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Comparing social sustainability assessment indicators and tools for bio-districts: building an analytical framework

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Bio-districts are a practical example of a sustainable food system, which uses agroecological principles as tools for rural development. This research aims to understand the role of bio-districts in sustainable development, particularly in relation to social impacts. It does so by developing a framework for assessing social impacts in the context of alternative food systems. To this end, a two-step methodology is adopted. In the first part, a systematic literature review is carried out according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) protocol. It presents the state of the art in social impact assessment of bio-districts, identifying the approaches and indicators used to assess social standards, codes of good practice and, more generally, the factors influencing social sustainability in rural areas. In addition, a set of social themes is developed and validated through a content analysis to uncover the trends in the debate on social sustainability in bio-districts. In the second part, promising analytical frameworks and tools from the literature are compared on the basis of how deeply they assess social issues related to bio-districts. Finally, a description of the main steps that should be taken to adapt existing tools and frameworks to the local context is presented. A detailed framework specifically addressing the social impacts of bio-districts was not found in the literature. IDEA, MOTIFS, PG tools, RISE, SAFA guidelines, SOAAN guidelines and S-LCA are considered a suitable starting point for the bio-districts' analysis, although tailored adjustments are required.

KEYWORDS

agroecology, alternative food system, analytical framework, bio-district, indicator assessment, organic agriculture, rural development, social sustainability

1 Introduction

Interest in analyzing global food systems has generally been driven by concerns ranging from the environment, equity, power, and trade to nutrition and health issues (Béné et al., 2019). Responsibility has been addressed to some structural aspects that directly shape human well-being (Lombardi et al., 2019) and account for a vast proportion of the human-nature impacts. Of the 3.4 billion people living in rural areas (UNDESA, 2021), the vast majority still depend on agriculture and food systems for their livelihoods (Woodhill et al., 2022). This makes them vulnerable to any form of shock to food and economic systems, as most rural people live in poor and vulnerable contexts, especially in low and middle-income countries (Tendall et al., 2015). For example, Guatemalan farmers, which live of subsistence and commercial food production, struggled to cope with the commercial restrictions during the COVID-19 pandemic as loss of

off-farm employment and lack of access to agricultural inputs were a threat to their livelihood (Rice et al., 2023). In addition, awareness of the conditions under which food is produced is often missing, leading to human rights violations (Farnsworth et al., 2018), with many agricultural commodity supply chains characterized by inadequate working conditions, overlooked land rights and gender inequality (UNDESA, 2021). Only after the shocks caused by increasing economic and political instability, has the critical importance of food workers and their value to society been recognized, which contrasts sharply with the typically hidden nature of such labor (Klassen et al., 2023).

Therefore, the concept of food and agricultural system transformation has attracted the attention of many scholars, practitioners, and policy makers. The body of research on the subject of 'sustainability transitions' has emerged, providing valuable insights into how societies can achieve deep systemic transformations. On the one hand, large scale interventions, expert- or corporate-led initiatives and innovative technologies have been identified as a viable solution (National Academies of Sciences, Engineering and Medicine, 2019), as opposed to alternative models that rely on small-scale changes, bottom-up approaches, and civil society-led processes of self-organization (Anderson et al., 2019).

As an alternative, agroecology has gained prominence, proposing different solutions for managing agricultural and food systems. In recent years, a plethora of different definitions of agroecology have been provided, following the different agendas of different institutions and countries (Wezel et al., 2020). However, there is a common agreement on the transdisciplinary nature of agroecology, which, unlike other approaches, promotes linkages across sectors and organizations of different sizes to address complex sustainability challenges (Pigford et al., 2018). In particular, agroecology can be divided into three domains: scientific discipline, set of agricultural practices, and social movement (Francis et al., 2003; van der Ploeg et al., 2019). The latter calls for socio-economic structural reforms to the agroecosystems, to support the economic viability of rural areas (de Molina, 2013). Key features include the promotion of smallholders and family farming production, involving farmers and rural indigenous populations, support for food sovereignty, social equity, local knowledge and traditions, and to indigenous access to basic inputs such as land, water and seeds (Altieri and Toledo, 2011; Wezel et al., 2020).

A concrete example of agroecological principles applied to food systems is represented by the bio-districts (also known as "ecoregions" or "organic regions")[1] shown in Figure 1. Described as a form of rural governance model with a bottom-up trajectory (Assiri et al., 2021), they aim do develop the economic and socio-cultural potential of the territory in which they are rooted through the involvement of farmers, the public, tourism operators, associations, and public authorities. The word "bio" relates to the widespread adoption of organic principles[2] and practices in the local production systems, while "district" relates to the high concentration of small and medium size businesses with a high level of specialization in agricultural and rural services (Guareschi et al., 2020).

A bio-district can therefore be considered as an alternative food system (AFS), having its alterity based both on the kind of products offered and on the different distribution system. However, as argued by Scrinis (2016), the current interest of the largest food and beverage manufacturing companies in alternative food highlights makes it difficult to classify a system as alternative based only on its products or distribution system. Indeed, the whole supply chain of bio-districts deals with organic or high-quality products. These products are produced locally, and can be identified by regional labels, for example, protected designation of origin labels, embracing the concept of location or territorialization, which implies that most of the production, processing, distribution and consumption processes are hosted in a specific geographically limited area (González De Molina and Lopez-Garcia, 2021). For what regards the second aspect, bio-districts apply a distribution system model linked to alternative food networks (AFNs). This definition covers networks of producers, consumers, and other actors, which incorporate alternative solutions to more standardized industrial food supply chains (Murdoch et al., 2000). All of them share a common set of values in terms of greater environmental sustainability, as well as social, political and economic justice along the food supply chain (Mier y Terán Giménez Cacho et al., 2018). Wholesalers and retailers play a subordinate role, as the objective is to directly connect producers to the customers. The use of diversified distribution channels linked to short supply chains are predominant (van der Ploeg et al., 2019), with established models such as local markets, local production-consumption cycles, and farmer-to-farmer networks (Altieri and Toledo, 2011; Jarzębowski et al., 2020).

However, to recognize the diversity of the system proposed by bio-districts it is worth highlighting not only the kind of product and the distribution system, but also a third pillar that includes the type of economic models and practices. This third pillar, as codified by Rosol (2020), encompasses clustering practices that extend beyond economic profitability to create new social and economic realities. It introduces "the plethora of hidden and alternative economic activities that contribute to social well-being and environmental regeneration" (Gibson-Graham, 2008). Indeed, different authors point out that bio-districts are an example of territorial transition toward agroecology, including issues related to food and nutrition safety and security, conservation of natural resources, landscape, and protection of rural populations (Wezel et al., 2018; Dias et al., 2021; Gargano et al., 2021). Moreover, the networking structure of the bio-district includes areas of activity related to research, training, the design of territorial development plans, financial support, and coordination efforts with governmental bodies (Zanasi et al., 2020), thus contributing to the shaping of the overall quality of life in rural communities[3] (Guareschi et al., 2020). More practically speaking,

1 In this paper, the expression bio-district is used as it univocally describes the integrated territorial and rural development strategy and it has been adopted by the European Commission in the Action Plan for the Development of Organic Production (European Commission, 2021); while the term ecoregion can be used to describe geospatial areas with specific patterns of environmental and ecological variables (Abell et al., 2008).

2 The adoption of "bio" as a prefix derives from an abbreviation of the Italian expression *biologico/biologica* applied to organic agriculture and food.

3 This is in line also with the definition given by the International Network for Eco-Regions (IN.N.E.R.) at https://www.ecoregion.info

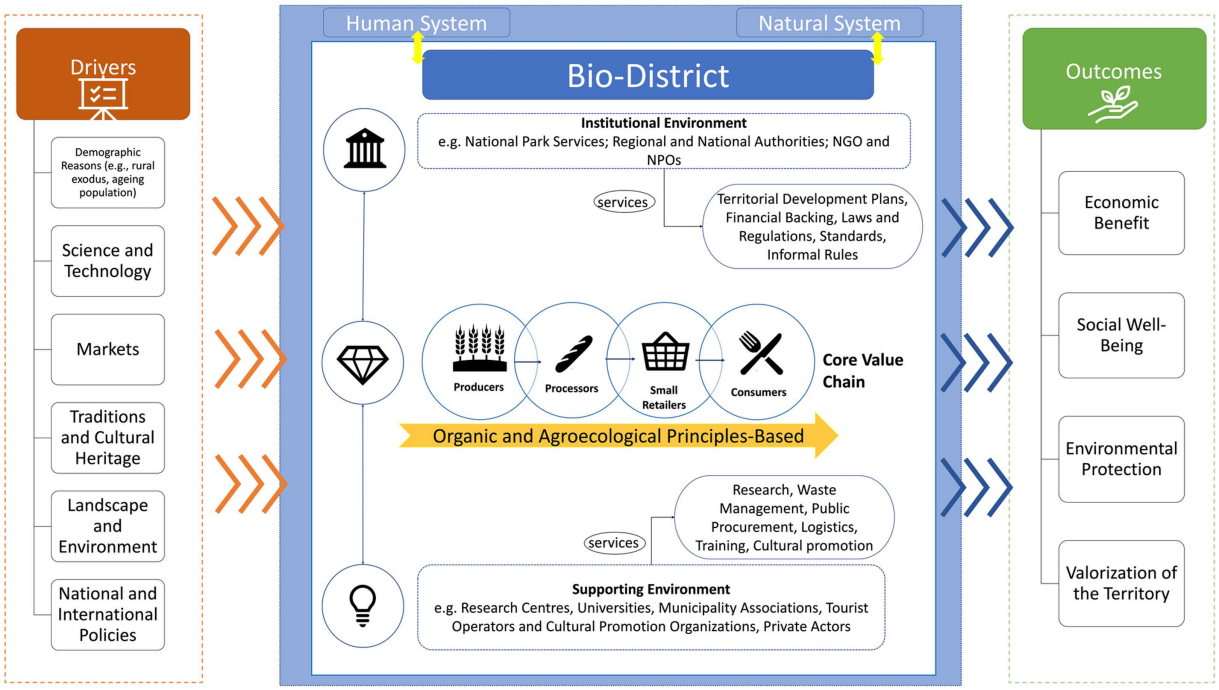

FIGURE 1
Conceptual model of a bio-district. Adapted from Woodhill et al. (2022).

examples of alternative economies and practices may include other forms of economic transactions (e.g., donation, production for self-consumption), working practices (e.g., unpaid work of members, equal pay for all employees), forms of economic organization (e.g., cooperatives, collectives), and forms of financing (e.g., member loans, cooperative shares, and crowdfunding; Rosol, 2020).

Therefore, all of these elements contribute to the concept that local production and distribution of organic food is a model of sustainable consumption for various economic, social and environmental reasons (Kamau et al., 2018). However, assessing the role of the bio-district in promoting well-being can be challenging, partly because organic certification does not focus on social and ethical values (Padel et al., 2009). Figure 2 shows that the Regulation (EU) 2018/848 sets out the principles of organic production, leaving issues related to gender, human, and labor rights, for example, outside its scope. As a consequence of the increasing "conventionalisation" of organic farming, the focus can shift further away from social issues and more toward intensive and industrialized models (Reed, 2005). Voluntary certification schemes are an option to address a range of sustainability issues, including social aspects, but the feasibility of equivalence between countries and control procedures is still not well-established (Cavallet et al., 2018). Moreover, the current literature on sustainable food systems focuses more on economic and environmental sustainability, with less attention paid to social aspects (Eizenberg and Jabareen, 2017). The reason lies in the fact that many and varied contributions of social scientists led to a degree of conceptual chaos, which has compromised the usefulness of the term (Vallance et al., 2011). According to some authors, it remains unclear what "social matters" really means (Littig and Griessler, 2005), highlighting the difficulty of determining which impacts should be evaluated and how to quantify them (Beske-Janssen et al., 2015). It has been argued that social sustainability is not a constant or absolute concept, but it is dynamic and changes over time (Dempsey et al., 2011). This volatility has been considered by some authors as a weakness, as the social issues addressed need to be constantly updated (Boström, 2012).

An exhaustive description and/or quantification of the social impacts of different territorial governance models is therefore still lacking. This is despite growing pressure from governments, customers, NGOs, and stakeholders to include social issues in the analysis of territorial and supply chain sustainability (Mani et al., 2016). Social sustainability is a key element in the assessment of sustainable food supply chains and food systems in general; identifying a system as "alternative" only for its links with quality labels can be misleading (Adams et al., 2021; González De Molina and Lopez-Garcia, 2021). Moreover, social outcomes are part of the strategic plan of the bio-district, a necessary step required by INNER[4] and some national legislations when starting a new bio-district (Italian Ministry of Agricultural, Food and Forestry Policies, 2022).

Following these considerations, the present study aims to contribute to the evaluation of the social impact of bio-districts. To achieve this objective, an analytical framework will be defined to guide the selection of the most appropriate approaches and indicators.

The following research questions were defined:

1. What are the main social sustainability issues addressed by bio-districts?

4 *Cf.* https://biodistretto.net/wp-content/uploads/2016/11/disciplinare_INNER_IT.pdf

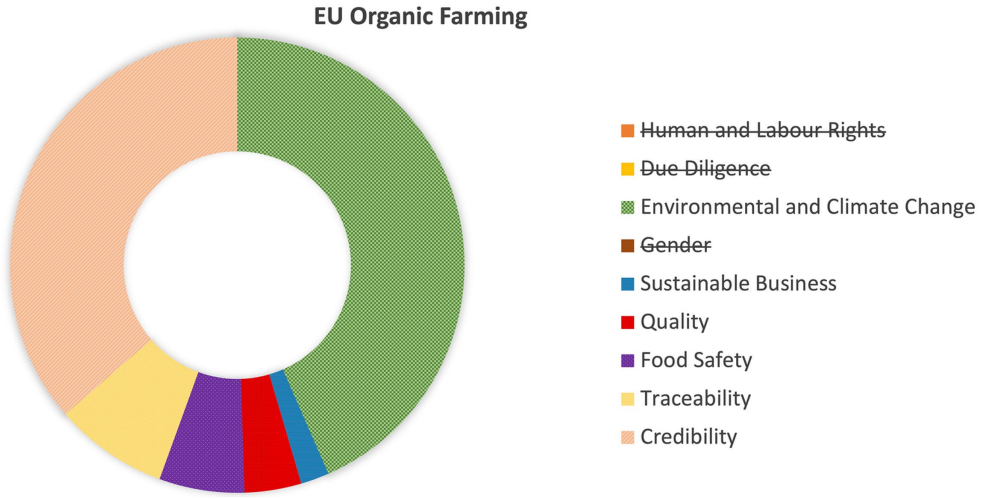

FIGURE 2
Main sustainability topics covered by the EU organic label. The deleted topics, which are directly related to social issues, are not addressed by the label. Source: ITC Standards Map (https://www.standardsmap.org/en/identify?name=EU%20%20Organic%20Farming).

2. What are the main categories of social indicators used to analyze the social impact of bio-districts?
3. How can existing tools and frameworks be applied to the social impact analysis of bio-districts?
4. Can social sustainability be assessed in different bio-district contexts?

Based on the research questions, this paper will provide a comprehensive overview of the main social topics addressed by bio-districts and of the indicators fitting their different characteristics. The focus will be on the role that bio-districts play in promoting social sustainability for small-scale farmers, the whole rural community, and the other relevant external stakeholders.

The paper is structured as follows: in the first part a systematic review of the literature on all the social issues that characterize bio-districts and on the different methodologies for assessing social sustainability will be carried out; in the second part, indicators, analytical frameworks, and social sustainability assessment tools will be selected and compared to build an analytical framework for assessing the social impacts of bio-districts.

2 Methods

2.1 Systematic literature review

The literature review was carried out according to the guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) protocol (Moher et al., 2009; Page et al., 2021). The PRISMA statement was chosen because it provides a set of recommendations designed primarily to support transparent and complete reporting of systematic reviews (Sarkis-Onofre et al., 2021). Sources of data included academic research documents, journal articles, proceedings, government and international agency studies, reports, working papers, and other gray literature sources, published in English, following a three-step research path as illustrated in Figure 3.

The first step included the identification of relevant peer-reviewed scientific literature. The search was conducted between February and September, 2022 in the web platforms and databases "Scopus" and "Web of Science." Different combinations of keywords were applied, such as "bio district*," "eco region*," "organic district*," "measurement," "assessment," "analysis," linked with Boolean operators "AND" and "OR." 670 records were identified from the databases and 234 remained after removing duplicate citations. In order to reduce the large number of documents and retain only the relevant ones, the studies were then screened by evaluating the abstracts according to the inclusion and exclusion criteria described in Table 1. The search was restricted to publications in English and to publications from 2005 onwards. Particular attention was paid to the definition of bio-districts, as some authors use the term eco-regions, which can be confused with ecological regions, which are described as areas of relative homogeneity in ecosystems (Omernik and Bailey, 1997). Full texts of potentially eligible documents that met the inclusion criteria were then retrieved and assessed for inclusion. By implementing a snowballing technique, 16 additional relevant studies were identified and included based on reference lists of the included documents and suggestions from website platforms such as Google Scholar. The result was that 24 documents were included in the literature review and the majority came from the snowballing technique. Eventually, the documents have been categorized based on their country, impact assessment, suggested social indicator(s) and whether or not social impacts were assessed.

2.2 Identification of social indicators

At present, the social dimension covers a plurality of fields, considers different levels of analysis and multiple approaches. Therefore, there is no consensus on a standardized approach to assessing the social impacts at different scales (Heinzle et al., 2006). Some have attempted to operationalize social sustainability through quantitative indicators (Hutchins and Sutherland, 2008; Popovic et al., 2018). However, an exclusively quantitative approach to social impact assessment is

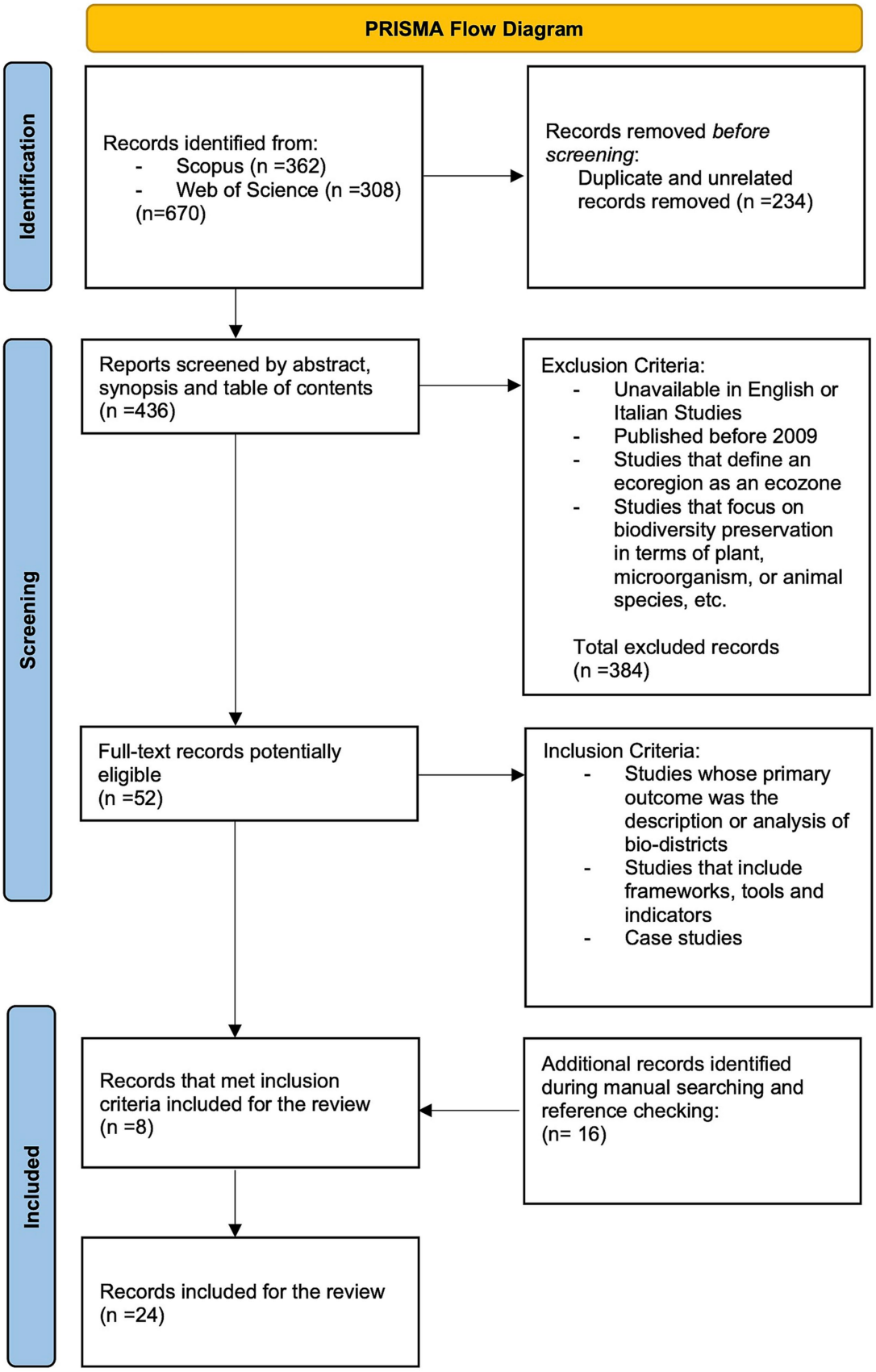

FIGURE 3
Three-phase systematic review process illustrating the number of records identified (*n*), screened and included in the final synthesis.

TABLE 1 Eligibility criteria for the systematic review.

Inclusion criteria	Exclusion criteria
- English documents - Studies published from 2005 - Studies whose primary outcome is the description or analysis of bio-districts, taking as a reference for bio-district the definition given in the EU organic action plan - Studies that include frameworks, tools, indicators, or other assessment approaches	- Non-English documents - Studies published before 2005 - Documents that refer to bio-districts in different meanings than the one of the organic action plan - Studies that describe ecozones (ecological zones) - Studies that focus on biodiversity preservation in terms of plants, microorganisms or animal species

frequently criticized. For example, *life quality* or *impact on the society,* are themes whose standards are commonly defined through threshold values, depending on socio-cultural and subjective factors (Janker and Mann, 2020). This has led researchers to drop social topics from many sustainability evaluation studies. Furthermore, the different indicators adopted in various social sustainability impact assessments of agri-food systems vary along with the goal and scale of the study. For example, Gosetti (2017) developed a social sustainability approach at farm and business level based on *quality of working life,* including those aspects linked to good working conditions. Singh and Hiremath (2010) considered only one social indicator (social equity index) at the regional/district level, defined by variables such as distribution of land, assets and income, people above poverty line and female literacy. On the other hand, some authors adopted a more systematic approach to identify the social impacts by using multiple indicators. Haryati et al. (2022) analyzed the crude palm oil supply chain through the social life cycle assessment (S-LCA), including different social aspects such as *Freedom of association and collective bargaining, Child labor, Forced labor, Fair salary, Working hours, Equal opportunities/ discrimination, Health and safety,* and *Social benefits/social security*.

The objective of this stage was to identify the presence of social sustainability impact indicators within the existing literature on bio-districts. These findings could be useful to uncover the depth of analysis on social topics in the literature. Highlighting the implementation of different types of indicators, could influence the efforts to address the social dimension of sustainability with more detail. During this step, pertinent empirical data were gathered from the previously identified documents, to assess the current state of research in this area. All types of indicators were included, qualitative, quantitative, and mixed approaches were equally considered. To avoid inclusion of unrelated indicators, further screening was carried out and some indicators were excluded based on the following criteria:

- Indicators that address issues related to different sustainability dimensions than social sustainability.
- Indicators that do not include at least one of the content and context information related to stakeholders, impact category, data type, or supply chain stage.

2.3 Content analysis

The aim of this step is to identify different social sustainability issues and to examine the extent to which the existing literature on bio-districts addresses them. To this end, content analysis was used to identify whether some social issues are under- or over-represented in the current narrative on bio-districts. It was used as a research technique because it is objective, systematic and generalizable to measure variables (Kerlinger, 1986). Moreover, "it goes beyond the impressionistic observations about the phenomena and can help you make a quantitative expression about the phenomenon" (Prasad, 2008). This quantitative expression was pursued by considering the occurrence of coding keywords. The keywords were then used as a unit of measurement and their frequency was considered an appropriate measure to represent the different social issues. However, the context of the keywords was examined to avoid repetition or ambiguity in the sentences. This involved analyzing words with similar meanings or different definitions that could have been misleading, as dealing with semantic differences or differences in the meaning of words can affect the validity and reliability of content analysis (Prasad, 2008). A further step in the content analysis was the development of coding categories, which are clusters of recorded keywords that are organized based on shared patterns and defined coding schemes (Hsieh and Shannon, 2005). These coding schemes adhere to specific coding rules in order to minimize subjectivity and ensure consistency throughout the coding process (Popovic et al., 2018). The list of keywords and coding schemes used is presented in Supplementary Table A. Each coding scheme reflects a social issue and the information is based on the SDGs and targets. With a view to using these coding schemes to develop a framework, they will henceforth be referred to as "social themes," as each of them provides an element of a transparent and aggregated framework for assessing social sustainability. Supplementary Table B shows the relationship between the themes and the SDGs and targets. The rationale for using SDGs as a reference lies in the bottom-up, collaborative and stakeholder-oriented process nature of SDGs (Hirons, 2020), which has the potential to emphasize social aspects rather than focusing on economic or environmental characteristics (Stevens and Kanie, 2016). In addition, the SDGs allow for the same visibility to be given to each social issue without a hierarchy or aggregation of issues. The content analysis was applied to the selected documents adopting the computer-assisted qualitative data analysis software "ATLAS.TI." This tool supported information and key concepts extraction. It contributed to coding the material: separate query was executed for each keyword, and content-specific terms were subsequently assigned codes according to the predetermined coding schemes. Then, counting of keywords for each theme was accomplished. The higher the word count of the keywords, the more important the current narrative on bio-district deems the specific theme.

2.4 Comparative analysis of social sustainability tools for bio-districts

Once the content analysis was completed and the different social themes were derived from the documents, a further analysis was carried out. The main objective is to identify the most appropriate frameworks to analyze each of the social issues in the bio-districts. To achieve this, different frameworks and tools were compared on the basis of the social issues they addressed. Supply/value chain and systems approaches were considered due to their ability to better capture complex social phenomena (Janker et al., 2019).

Following the work of Janker and Mann (2020) on the review of different social sustainability assessment tools at farm level, the most promising tools and frameworks were analyzed and compared. The main purpose of the comparison is to gain insight into the procedures and complexities involved in applying social sustainability assessment in practice, and to provide guidance on how to build a framework that fits the context of bio-districts. All these tools generally use a hierarchical structure to assess sustainability. For example, SAFA uses dimensions as pillars of sustainability. They are the highest and most general levels in the analytical framework. At an intermediate level, universal sustainability goals are translated into themes, which are often further broken down into sub-themes. Finally, indicators are the measurable variables used to assess the sustainability of the (sub) themes (FAO, 2014).

The inclusion of the tools in the comparative study is based on six criteria:

a. It allows to perform an ex-post assessment.
b. It allows the implementation of indicators for sustainability impact assessment. Greater relevance was given to frameworks and tools that involve a larger number of indicators.
c. It is possible to expand the scope of the analysis from farm-level to supply chain and system-level.
d. It is possible to adopt a multi-stakeholder approach since bio-districts involve different stakeholders.
e. It can be tailor-designed to assess organic and/or agroecological farming systems.

Once the frameworks and tools were identified, they were compared based on the different social themes and sub-themes[5] they covered (no hierarchy was developed and sub-theme categories were considered at the same level of the themes). Eventually, a description of the main steps that should be performed to adjust the existing frameworks for the bio-districts' case was presented. This included the validation of themes based on the different contexts and the decision of the most appropriate indicators.

3 Results and discussion

3.1 Literature review results

The number of published documents on bio-districts is presented in Figure 4. The first published document on bio-districts dates from 2005. From that year on, the number of circulating documents was minimal, increasing to six by 2020 and peaking at nine the following year, ending with two documents in 2022. Only eight of the 24 documents on bio-districts did not refer to case studies. Of the latter, one document (Jamil et al., 2021) examined case studies outside Europe,[6] while the rest analyzed only bio-districts belonging to EU countries. As shown in Figure 5, 15 studies were carried out in Italy, four in France, two in Austria, Portugal and Sweden, and one each in Spain, Nigeria, India, United States, Ecuador, Philippines, South Korea, and New Zealand. 11 of 24 studies analyzed social-related issues. Different methodological approaches were identified. Six papers used qualitative methods, including participant observation and semi-structured and in-depth interviews. Three articles used quantitative methods, including structural equation modeling. Two articles adopted mixed approaches, combining both qualitative and quantitative methods, as shown in Table 2.

3.2 Social indicators identification results

A holistic framework or an in-depth analysis focusing on the social impacts of bio-districts was not retrieved in the literature. However, there were documents, which assessed social impacts, focusing only on some aspects of social sustainability. 11 out of 24 provided detailed description of the methods and the indicators used for the impact assessment. The majority analyzed social aspects using qualitative methods. These methods were useful for exploratory purposes. They provided a detailed picture of the drivers that set in motion the first steps of a bio-district and the actors involved in the decision-making and implementation process. Governance, co-governance, and stakeholder involvement were the social objectives of the studies from Pugliese et al. (2015), Favilli et al. (2018), and Dias et al. (2021); using structured and semi-structured in-depth interviews.

Similarly to the previous examples, exploratory purposes were pursued with qualitative data to link bio-districts with the SDGs. In detail, Cipullo (2020) investigated cooperation, education, and bio-cultural diversity, while rural livelihoods was another social indicator used by Schermer (2005) to assess the scope of improvements in the livelihoods of small organic farms. In these cases, such indicators were used because of their user friendliness and strong communicative capacity to identify the likely impact of bio-districts on the social sustainability of the area of establishment.

Quantitative methods were broadly adopted as well. These are important for different reasons, as they allow to be in compliance with more sustainable policies, strategies, and action plans. For example, Assiri et al. (2021) and Belliggiano et al. (2020) analyzed the vocation of territories to become a bio-district and identified specific clusters of municipalities with a higher affinity to bio-districts. The indicators they used, which are shown in Table 2, can also be used to assess the performance of different fields, taking into account the objectives of each specific indicator. For example, indicators such as the old age rate, the number of conductors under 40 and the agricultural employment could be combined to assess whether there is an effect caused by the presence of a bio-district in a target area. A positive or negative trend could then trigger a response from policy makers and decision makers based on the predefined objectives. Moreover, this approach makes it possible to measure the sustainability performance of different bio-districts in order to rank and classify them based on the different levels of sustainability. Finally, it is possible to highlight strengths and weaknesses in the rankings, by simply checking which indicators have low values and should therefore be addressed to achieve higher sustainability.

The last group of approaches used mixed methods, where researchers collected and analyzed both qualitative and quantitative approaches. These were applied in the studies of Truant et al. (2019) and Gargano et al. (2021). The former analyzed organic agricultural

5 Some tools and frameworks do not use the term themes and sub-themes, but in order to allow for a better comparison, these definitions will be used.

6 The document referred to the concept of organic food system rather than bio-district, however it included in this perspective the Cilento Bio-district.

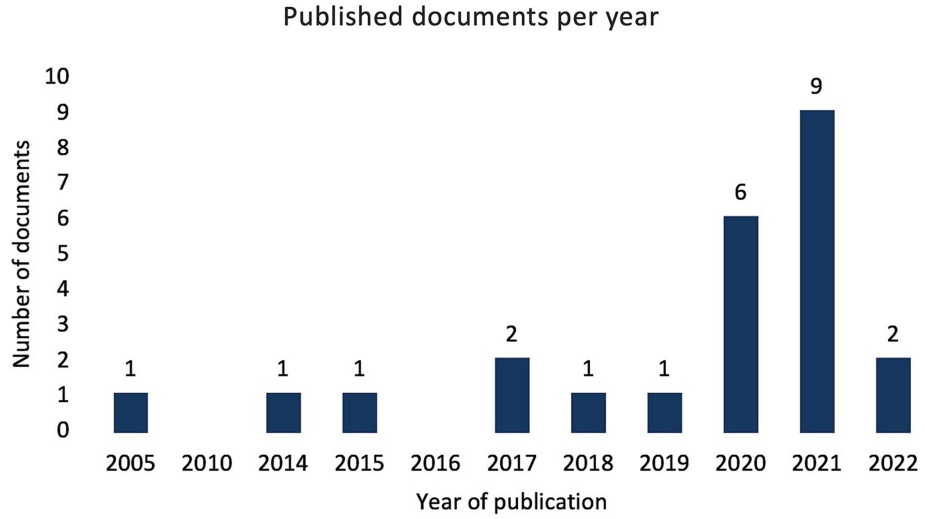

FIGURE 4
Number of published documents per year.

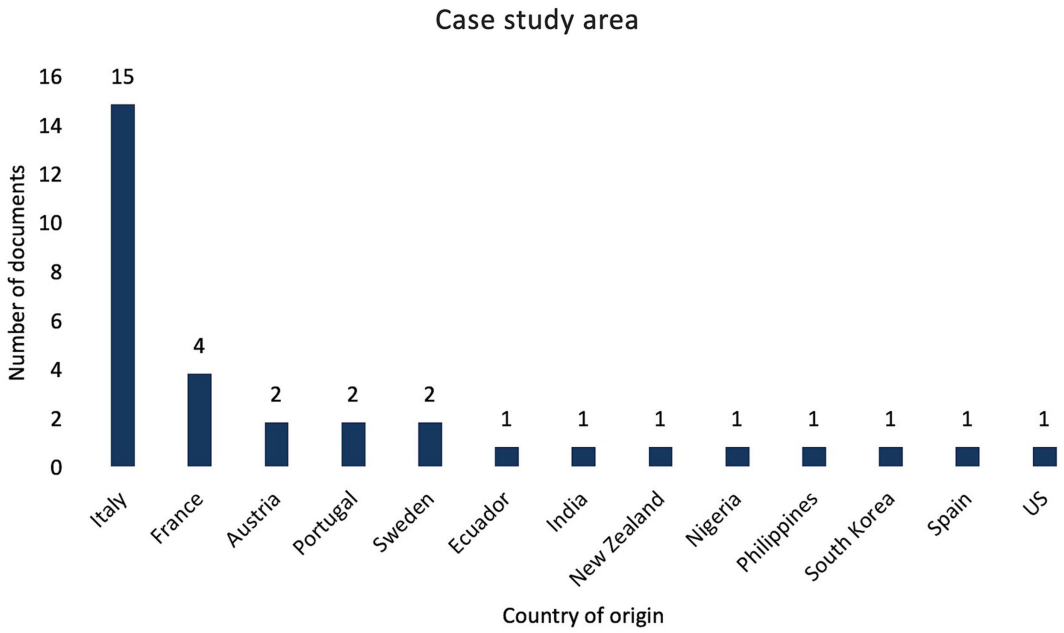

FIGURE 5
Location of the different case studies.

companies within bio-districts adopting some specific social indicators. These indicators were clearer, as they allowed to cluster passive companies with a low performance compared to the average in the bio-district or to profile proactive companies that were benchmarks in certain areas, such as the inclusion of disadvantaged people or gender diversity. Similarly, Gargano et al. (2021) investigated multifunctional farms and their relationship with agroecological principles. Particularly relevant to the goal of bio-districts was the analysis of the parameter "networking." Aspects of human and social capital were considered. The former was calculated by verifying the participation in research projects (public-private partnerships), while the social capital indicator was developed on the basis of collective learning, the adoption of participatory approaches, and the number of network memberships. Again, a mixed approach was implemented by Stefanovic (2022). The indicators chosen by the author had the dual utility of both tracking the actual performance of different local organic food systems in achieving the SDGs and the targets, and being user-friendly as the social categories were already created: SDG 1 "No poverty," SDG 7 "Affordable and clean energy," SDG 8 "Decent work and economic growth," SDG 11 "Sustainable cities and communities," SDG 12 "Responsible consumption and production," and SDG 16 "Peace, justice and strong institutions."

TABLE 2 Types of social assessment used in the identified literature.

Document	Case study	Social assessment	Type of analysis	Social issue/Indicator
1. Assiri et al. (2021)	Italy	X	Quantitative	*Per capita* income (Euro); Old Age Rate (index); GAS (n); Tourism rate (index); U40 conductors (n); PDO and PGI companies (n); employed in agriculture (%)
2. Basile et al. (2021a)				
3. Basile et al. (2021b)	France, Italy, Spain, Portugal			
4. Belliggiano et al. (2020)	Italy	X	Quantitative	Migration balance (n); aging index (n); youth unemployment rate (%); *per capita* average taxable income (Euro)
5. Chaminade and Randelli (2020)	Italy			
6. Cipullo (2020)	Italy	X	Qualitative	Cooperation, education, and Bio-Cultural Diversity
7. Dias et al. (2021)	Italy and Portugal	X	Qualitative	Governance, stakeholder involvement
8. European Commission (2021)				
9. Favilli et al. (2018)	Italy	X	Qualitative	Co-governance
10. ALGOA and IN.N.ER. (2020)				
11. Gargano et al. (2021)	Italy	X	Mixed	Community empowerment (physical, economic and income data); education level; preservation local varieties; job creation; services to population; networking (human and social capital)
12. Guareschi et al. (2020)	Italy			
13. Basile (2017)	Italy			
14. Jamil et al. (2021)	Ecuador, France, India, Italy, Philippines, New Zealand, Nigeria, South Korea, Sweden, and United States			
15. González De Molina and Lopez-Garcia (2021)				
16. Mazzocchi et al. (2022)	Italy	X	Quantitative	Non-profit associations (n); LAG (n); Unemployment rate (index); farmers age (n); direct farms selling (n); PDO and PGI (n farms); *Per capita* income (euro/municipality)
17. Poponi et al. (2021)	Italy			
18. Pugliese et al. (2015)	Italy	X	Qualitative	Governance
19. Schermer (2005)	Austria	X	Qualitative	Rural livelihoods
20. Stefanovic (2022)	France, Italy, and Sweden	X	Mixed	SDG target related outcomes
21. Stotten et al. (2017)	Austria, France, and Italy			
22. Triantafyllidis (2014)				
23. Truant et al. (2019)		X	Mixed	Valorization of tourism and landscape heritage, links with population and local territory, inclusion of disadvantaged people, gender diversity, and promotion of local varieties
24. Zanasi et al. (2020)				

The documents that did not include social aspects in the research are left blank. $N = 24$.

3.3 Content analysis results

The content analysis was carried out with the purpose of identifying the social themes that can provide an analytical framework. The results of the content analysis in Figure 6 show that the majority of the identified thematic keywords are used in project reports and proceedings of the bio-districts. The 26 different social themes are all mentioned, and many of them are interrelated. Based on the number of words, different trends could be identified, highlighting that the agenda of the bio-district in terms of sustainable development can vary. To better understand the relative importance of each social theme in the current literature, the top five and bottom five themes were identified based on their word count. The top five social themes with the highest frequency of occurrence are *Social Cohesion and*

Networks, Local Traditions and Cultural Heritage, Knowledge Exchange, Governance, and *Health*. All the documents pointed out the prominent role of *Social Cohesion and Networks* for bio-districts. Gargano et al. (2021) highlighted networking between different actors as a core element characterizing the bio-districts' commercial and institutional areas. Key element is not only the vertical and horizontal integration of stakeholders operating along the supply chain in the bio-district, such as farmers and processors, but also the connections with external agencies, that can provide greater access to markets and income-generating activities. Moreover, linking farmers with research institutions and universities plays a crucial rule for the dissemination of information and knowledge on agroecological practices. This finding is in line with studies that place networks and social capital at the center of neo-endogenous rural development (Ray, 2006). Establishing a shared value system and drawing on local and extra-local knowledge provides the tools to respond to local needs and add value to those local resources that can carry a comparative advantage (Bosworth et al., 2016). Empirical research is therefore of paramount importance in examining the local formation of partnerships and interlocking networks and their links to the governance structure of bio-districts. Furthermore, it is crucial to explore the operational mechanisms through which these partnerships effectively address structural challenges related to depopulation and the need for local economic growth by facilitating innovative solutions. Examples of innovative partnerships include agricultural production and related food marketing channels such as consumer purchasing groups, community supported agriculture, producer markets, family farm markets, agroecological markets, green public procurement, and the hospitality industry (HORECA), e-commerce and small food retailers including local, regional and national organic shops and supermarkets (IN.N.E.R., 2017; Stotten et al., 2017). Indeed, this highlights the relevance and the connection of the *Social Cohesion and Networks* theme with the *Innovation* theme, which is crucial for the development of social sustainability (Mani et al., 2016).

Regarding *Local Traditions and Cultural Heritage*, the bio-district agenda prioritizes the involvement of the local community as carriers of identity, tradition and culture, not only in agricultural practices that help to preserve the landscape but also in the maintenance of local ancient plant varieties (Truant et al., 2019; Gargano et al., 2021; Mazzocchi et al., 2022). Analyzing this theme has a 2-fold outcome. Sustainable landscape management practices can be evaluated under the broader umbrella of cultural services of ecosystem (CES). CES is often conceptualized as the intangible benefits that individuals derive from ecosystems and includes spiritual enrichment, cognitive advancement, introspection, recreational opportunities, and esthetic encounters (Plieninger et al., 2015). It can inspire a significant transformation in the representation and analysis of the co-evolution of human well-being (related to the themes *Health* and *Quality of Life*) and ecological changes, aiming to facilitate a deeper understanding of how these dynamics may interact and impact one another (Chan et al., 2012). The second outcome refers to the concrete value this theme provides as it fosters the development of sustainable cultural tourism. The interest of sustainable tourists is not so much related to the beauty of the "end result," but to the intrinsic value they have from a cultural perspective. Landscapes, especially those associated with agriculture, are mutable and identity-defining (Ruiz Pulpón et al., 2023). Society endures in them through their use and transformation. Therefore, the implementation of many landscape practices combined with the activities from the LAG can play a relevant role in promoting both tourism and cultural activities (Pugliese et al., 2015).

The theme of *Knowledge Exchange* can be linked to *Social Cohesion and Networks*, as the promotion of training, information, exchange of the best practices, and participation in bio-districts (Mazzocchi et al., 2022) is achieved from a starting point of mutual shared values and trust (Chen et al., 2022). The knowledge flow between rural and urban contexts facilitates the advancement of collective action involving individuals from both settings, with the aim of fostering agricultural innovation and development. In addition, by integrating new knowledge and techniques, the rural talent structure of bio-district actors can be improved, thereby strengthening their ability to adapt effectively to external changes. Therefore, it is inclusion within the framework can contribute to the development and understanding of not only of themes such as *Innovation* and *Social Cohesion and Networks*, but also *Resilience*.

Governance is frequently mentioned, as bio-districts are broadly perceived as a multi-level governance and bottom-up approach (Pugliese et al., 2015), involving public administrations to coordinate the various actors in the bio-district system (Assiri et al., 2021). From a multi-actor perspective, they involve both private and public actors at the territorial level (Favilli et al., 2018), and the core organizational structure is generally built on private actors and civil society. Strong governance influences the final outcomes of a bio-district. It regulates the degree of symmetry of information and the definition of common principles (Guareschi et al., 2020). Identifying the *Governance* theme, contributes to progress toward a "good" governance, which seeks to shift governing relations away from perceptions of inefficiency, corruption, maladministration, and excessive bureaucracy. Instead, it strives to promote greater accountability, transparency, effectiveness, fairness, and participation in decision making processes (Devaney et al., 2017).

Eventually, *Health* is a frequently addressed issue related to the context of social sustainability. This theme includes the protection of farmers' and consumers' health (Dias et al., 2021), which reinforces the idea that workplace benefits and health and safety measures are some of the most addressed issues in terms of social sustainability (Mani et al., 2016). As mentioned above, the concept of well-being is also included in this theme, suggesting a more subjective and culturally dependent perception of health; the link between individual and the ecosystem health is also considered (Stefanovic, 2022).

At the current moment, the literature on bio-districts pays less attention to *Working Conditions, Access to Services and Inputs, Food security, Community Empowerment,* and *Peace and Justice*. Although relatively less considered, the issues connected to these themes are high in the agenda of sustainable development and therefore should be included in the framework. One possible explanation for this discrepancy is that the context of the case study may influence the relative importance of a social issue. Indeed, bio-districts show different characteristics also in terms of social themes involved depending on specific local conditions and/or the general national context. All of the documents, with the only exception of Jamil et al. (2021), considered bio-districts or farms located in developed countries. Topics linked to food security, peace and justice, and access to services and inputs are more relevant in developing countries, which often have weaker infrastructure, limited access to resources, and a higher incidence of poverty, inequality, and conflict are often present (Bhattacharya et al., 2023; Chan et al., 2023; Lin et al., 2023).

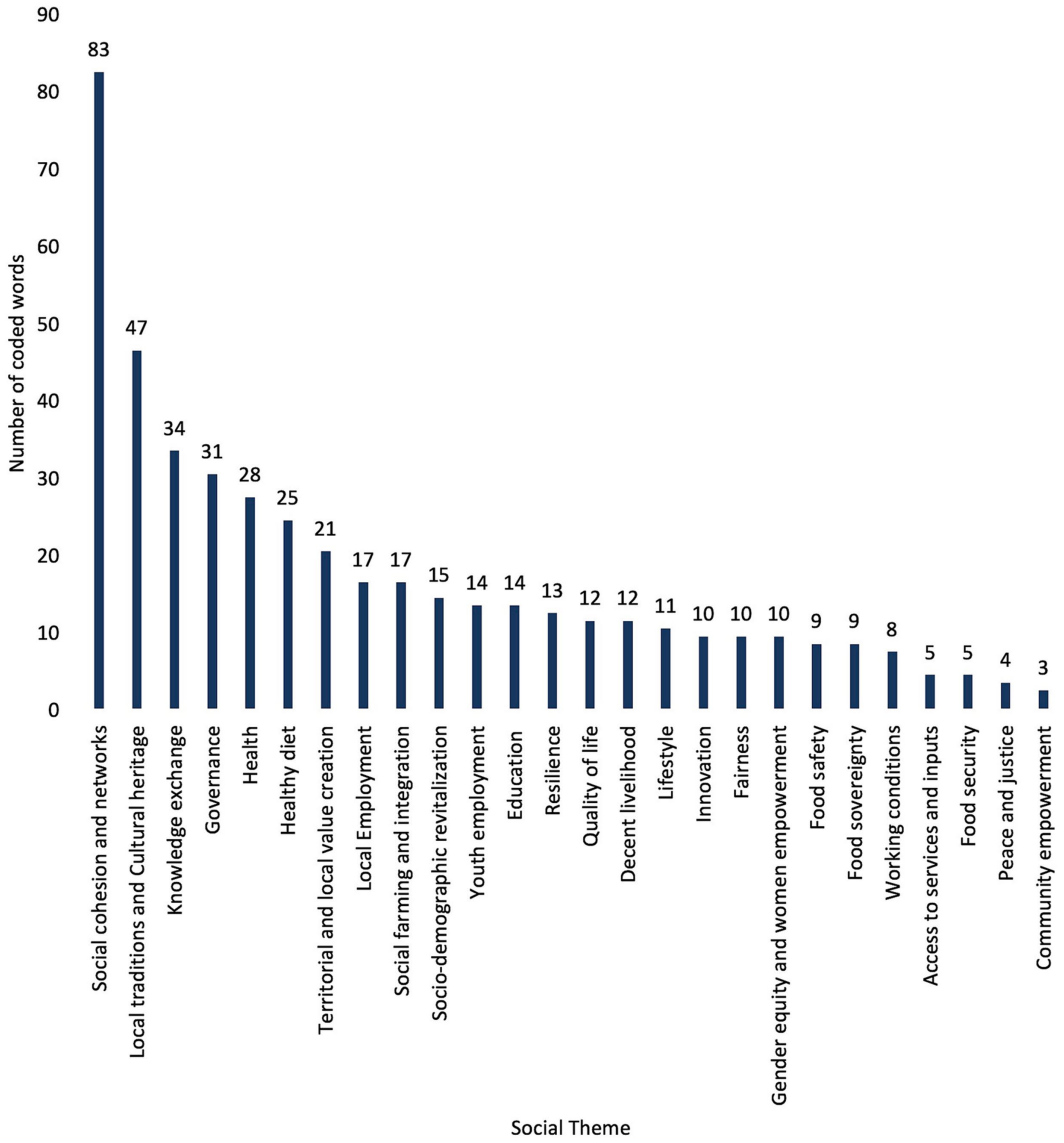

FIGURE 6
Results of the content analysis, showing the different trends of each social issue.

Access to basic inputs such as water, electricity, is also more limited in developing countries, which can perpetuate cycles of poverty and inequality (Rijsberman, 2006; Adair-Rohani et al., 2013).

Peace and Justice was mainly retrieved from the work of Jamil et al. (2021), which describes the case of Inba Seva Sangam, an Indian organic district that has contributed to peace in the area by dismantling the caste system in society. In contrast, developed countries tend to have more robust infrastructure and resources to meet these basic needs. This is supported by research showing that the main role of bio-districts in developed countries is to support access to the means of production, such as land (Triantafyllidis, 2014; Stotten et al., 2017), rather than to contribute to the meeting basic needs.

The lowest frequency of words was recorded by *Community Empowerment*. However, this theme is central in different documents on bio-districts, indicating that bio-districts support small farmers and rural communities (IN.N.E.R., 2017; Poponi et al., 2021; Mazzocchi et al., 2022). Including this theme in the framework allows the identification of drivers for sustainable local development. For example, community empowerment has been studied to reduce relative poverty and to maintain the population in rural areas. To improve the quality of life, jobs are created and incomes are increased for local residents in underdeveloped countries (Jung, 2020). The low word count number could be explained by the broad scope of the concept, which overlaps with other closely related issues described by themes such as *Local Employment, Territorial and Local Value Creation, Quality of Life*, and *Socio-demographic Revitalization*. However, the vastity of the concept underlines the need to implement a theme, which covers issues related to rural community empowerment, perhaps as a sub-theme of one of these social themes.

3.4 A tailored analytical framework on social sustainability

Considering that the social dimension is interrelated with the other dimensions that characterize the sustainability of bio-districts, and that they sometimes overlap, it is essential to clearly define the conceptual approach behind the framework. A first important feature is the objective of the framework developers: although their general objective is similar, i.e., to provide farm-level insights to support the farmers' decision making, the specific objectives may differ. To this end, the work on social impact assessment tools from Janker and Mann (2020) was investigated to identify approaches with different aims but that could fit bio-districts' case with their social themes. In particular, seven approaches from the review were considered suitable starting points for the bio-districts' analysis: IDEA (Zahm et al., 2008), MOTIFS (de Mey et al., 2011), PG tools (Gerrard et al., 2012), RISE (Häni et al., 2003), SAFA guidelines (FAO, 2014), SOAAN guidelines (SOAAN, 2013), and S-LCA (Benoît Norris et al., 2020). Apart from S-LCA, all approaches analyzed social sustainability as one of the pillars of sustainability.

As shown in Table 3, there are several themes covered by the selected approaches. Four approaches (PG tools, RISE, IDEA, and MOTIFS) explore site-specific social aspects, which are easily accessible at farm level and that can be scaled up by aggregating data. Placing farms and farmers at the center could be an effective perspective as they provide the core values, resources, and processes for the bio-districts. The Public Goods Tools represents a valuable option for assessing social sustainability through the lens of public goods, which are described as "*things of benefit to the public which cannot be bought in the marketplace and for which there is no incentive to pay… but which are valued by society as a whole*" (Gerrard et al., 2012). This tool covers 11 themes with 33 "sub-themes." Of the key 11 social aspects related to public goods at farm level, only four were deemed relevant to social sustainability: *Landscape and Heritage; Food Security; Social Capital* and *Farm Business Resilience*. Each of these themes is subdivided into smaller sub-themes, which are assessed through indicators with a score that ranges from 1 to 5.

The Response-Inducing Sustainability Evaluation (RISE) is another tool that has been designed to access results at farm level. It covers sustainability through 12 themes (defined as indicators) divided into 57 sub-themes (defined as parameters). Four themes were considered linked to social sustainability: *Economic Stability, Local Economy, Working Conditions,* and *Social Security*. The scores for each sub-themes range from 0 to 100 and are based on the aggregation of several indicators.

Indicateurs de Durabilité des Exploitations Agricoles (IDEA) follows the trace of the sustainability assessment at farm level by including 10 themes (defined as components) divided into 41 sub-themes (defined as indicators). Five of the themes were considered generally relevant to assess social sustainability: *Quality of the Products and Land, Organization of Space, Ethics and Human Development, Economic Viability,* and *Independence*. However, there were several sub-themes that assessed issues linked to social sustainability, even though they were grouped under themes not directly related to social aspects. A certain number of points can be obtained for each indicator. In addition, IDEA has set a threshold for each sub-theme and theme in order to reduce the possibility of compensating for low scores.

The Monitoring Tool for Integrated Farm Sustainability (MOTIFS) assesses sustainability through 10 themes (defined as major themes) and 23 subthemes (defined as themes). *Risk, Internal Social Sustainability,* and *External Social Sustainability* were considered as particularly relevant for social assessment. The farmer himself determines the score on a scale between 0 and 100.

Although the development of a sustainability framework in a bio-district should necessarily include impacts at farm level, some authors consider a systems approach to be more appropriate as it broadens the scope of analysis to include the different actors and related social indicators involved in a sustainable food system. Indeed, the Sustainability Assessment of Food and Agriculture Systems (SAFA), the Sustainable Organic Agriculture Action Network (SOOAN) Best Practice Guideline for Agriculture and Value Chains, and S-LCA were the approaches that included the broader range of themes consistent with assessing the impact of bio-districts on social sustainability. These approaches correspond to the multidimensional and multi-stakeholder nature of bio-districts, making them particularly suitable for assessing their impact on social sustainability. An inherent part of a systems approach is the analysis of the relationship between the stakeholders involved. This would make it possible to identify one of the main social themes identified in the literature review: *Social Cohesion and Networks*. In this way, network structures could be examined to reach all the interactions of key actors and within the institutional and supporting environment, including national park services, policy makers, public administrations, research centers, and private actors.

However, these indicator-based sustainability assessment approaches have been criticized for their lack of flexibility to adapt to different contexts characterized by a variable stakeholders' involvement (Röös et al., 2019). While social themes are considered universal, a detailed sustainability assessment should first assess the context and ultimately adapt its structure and scope to address the social and structural heterogeneity of the systems analyzed (Ssebunya et al., 2017). Indeed, the context of bio-districts is characterized by a certain degree of heterogeneity in terms of organizational structure and governance, territorial morphology, activities implemented, and development strategies (Viganò et al., 2019). For example, the maintenance of vibrant areas is high on the agenda of the bio-districts that are located in rural areas, facing challenges such as rural depopulation, population aging, and socio-economic marginalization; while urban or peri-urban bio-districts face problems more related to environmental degradation and intensive agriculture (Sturla, 2020). The same considerations should be also based on the geographical origin of the bio-district, whether it is in a developed or developing country.

When presenting a tool or framework on social sustainability to the end user, there are several alternatives social themes (e.g., *Working Conditions* and *Governance*) that can be described by different social indicators, which may show different performance and different levels of accessibility to the end user. This necessarily leads to a multi-criteria decision making (MCDM) process where a method must be defined to prioritize some social themes and indicators over others that are more in line with local needs and expectations. In sustainability studies, one viable way to achieve this target is through bottom-up participatory approaches (Innes and Booher, 1999). The involvement of stakeholders and experts

TABLE 3 List of frameworks and tools that could fit bio-districts' related social themes assessment.

	IDEA	MOTIFS	Public Goods tool	RISE	SAFA	SOAAN guidelines	S-LCA
Access to services and inputs	X	X		X	X	X	X
Community empowerment							X
Decent livelihood					X	X	X
Education					X		X
Fairness					X		X
Food safety					X		X
Food security			X		X	X	X
Food sovereignty					X	X	
Gender equity and women empowerment				X	X	X	X
Governance					X		
Health			X		X	X	X
Healthy diet	X		X		X	X	X
Innovation							X
Knowledge exchange	X		X	X	X		
Lifestyle					X		X
Local Employment	X		X		X		X
Local traditions and cultural heritage	X	X	X		X	X	X
Peace and justice					X		X
Quality of life	X	X			X		
Resilience	X	X	X	X	X	X	
Social cohesion and networks		X	X		X	X	X
Social farming and integration					X		X
Socio-demographic revitalization					X	X	X
Territorial and local value creation					X		X
Working conditions				X	X	X	X
Youth employment							X
Multistakeholder approach	No	No	No	No	Yes	Yes	Yes
Scale level	Farm/Sector	Farm/Sector	Farm/Sector	Farm/ Sector	Farm/Chain/ Sector	Farm/Chain/ Sector	Farm/Chain/ Sector

can be a valuable tool to prioritize the social themes according to their importance and feasibility for each bio-district. To obtain reliable and comprehensive findings, it is advisable to assemble a heterogeneous set of stakeholders and experts on the bio-district, and where feasible, use sub-groups, key informants, or experts to verify the consistency of the results (Ssebunya et al., 2017). Combining expert-led technical knowledge with the needs of local stakeholders would ultimately allow better value judgments and assumptions to be made about, for example, about which attributes contribute to social sustainability for the specific bio-district (themes). The attributes should then be organized hierarchically to represent their relationships should be performed (defining the sub-themes). A hierarchical structure helps to break down the decision problem into smaller sub-problems (De Olde et al., 2016).

Indicators play a crucial role in the assessment and monitoring of performance against predetermined themes and sub-themes. The application of MCDM to the choice of indicators also involves operational issues, such as whether indicators are considered individually, as part of a balanced/weighted group, or combined in a composite index (Farrell and Hart, 1998). However, there is no consensus on the best way to evaluate each social theme. In any case, the choice of indicators must take into account very complex concepts that are particularly difficult to capture with a single indicator. The use of composite indicators is therefore an important tool when dealing with complex social themes. For example, when discussing *Well-being*, the range of indicators should be extended to cover all the necessary information on what is generally a multidimensional issue (Greco et al., 2019). Composite indicators are based on sub-indicators that do not have a common meaningful unit of measurement, and there is no straightforward way of weighting these sub-indicators (Saisana and Tarantola, 2002). Although criticized for a certain degree of arbitrariness (Sharpe, 2004), there are a number of applications of composite indicators in the field of sustainability that make them a reliable tool. Moreover, one of the approaches that improves the accuracy in choosing the sub-indicators is based on SMART criteria: *Specific, Measurable, Available cost-effectively, Relevant, and Timely*

available (Desiere et al., 2015). Finally, the choice of weights for each sub-indicator also has a significant impact on the final outcome of the framework. To avoid the risk of manipulating the indicators, the weighting system should be as appropriate as possible to the purpose of the analytical framework (Nardo et al., 2005).

3.5 Study limitations

It is important to consider some of the limitations of the research on bio-districts. There is currently a limited body of research on the subject and only 24 documents were included. The PRISMA methodology is a valuable tool for tracking the various review stages. However, when the research is dealing with an emerging topic and the literature is limited, a more flexible approach may be preferable. In addition, the quality of the literature was questionable, with many sources classified as "gray literature." This means that the information has not gone through the traditional peer-review process and may not be as reliable as other sources. Of the 24 documents available, only eight are peer-reviewed, further limiting the quality of data available. Language is also seen as a barrier to access to many documents, which does not allow for a full representation of social aspects. It is also important to note that the geographical origin of the available literature is mostly European. This means that the social themes identified may not have general applicability or relevance to other regions of the world, while at the same time other themes that could be relevant to these regions may have been neglected. Overall, while the available literature on bio-districts is growing, the limitations in terms of quantity, quality, and geographical scope should be acknowledged. Scholars and practitioners should take care to critically evaluate the available information to avoid potential biases or limitations in further research.

4 Conclusion

Bio-districts are a new and fast-growing example of sustainable food systems, often involving an agroecological approach. There is a limited body of literature that only considers social aspects in the analysis of food system sustainability (Janker et al., 2019). This study contributes to the growing body of knowledge on alternative food networks and their potential impacts by answering the research questions: (1) It identifies the main social issues addressed by bio-districts contributing to social sustainability. Twenty-six themes form the backbone of a framework for analyzing the impact of bio-districts. The content analysis validated these and showed the importance of social aspects in the sustainability debate. The results showed that some issues, which are high on the sustainable development agenda, such as *Working Conditions, Access to Services and Inputs, Food Security, Community Empowerment*, and *Peace and Justice*, are relatively underrepresented in the literature. Further analysis is therefore needed to understand the factors that influence the relative frequency of some keywords between different themes. (2) It examines the main categories of social indicators and impact assessment approaches used by academics and practitioners to analyze social impacts in bio-districts. For each approach, the different methodologies and associated indicators are highlighted and categorized according to the scope and type of data implemented. However, none of them applies a detailed and holistic approach to social sustainability assessment. (3) The research reviewed the literature for existing social sustainability approaches that could comprehensively address the social sustainability impacts of bio-districts. The results made it possible to compare different tools and frameworks that capture social sustainability in agri-food systems, in order to identify a suitable starting point for a tailored framework on bio-districts. PG, IDEA, MOTIFS, and RISE are tools that can provide valuable information and indicators at farm level. However, a multi-stakeholder approach is preferred as it allows to capture the complexity of the social dimension in a bio-district. The SAFA, SOAAN, and S-LCA guidelines can contribute to this by providing a holistic pathway toward social sustainability. However, in order to adapt the approach to the specific context of a bio-district, it is necessary to make appropriate adjustments to the scope and objectives of each social theme. (4) The identification of the themes aims to provide an overview of the social sustainability aspects in the context of bio-districts. In order to adapt the existing tools and social themes to the different bio-district contexts, further steps should include the process of weighting, ranking, and finally creating and then aggregating the sub-themes into themes. This can be done through a participatory approach involving relevant stakeholders and experts in the bio-district context. A diverse group can better contribute to the prioritization and ranking of the social themes and sub-themes identified from the existing social frameworks. The choice of assessment indicators should be based not only on the boundaries of the research (food system, supply chain, or farm-based), but also on the possibility of implementing them in different geographical and socio-cultural contexts. In addition, the possibility of using composite indicators should be considered, given the characteristics of bio-districts and the complexity of social aspects related to sustainability. The choice of sub-indicators can be based on a SMART approach. Such criteria, which are commonly used for goal setting, support the selection of indicators and make them suitable for further analysis (Shahin and Mahbod, 2007). Moreover, the use of SMART criteria allows for regular monitoring and analysis of the indicators, with the possibility of quickly adapting their number or content to the existing context, since social systems always change not only in place but also in time (Parsons, 1991). Further studies should test the proposed steps for defining a suitable analytical framework in an existing bio-district to assess effectively and efficiently its ability to assess the social sustainability impacts of bio-districts.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary material; further inquiries can be directed to the corresponding author.

Author contributions

GP and CZ contributed to the design, writing, and editing of the manuscript. All authors contributed to the article and approved the submitted version.

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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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Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fsufs.2023.1229505/full#supplementary-material

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