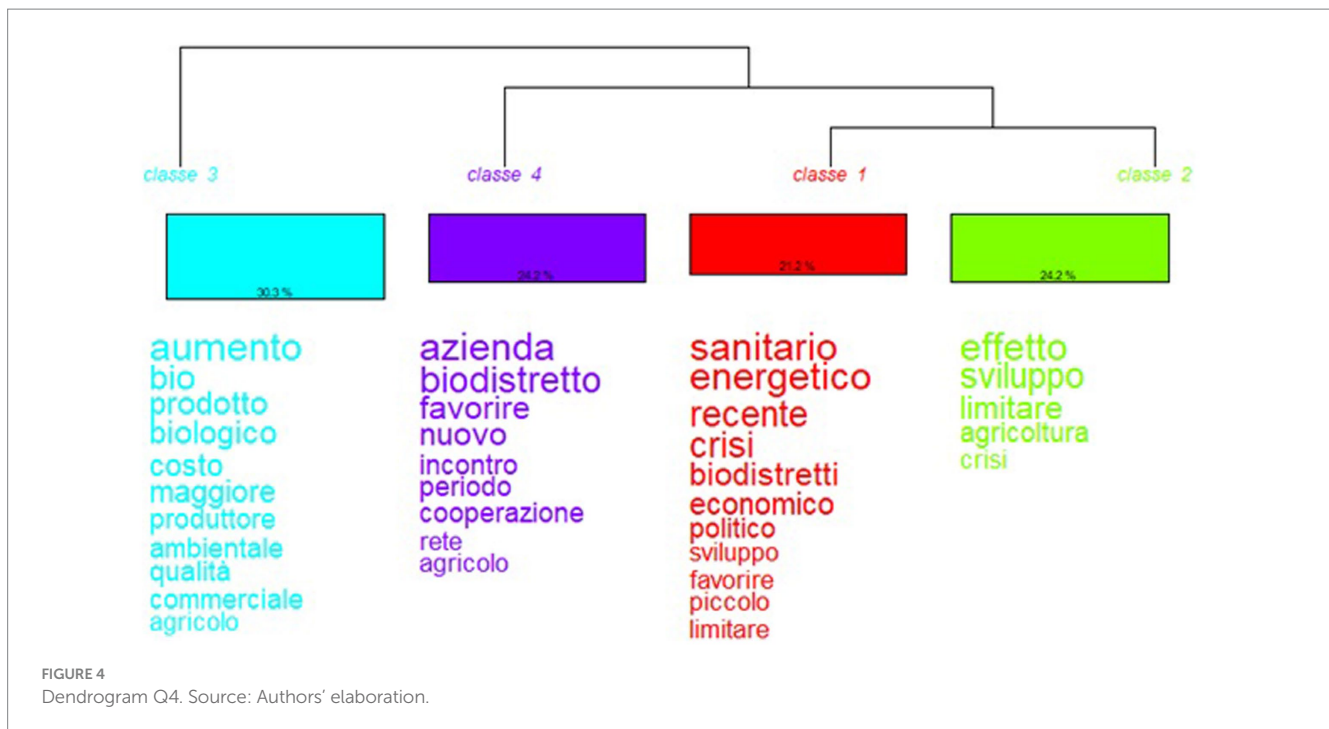
3.2 Second round

From the textual results on questions Q1, Q4, Q5, and Q7, the panelists gave rise to potential routes of consensus on the four asked topics. In this respect, close-ended questions were generated for the second round from each first-round question to better address the panelists and consolidate their opinions. Table 4 reports the percentage of respondents that granted a strong agreement to the questions (by summing 4 and 5 scores) and the statistics of centrality mode, median, and the interquartile range (IQR) to evaluate a

consensus across Delphi experts. According to Hsu and Sandford (2007), Keeney et al. (2006), Hasson et al. (2000), Green et al. (1999), and Tomam and Picioareanu (2016), a range between 70 and 80% of the percentage of agreement might be considered like a reasonable consensus with the further support of mode, median and IQR (Table 4).

According to Table 4 the questions that reached a good consensus were Q1.1, Q1.2, Q7.1, Q7.2, and D7.5, whereas Q1.3 got a partial consensus. The rest did not get sufficient agreement among the panelists and required attention to further re-wording and consideration for the third round.

Panelists agree that BDs are a tool for local development through participation and integration of economic activities, as shown by the large consensus in Q1.1 and Q1.2. However, “A paradigm shift requires resources, dedicated expertise, and incisive policies. At the moment, I do not see these characteristics in BDs, but they have a high potential for sustainability-oriented change” [AP5]. Statement Q1.3 has been much more debated: although for the majority of the respondents, BDs are well-defined entities with their own



According to the panelists, it is neither economic nor environmental/social, so it stands in between. As for the first, it is a consequence of the “*lack of a market-oriented approach in BDs*” [AP1].

Despite such pessimism, respondents clearly understand the role of the BD with respect to the market. It is widely accepted (Q7.1) that the BD cannot be an economic actor enmeshed in market relationships, but rather, it must act as a facilitator of market initiatives. Its function in involving consumers is fundamental (Q7.2). Anyway, its horizon is strictly local: “*I do not think a BD should set itself the goal of being an economic entity. It can perhaps facilitate some exchanges and collaborations (by means of a purchasing group, for instance), or it could have an “operational arm” (e.g., a logistics platform) with a separate management. But I do not think it is conceivable, and I do not see that this is its purpose, to insert itself into national or international supply chains that are increasingly managed by companies and very aggressive and penalizing dynamics, where a BD would only play the role of sending its producers to slaughter*” [EP3]. The geographical span of the supply chain for BD products is a debated issue (Q7.4). Although local markets are perceived as the most feasible method of guaranteeing the authenticity and consumer involvement, it is also acceptable that the broadening of the supply chain at the national or even international level could be an opportunity for growth since “*There’s nothing impeding that a BD that represents an important and ‘leading’ supply chain, can also expand market outlets for its members on a national scale or even international scale if it really has production volumes that allow it*” [EP3], even if market expansion is not a suitable choice for local development to most of the BDs, that gather small farmers devoted to multifunctionality, whose production is mostly sold through direct selling. A method of granting access to new markets to small farmers could also be propitiated by networking among BDs (Q7.3), a method for granting a widening of the outlets without losing contact with the territory and its values. Green public procurement (Q7.5) is a cornerstone of BD’s strategies, often adopted

in public canteens to valorize local production, hence the high consensus reached by this statement.

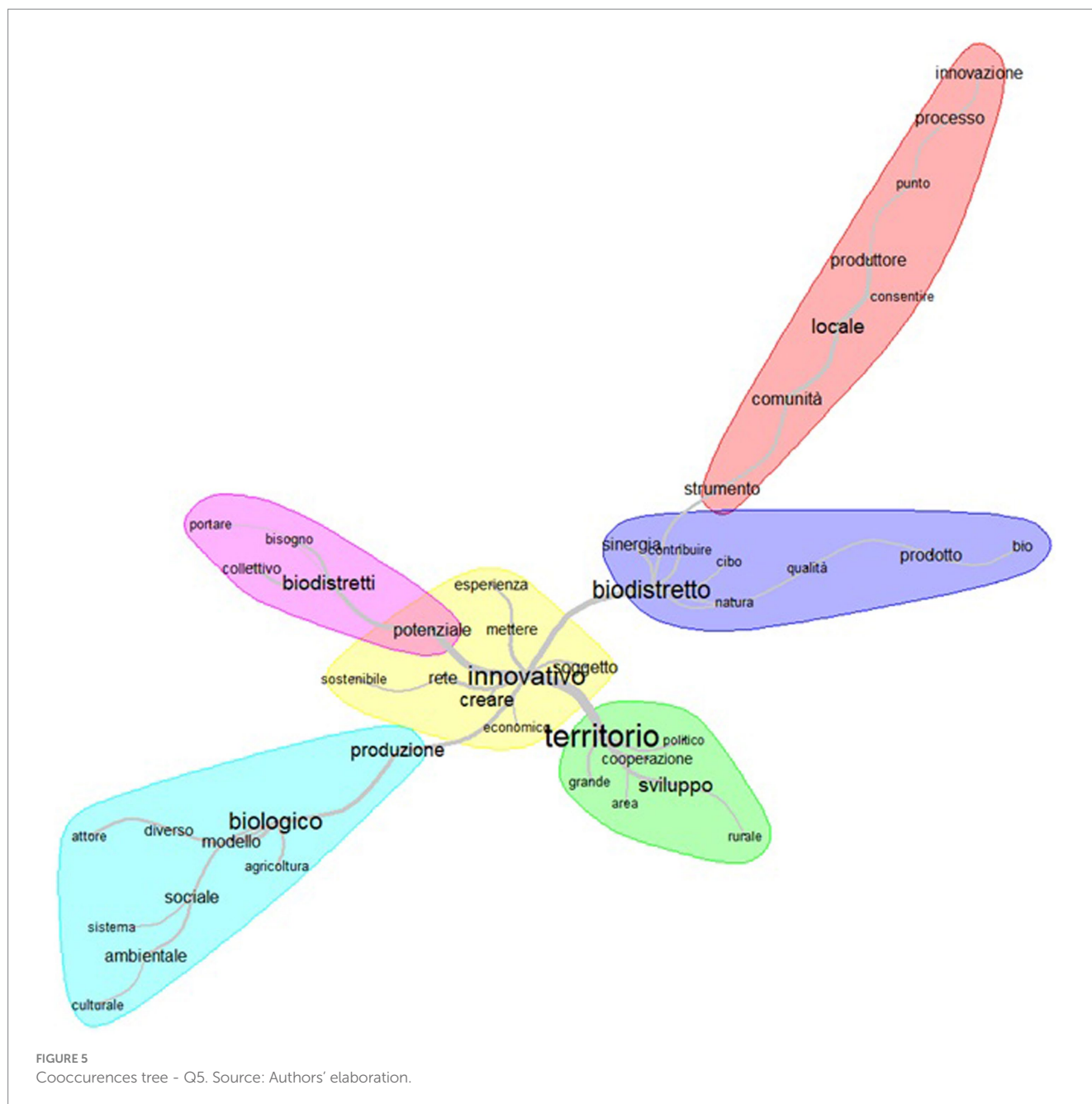
3.3 Third round

In the third round, the themes that did not find sufficient convergence in the previous round were resubmitted to the experts. In this case, we proceeded to reformulate the statements based on the reasons expressed in case of disagreement. In reformulating the statements, great care was also taken to avoid contradictions, integrating what the panel had already shared into them to avoid possible problematic retractions. In other words, the new statements accepted the elements of disagreement expressed by some experts by re-elaborating what had already been shared in the previous round. The points of disagreement recorded in the second round and relating to questions Q1, Q4, Q5, and Q7 were therefore reformulated into the five statements reported in Table 5.

A significant convergence was achieved for Q1.4, Q7.3, and Q7.4 (Table 5), while this did not happen for Q4.1 and Q5.1, which, compared to the others, were conditioned by specific experiences and some rather radical differences in approach.

From the results of the second round, it can be deduced that only some BDs have managed to take advantage of the crises that have occurred in the past few years. It must be considered, however, that most BDs are very young, so their ability to promote the match of local supply and demand and to support the reorganization of the former is yet to develop, although this appears to be an obligatory path if these crises show no sign of stopping hindering the trade of raw materials. Furthermore, consumers’ greater attention to healthier food products is counterbalanced by the contraction in their purchasing power (Grunert et al., 2023).

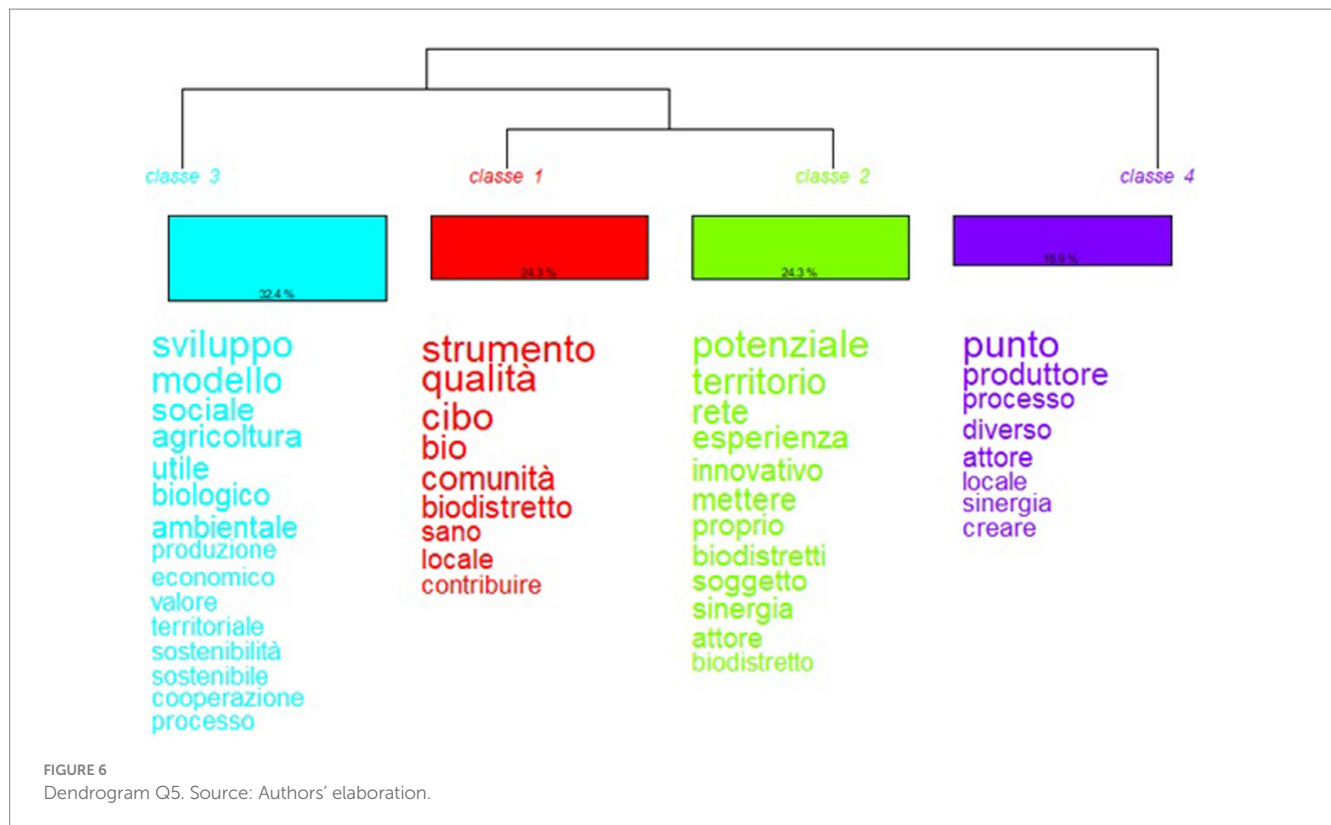
Specifically, no agreement was found on the lack of market orientation of the BD and its too ideological approach in dealing with



this issue (Q5.1), which was later partially denied by the agreement reached on Q7.3. BD has as its priority objective the development of small farms through the organization of supply and the promotion of activities aimed at structuring local supply chains, but it must also be able to reconcile the needs of larger ones, making its task more problematic (Guareschi et al., 2023). BD does not preclude from penetrating the national and international markets once local demand has been satisfied. The latter, however, could also be rather limited (scarce), given the recurrent lack of consumer awareness of the presence of a BD in their territory of residence and of its functions and organization. The process of involvement of the resident community by the BD in its activities and in promoting interaction between producers and consumers could also be very long, so the sale of local organic products on markets that transcend the local one could be functional to the development of the same BD.

4 Discussion

As observed earlier, the Delphi technique allows for an (almost completely) shared interpretation of complex phenomena still widely debated in the literature. Through indirect expert comparison, the technique progressively refines interpretations by integrating sensitivities and experiences according to each participant's profile and point of view. The result is the generation of new constructs, whose consideration is indispensable for further exploration of the theme. Such constructs show different visions around BDs that imply the need to tailor managerial tools and governance to encompass local specificities beyond law requirements. Moreover, they cast a light on the need for an M&E system tailored to development paths that very different conceptions of sustainability could have generated. Social innovation, for instance, needs to be considered (Packer and Zanasi,



2023). Besides, Delphi approaches have already been proven effective in tailoring evaluation needs to the specificities of local food systems (for instance, Rittirong et al., 2024; Allen et al., 2019).

The first issue analyzed by the study was the definition of BD itself, considering the ambiguities generated, especially in Italy, by the presence of similar experiences, such as rural districts. The Delphi revealed significantly divergent positions connected to the mere presence of a significant share of the organic area as opposed to the presence of practices of repurposing and re-socializing food (Marsden et al., 2000), which instead substantiate in Alternative Food Networks (Higgins et al., 2008; Bazzani and Canavari, 2013; Oñederra-Aramendi et al., 2023).

This latter representation has shaped the recognition of BD as an effective tool for local development based on sustainable agricultural practices and centered on the integration of economic activities (Lamine et al., 2023), even though certification and the definition of parametric constraints would differentiate it from similar initiatives. However, the use of PGSs could ensure the achievement or maintenance of such requirements, considering that, in many cases, especially for smaller farms, organic certification could prove costly or unprofitable despite complying with the constraints imposed by organic production regulations (Bellamy et al., 2023).

The study thus revealed a new complex vision of BDs by the panel. On the one hand, they are defined, from a “Marshallian” perspective, by parametric thresholds and, on the other, they differ from other district forms mainly for their nature as a tool for social innovation aimed at promoting agroecological approaches in geographical contexts whose boundaries are determined by the sharing of values and rules of behavior.

Regarding the potential resilience expressed by BDs, evaluated on their ability to benefit from recent economic and health crises, the

study provided rather contradictory responses, attributable to different perspectives, reflecting profoundly different structural conditions and methods of interpreting BDs' mission. More mature BDs appear to be capable of reacting to crises due both to more structured governance, which avoids the dispersion of local actor networks, and to the ability to intercept demand for quality food, which has increased because of the pandemic and a new awareness of the possible consequences of productive and globalist development.

On the other hand, crises have revealed an unexpected and intrinsic weakness of BDs, especially younger ones, resulting, for example, from the isolation suffered by agricultural businesses during the pandemic. It is because of the poorly structured networks that are based on merely declared cooperation rather than concrete forms of collaboration among farms. Before the crises, some of them had benefited opportunistically from the positive externalities (visibility, reputation, promotion of the territory) produced by the establishment of the BD. The absence of tools capable not only of valorizing the competitive advantage deriving from participation in the BD but also of preserving the same volume of exchanges as before the pandemic has led to situations of extreme distress in some BDs, especially for small farms, already with scarce political representation and limited capacity of influence. This situation sums up the paralysis of the process of involvement and active participation of various territorial actors, generating inevitable disenchantment toward BDs, which could prove fatal.

Following Porter (1998), such differences suggest the importance of strengthening the social capital in BDs, lacking the support of relationships, networks, and a sense of common interest needed to foster a competitive advantage (Viganò and Sturla, 2013). The experience of more mature and successful BDs shows a potential capability to overcome crises much better than individual farms,

TABLE 4 Q1-Q4-Q5-Q7: second round statistics.

Items	% of agreement	Mode	Median	IQR
Q1—Definition				
1. BDs can promote agroecological or organic practices beyond EU certification, also involving actors other than farmers or organic operators (consumers, institutions, green and social associations, ...) in a limited geographical area, defined on the basis of shared values and a sense of belonging (identity)].	94%	5	5	0
2. BDs can foster a paradigm shift in agrifood production, including forms of tourism diversification and social inclusion, which activate regenerative processes in rural territories	83%	5	4.5	1
3. BDs are less ambiguous entities than the other district forms, less sectoralist, and more inclusive, founded on the search for a harmonious relationship with the territory through organic farming. Their promoters are more motivated	78%	4	4	1
4. BDs must be defined on the basis of thresholds linked to organic supply chains: surface area, number of producers and operators, quantity and type of products produced, etc.	39%	3	3	2
Q 4—Resilience				
1. The recent crises have favored BDs because they have stimulated the reflexive process of citizens, increasing awareness of the social utility of organic production, which is verified through the finding of an efficient system that is naturally willing to reconnect consumption and production	59%	4	4	1.75
2. The recent crises have limited the development of BDs because they have mainly affected the BDs base, which is predominantly made up of small companies, disrupting the internal debate, as well as the organizational process, which needs significant further refinement	41%	3	3	1
Q5—Innovation				
1. The innovative potential of BDs is economic in nature and lies in their ability to promote the diversification of local economies centered on (healthy and quality) food and tourism	39%	5	4	1.75
2. The innovative potential of BDs is of a socio-ecological nature and is underpinned by the widening of networks and thickening of local social relations that have increased awareness of the usefulness of organic production...	33%	4	4	1
Q7—Market and supply chains				
1. BDs must create the basis for market and supply chain development, acting not as economic actors but as promoters of different types of initiatives, mainly related to the aggregation of supply and marketing	72%	5	4.5	1
2. BDs should promote consumers' involvement through education/information on the values of organic/local agriculture, stimulating demand aggregation in purchasing groups or CSA and establishing a direct relationship with metropolitan areas	100%	4	4.5	1
3. BDs should establish forms of cooperation with other BDs or institutions for the purpose of national and international market expansion	67%	5	4	2
4. The strictly local scale of the BD market is the fundamental prerequisite for ensuring the authenticity of their offer...	50%	3	3.5	2
5. On the demand side, BDs should stimulate green public procurement practices related to public catering, enhancing the plurality of goods and services offered	83%	5	4.5	1

Source: Authors' elaboration.

agroecology, which allows them to generate new territorial capital (De Rubertis et al., 2019) through processes of social innovation (Neumeier, 2012, 2017; Labianca et al., 2020) rather than simply leveraging BD potential as a competitive advantage. The farms involved in BDs prioritize implicit costs—those linked to the endogenous factors of local businesses—over explicit or market-driven costs. This approach allows for greater remuneration of territorial resources and retains a significant portion of wealth within the local area, thereby reducing the value dispersion typically observed in extractive agribusiness models (Veltmeyer and Ezquerro-Cañete, 2023).

The focus is, therefore, on the know-how of local farmers and other social actors involved in the BD, who have preserved traditional practices and, in doing so, have safeguarded the valuable tacit knowledge of their communities, which remains unaffected by the technocratic paradigm of the Green Revolution. This cultural knowledge forms the essential foundation for introducing organizational (governance) innovations based on networks with hierarchical control (Cumming, 2016). These innovations are better suited to the environmental conditions and productive scales of farms and businesses within BDs, thereby fostering the sustainable development of the regions they inhabit.

TABLE 5 Q1-Q4-Q5-Q7: third round statistics.

Items	Percentage of agreement	Mode	Median	IQR
Q1—Definition				
4. BDs should be defined by thresholds related to organic supply: area, number of producers and operators, quantity, and type of products produced. However, there would also be a need for an acknowledgment of the presence of small-scale organic farms with a strong agroecological footprint, certified under PGS	93%	4	4	1
Q4—Resilience				
1. Recent crises have improved consumer perceptions of organic production and thus favored BDs while threatening their underlying economic sustainability and limiting their necessary organizational refinement	57%	4	4	1
Q5—Innovation				
1. The innovative potential in the economic field of some BDs, although correctly oriented toward diversification of local economies centered on food (healthy and quality) and tourism, suffers from the lack of a market-oriented attitude and the overly ideological approach that excludes rather than includes	64%	4	4	1
Q7—Market and Supply chains				
3. Given that BDs must primarily meet local demand, participation in national and international networks to expand market opportunities is desirable.	79%	5	4	1
4. The strictly local scale of the BDs' market, by virtue of a social control provided by BDs themselves, is the basic prerequisite for ensuring the authenticity of its supply	93%	4	4	0.75

Source: Authors' elaboration.

The recovery and valorization of local knowledge imply an economic potential also linked to the diversification of rural economies, offering new interpretative keys to the innovative potential of BDs based on the valorization of food and its supply associated with the integrated development of experiential rural tourism (Saxena et al., 2007), which, although capable of increasing the profitability of agricultural businesses (Hernández-Mogollón et al., 2011), could conceal potential threats to the ecological and cultural integrity of places (Lane, 2009; Belliggiano et al., 2020). The innovative potential should, therefore, be attributed to the BD's ability to combine food and tourism by promoting alternative food markets (De Rubertis and Belliggiano, 2024), whose quality evaluation metrics are expressed by the extent of consumer involvement (Ventura et al., 2016), as well as by the symbolic and political value of production and consumption choices (Renting et al., 2012; Bindi and Belliggiano, 2023).

The study has revealed a point of disagreement regarding the opportunity for market expansion beyond the BD territory, which, according to some panelists, would reduce it to a mere market player, compromising its mission and, even worse, threatening the authenticity of the supply due to the inexorable adaptive behaviors of such a position (De Rubertis and Belliggiano, 2024). The market expansion also appears unsuitable for small-scale, multifunctional farms, leading to the consideration of a local market founded exclusively on face-to-face relationships as ideal (Marsden et al., 2000).

However, the agreement reached in the third round of the study implies openness to other forms of reconnection with the consumer, admitting progressively increasing distances from them and attributable to models that Renting et al. (2003) call "proximate" and "extended" short supply chains. These are modes whereby the impact of market expansion on the BD remains rather mild, avoiding interference with its identity and development trajectories that had

generated doubts and distrust toward more conventional agrifood markets.

The first model (proximate) is based on organizing cooperation among producers, aimed at mutually expanding the supply with goods that they do not directly produce but are supplied by other participating farms in the BD, consistent with the network and cooperative model implicit in its mission. This mode of market expansion, by facilitating the promotion of ecological and social values of BDs, would increase the perception of the superior quality of their productions, enhancing their commercial valorization.

The extended model should be considered exclusively in the "absolutely short" mode (De Rubertis and Belliggiano, 2024). While increasing the distance between producer and consumer may not inherently compromise the direct relationship characteristic of short supply chains, the risk of adaptive strategies or policies—especially over very long distances—cannot be dismissed. Such risks could potentially and irreversibly damage the image and value of the BD. In this model, market expansion occurs indirectly through visits to the BD, thereby favoring those with a greater propensity for tourism. This expansion then develops and solidifies over time, even at greater distances, by fostering trust and reputational mechanisms with communities and local businesses.

Several recommendations emerged from the study, addressing various aspects of BDs. The first recommendation highlights the importance of enhancing communication about the uniqueness and prerogatives of BDs, as well as increasing consumer awareness of the environmental and social quality of their products. The second recommendation emphasizes the need for supporting the integration of food and tourism within BDs. This integration is considered a

strategy to boost the resilience of the most fragile rural areas and to reconnect these areas to the market. The third recommendation focuses on promoting BDs within the context of hybrid markets, which, as Milone and Ventura (2024) suggest, can foster new forms of proximity based on reciprocity and reputation.

Although the study has highlighted the role of BDs in rural development processes (including their resilience capacity) and the complexity of their mission (balancing innovation and market dynamics), it also shows some limitations that future research must address. While the study reveals significant differences among the BDs investigated, the methodological approach does not allow for an exhaustive exploration of these points of disagreement, nor does it fully investigate the nuances that emerged in some of the collected opinions.

Future research should, therefore, focus on systematizing these diverse approaches to optimize common and scalable intervention strategies within the broader EU policy frameworks for each category of BD. However, this does not preclude the possibility of tailoring development strategies to the specific contexts in which individual BDs operate, considering their unique characteristics, knowledge, and perspectives.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Author contributions

AS: Investigation, Methodology, Writing – original draft, Writing – review & editing. LV: Investigation, Methodology, Writing – original draft, Writing – review & editing. MV: Formal analysis, Investigation,

Methodology, Writing – original draft. AB: Conceptualization, Investigation, Methodology, Writing – original draft.

Funding

The author(s) declare that financial support was received for the research, authorship, and/or publication of this article. This study has been carried out within the WP4 “The Bio-district as a policy model for sustainable development” of Project fiche 5.2 “Actions for Organic Agriculture” of the CREA National Rural Network 2014–2020 Project.

Acknowledgments

The authors wish to thank all the experts who have contributed to the three rounds of the Delphi Survey, as well as the referees, for their valuable suggestions.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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