The interface of disasters, sanitation, and poverty in Brazil: a sociological perspective

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In Brazil, the high frequency and types of disasters are symptoms of misguided socioenvironmental public policies. While approximately 25% of municipalities decree emergency every year, over 75% of the occurrences are linked to sanitation issues. Such events range from the lack of urban drainage infrastructure to handle large volumes of rainwater to the insufficiency of backup water supply strategies during prolonged drought, both further impacting other precarious infrasystems such as solid waste management and sewage, with the most heavily and extensively affected group being the citizens facing poverty. Therefore, the issues of disaster, sanitation, and poverty are intertwined in Brazil. Using a network science approach, we investigate how the sociological debate is overcoming the fragmented approach about these subthemes and within the disciplinary fields in social sciences by analyzing the connections between the keywords of the open-access research articles from 2003 to 2022 from four databases. This mini review highlights the main contemporary axes between the themes, identifies the potential for tackling the gap at the interface, and clarifies the needs for future studies given the aims of the Sustainable Development Goals.

1. Introduction

The disciplinary field of sociology emerged in Brazil by dedicating itself to development studies and consolidated itself by persevering in such a purpose. In this field, the subtheme of poverty stands out due to the spiral of social disaffiliations and inconsistencies related to successive government policies discursively committed to economic progress and social prosperity. When sociology devoted itself to understanding the reasons for the persistence of poverty -despite the profound behavioral, productive, political, technological and environmental changes that took place in the country in the last century–, it was led to approach other disciplinary fields, especially economics, geography, history, anthropology, law, literature, architecture and public health, establishing fruitful dialogues with them. As much as Brazilian sociology emerged and maintained its syncretic characteristics, through the predisposition to assimilate analyses from other disciplinary fields since its beginning (Holanda, 1936; Prado, 1942; Castro, 1951; Santos, 1998), it also remained open to a bidirectional flow as it consolidated. It means also being receptive to studies from other disciplinary fields, which have incorporated, in different degrees, a sociological perspective in their way of interpreting development issues (Furtado, 1959; Mello, 1984; Maricato, 1996).

The sub-theme of poverty in Brazil and its perverse associations, such as the trinomial lack of housing-precarious infrasystems-unemployment, has been at the top of general sociological concerns and of many of its subspecialties. Urban, rural, economic, health, and labor sociologies are some of the subspecialties which have focused on the subject and created bridges so that architects, urban planners, engineers, economists, and geographers calibrate their analyses with a sociological vision and vice versa. When the sociological view goes beyond the mere economic aspect of poverty, this enables other analytical components to gradually become relevant in this disciplinary field, such as the lack of access to infrastructure and basic sanitation services and the recurrent deprivation in the context of disasters. These components reinforce and/or expand the sociological connections with medical sciences, public health, sanitary engineering, environmental sciences, and geography, among other disciplines.

The association between the poverty-sanitation-disaster sub-themes is not accidental. In Brazil, the high frequency and types of disasters are symptoms of misguided socioenvironmental public policies. While approximately 25% of municipalities decree emergency every year, over 75% of the occurrences are linked to sanitation issues (Londe et al., 2018; Valencio et al., 2022). The poor people are the group most affected by the lack of urban drainage infrastructure to handle large volumes of rainwater, the insufficiency of water supply during prolonged droughts, the inefficacy of solid waste management, and the precarious sewage infrasystems. Thus, the issues of disaster, sanitation, and poverty have become intertwined in their daily lives. However, the process of intertwining poverty-sanitation-disaster in the country, from a sociological perspective, is not yet consolidated in the debate, with fragmented approaches and different levels of articulation between these sub-themes. This mini review adopts a methodology of Network Science to investigate the associations between keywords of research articles in the debate and present a view of the status of this process of integration. The results highlight the main contemporary axes between the three topics, identifying the potential for tackling the gap at the interface, and clarifying the needs for future studies, given the aims of the Sustainable Development Goals.
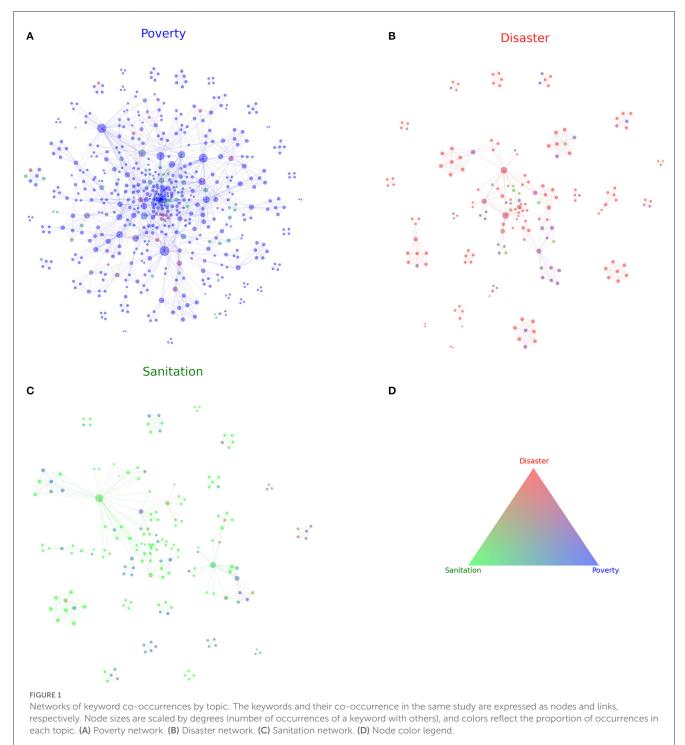
2. Methods

Bibliometric studies traditionally focus on the convergence between publications by using the cited references (Marx and Bornmann, 2016; Mejia et al., 2021) and then identifying the key publications and authors in a topic. In this study, we are concerned, instead, in highlighting the topic itself, i.e., unveiling whether the contemporary Brazilian debate in sociology is intertwining the sub-themes of poverty, sanitation, and disasters and how it occurs. Hence, a better tool is to use the set of keywords listed in the study. Keywords are not only an instrument for virtual publications to be easily accessed in an electronic or physical search about some subjects but also a set of clues about actors-contexts-categories of analyses of the main content. It means that, even around the same subject over a given period, the set of keywords could change, following new terminologies, trends, or pathways of the

larger debate, thus indicating initial or processual articulations and distances from a common starting point of the scientific debates.

We have performed the search on four publication search and citation databases, provided by the systems as follows: CAFe-CAPES (the main one for Brazilian public scientific institutions), Scopus, Web of Science, and Sage. The search queries were "Brazil AND sociology AND disaster," "Brazil AND sociology AND poverty," and "Brazil AND sociology AND sanitation". We have adopted the filters as follows: "article," "open access," and publication year within the period of 2003–2022. When available, we double-reinforced the query terms (Brazil, sociology and, as applicable, disaster, poverty, or sanitation) in the additional filters. As a result, we have obtained 597 references about these topics, which were saved in RIS format. All references were individually checked. It was removed from the dataset that did not conform to the search criteria, i.e., (i) those that were not research articles but editorials, reviews, comments, or e-books, (ii) those that were not open access, (iii) those that were unrelated to the search topic (e.g., cited in the body of the text, an international treaty signed in Brazil, but the Brazilian context was not itself mentioned in the debate). In addition, the keywords of the RIS files were checked against the original studies and replaced by the ones chosen by the original study authors when there were divergences. All keywords in foreign languages were translated into English. References without keywords were removed from the dataset. A total of 329 references remained after this first data-cleaning step. Then, the references were imported into a Python Pandas DataFrame and those that appeared repeatedly by the same search query were marked as duplicates and removed. Therefore, 278 unique references remained in the final dataset. These are listed in the Supplementary material (Supplementary Section 4).

The keywords from each study were extracted, and each keyword was considered a network node. Two nodes were connected by a network edge if their respective keywords appeared together in a study. The keywords used in the search query were removed from the dataset, i.e., "Brazil," "sociology," and its broader field "social sciences", and depending on the query, "poverty," "sanitation," and "basic sanitation", or "disaster"(s) and "natural disaster"(s). Similar keywords, expressing the same idea, were replaced by a common terminology. This was the case, for example, of the keywords, such as "bolsa-família program", "bolsa-família programme", "federal emergency transfer", and "cash transfer program", which were replaced by "cash transfer program", as the first three refer to similar cash transfer initiatives by different governments. Spacing and punctuation issues were also fixed. As a result, we have obtained 837 unique keywords. The search about poverty subtheme returned 593 keywords, the search about disaster returned 178 keywords, and the search about sanitation also returned 178 keywords, with some keywords from the search in one topic also appearing in others. From this result, two organizational and analysis steps were carried out using network graphs, one focusing on the individual subthemes and the other containing all the nodes from the three subthemes, enabling the observation of how they converge. The nodes of these networks represented the individual keywords and the links to the co-occurrences in a study. The node sizes were defined as proportional to their degree, and their colors were proportional to the number of occurrences in each topic from disaster-sanitation-poverty,

FIGURE 1
Networks of keyword co-occurrences by topic. The keywords and their co-occurrence in the same study are expressed as nodes and links, respectively. Node sizes are scaled by degrees (number of occurrences of a keyword with others), and colors reflect the proportion of occurrences in each topic. **(A)** Poverty network. **(B)** Disaster network. **(C)** Sanitation network. **(D)** Node color legend.

following a red-green-blue (RGB) grading scheme. The node positioning followed the ForceAtlas2 algorithm (Bastian et al., 2009), and the plots were built using the NetworkX package for Python (Hagberg et al., 2008).

3. Results and discussion

Since its beginning in Brazil, the main contribution of the sociological approach to development studies has been in highlighting and clarifying the profound changes in collective behaviors, values, beliefs, and customs (Viana, 1939; Fernandes, 1960; Torres, 1968; Martins, 1994; Cardoso, 2003; Cohn, 2004; Candido, 2006; Freyre, 2013). Furthermore, this field has maintained a fruitful dialogue with other ones, from history to geography (Fausto, 1976; Santos, 1985) and from economics to urban planning (Dowbor, 1982; Tavares and Assis, 1985; Rolnik, 1997; Belik et al., 2001; Kageyama, 2004). There were convergences between them and the sociological explanations about the social
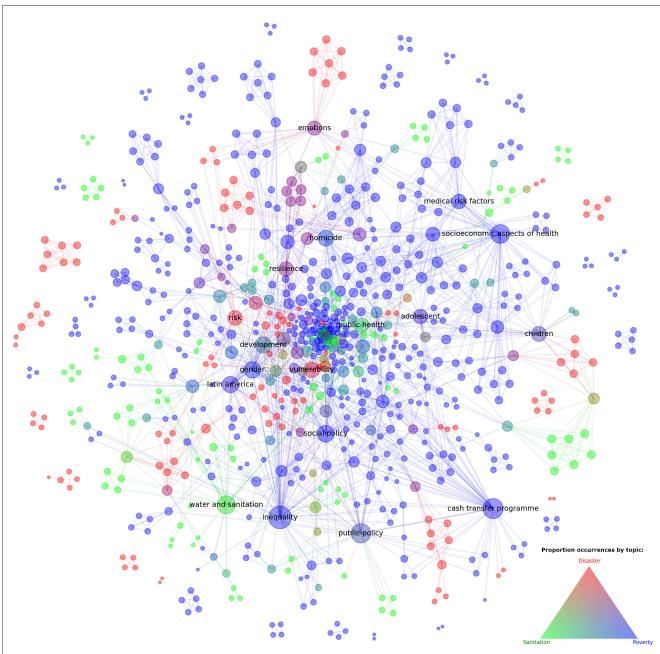
FIGURE 2
Network of all the co-occurrences of keywords in the dataset of open-access research articles in the topics analyzed. Node colors indicate the proportion of keyword occurrence in each topic (red for disaster, green for sanitation, blue for poverty, and intermediary colors for a mixed proportion between the topics according to the legend). Node sizes are proportional to their degree (number of co-occurrences of a keyword with other keywords).

structures and dynamics of the productive-commercial-financial-legal circuits (Cardoso and Faletto, 1970; Fernandes, 1973; Cardoso, 1980; Lima and Oliveira, 2022), as well as about the social challenges underlying the mutual reconfigurations of rural and urban areas (Martins, 2000; Silva, 2004).

The sub-theme of poverty has been one of the main threads of this type of interdisciplinary connection due to the scientific concerns with the persistence of social injustice, given the material, spatial, and environmental metamorphosis that the country has been going through. The sociological perspective has produced

significant links to reinforce the connectivity in this topic through four simultaneous routes. First, stimulating other disciplinary fields to enrich the vision of the social unbalance behind their subjects—housing policies, healthcare services, economic, and educational opportunities, and so on—adding a sociological approach. Second, amplifying the sociological partnership with other fields to explore complex problems that deepen social inequalities, such as large investment project issues (Vainer and Araujo, 1992; Acserald et al., 2009; Zhouri et al., 2016; Milanez et al., 2022). Third, unfolding sociological studies about the missteps of the Brazilian

development both into subspecialties and correlated subthemes, such as sanitation, focused on sociology of health (Nunes, 2014), and disasters, subject approached by a sociology subspecialty of the same name (Siena, 2014). Finally, with the contributions from other fields, such as the computing sciences, it became easier to identify the articulation between trinomial components of poverty-sanitation-disasters and quantify their influence (Valencio et al., 2022).

All mentioned routes, in which the sociological perspective participates, have situated the poverty, sanitation, and disaster studies in different stages of consolidation, as well as different stages of internal articulation and articulation between them, evidenced by the graphs below. The networks constituted by the keywords of open-access articles in the 2003–2022 period on poverty are given in Figure 1A, disasters in Figure 1B, and sanitation in Figure 1C, with a node color legend in Figure 1D, indicating the proportion of occurrences of a keyword in each topic.

The patterns of Figure 1 reveal the existence of some defining structures of their respective subfields, of which we highlight four features as follows:

1. Single appearance keyword sets: Several connected components with fewer than six nodes are observed, presented as small sets in the edge of the network, unlinked to the main debate. They indicate that the core idea they express appeared only in one or a few articles of their topic, hence being regarded as the margins of the debate in their own space of thematic affiliation. However, these sets may also occur during emerging views, which take some time to be addressed by the mainstream of the debate, either to be legitimized or refuted.

2. Double (or more) appearance keyword sets: These are connected components in an all-to-all or almost all-to-all structure, which express strong reinforcement of same keywords. This structure is particularly present when the subthemes address public health issues. The public health field is strategic in the systematic and intense publication of its findings in the format of open-access articles and in the meticulous choice of keywords that translate the core of the study in connection with their main debate, which gives it quick visibility, engagement in the peer-to-peer network, and favors their collaborations with sociology and other disciplines.

3. Double (or more) appearance keyword sets with keywords appearing in different domains: These cases are all-to-all or almost all-to-all structures that intersect studies on poverty–sanitation, sanitation–disasters, poverty–disasters, and poverty–sanitation–disasters. Although these connected components may be inexpressive, disjointed, and peripheral in the structure of one of the specific subthemes (e.g., disaster studies), one or more of their nodes may be linked to a main connected component in another topic (e.g., poverty studies). Therefore, it indicates that the collaborative exercise, of scientific polyphony, can re-situate the importance of the findings, marginalized by a certain set of peers but valued by others.

4. Large complex components: These are the connected components composed with a large variety of keywords so that it necessarily requires a substantial number of articles to be formed. They are constituted by the progressive agglutination of subgraphs from each study and, when transcending an all-to-all structure, present a *complex* structure. The network hubs (central nodes, those with the greatest number of links) of the subthemes tend to reside in these large complex components. In the networks of poverty and disasters, one large complex component, forming the mainstream of the debate on the field, is clearly defined. The main hubs in the poverty network are "inequality", "cash transfer programme", and "socioeconomic aspects of health", while the main hubs in the disaster network are "vulnerability", "risk", and "climate change, variabilities, vulnerabilities, and extreme events". In the network of sanitation, two large complex components can be observed, the largest one reflects issues of "water and sanitation" (the main hub), "infrastructure", and "public policy", and the second largest component reflects issues of "public health" (the second main hub), "environment", and "social thought". The keywords that express the hubs from each field are presented in Supplementary material (Supplementary Section 3).

By observing the poverty studies network (Figure 1A), it is clear that it is the most connected among the three. Disasters (purple/red) and sanitation (green/brown) mediate links between poverty nodes. It means that the main ideas about poverty are passing through the approach to infrastructural and health issues (focused on sanitation), as well as the environmental–territorial dimension (focused on disaster studies), and are not limited to the socioeconomic dimension which they were traditionally associated with. The disaster studies network (Figure 1B) is the most fragile in terms of connectivity between its own studies, with a significant proportion of links being at the interface with the other subthemes. Although this indicates that the subtheme of disasters is more open to dialogue with the other topics, it also reveals that it is still in the process of building its own independent system of meanings. Although the association of disasters with poverty (purple/blue nodes) is more direct, including in the co-occurrence of several of the hubs of their networks, the associations with sanitation (green/brown nodes) often act as a mediator of both disaster-to-disaster and poverty-to-poverty nodes; that is, sanitation studies have acted as mediators in debates parallel to their focus. This is because the material and environmental expressions of the disasters that frequently occur in Brazil are directly related, as a cause or consequence, to the non-existence, inadequacy, or failure of the sanitary infrastructures of socioeconomically more susceptible territories, those where the impoverished of society is found. Finally, the sanitation studies network (Figure 1C) is very sparsely connected, more than the disaster network. However, it has significant connections with poverty, suggesting that one cannot discuss sanitation problems in the country without considering the dimension of poverty at its core. Disasters appear very little in the sanitation network as if the structural or day-to-day issues of pure sanitation aspects were more relevant to the debate than this type of acute crisis.

In the graph of the general network in Figure 2, the expressive scope of studies on poverty in the full debate is highlighted in comparison to sanitation and disasters, which occupies a smaller proportion of the network. Sanitation studies form hubs and connection regions slightly separated from the other fields, while most of the disaster connections are merged with the poverty debate.

The hubs in the general network enable the identification of the key issues to be addressed by science policymakers invested in the articulation of SDG objectives in the poverty–sanitation–disasters framework. Examples of observed hubs are "inequality", "cash transfer programme", "public policy", "socioeconomic aspects of health", and "water and sanitation", indicated in Figure 2, and with a full list provided in Supplementary material (Supplementary Section 2). Such hubs express the key ideas to be fostered not only in a future research agenda but also in the organization of events (conferences, workshops, and seminars), with scholars, government technical sectors, community leaders, NGOs, social movements, businesses, and the like. The sub-specialties of the disciplinary field of sociology have the merit of linking various aspects of poverty issues with the quality of the corresponding sectoral public policy. It does so by evidencing the contradictions when an expected public policy does not exist or is designed and implemented inappropriately, ineffectively, or insufficiently, making explicit the normalization of sub-citizenship. On the other hand, this fragmentation of sociological knowledge goes against the grain of the social and institutional interest in multifactorial links to facilitate the achievement of SGDs.

The structures of the networks presented point to an ongoing process of building a plural debate, still not fully consolidated, which is necessary to produce consistent theoretical and applied subsidies addressed to intersectoral public policies. Such plural debate is key for providing an effective contribution for the country to achieve and fulfill several objectives of the SDGs. Paradoxically, the stimulus of Brazilian scientific policies for interdisciplinary research, through research grants, linking the sociological field with other specialties and joining together the subthemes in this disciplinary field, leads to the further appreciation of the corresponding critical mass within each subtheme, and re-links them with the root theme of national development, so back to the origins of sociological thought but with fresh perspectives.

4. Conclusion

Brazil is a young multicultural nation and predisposed to experience rapid changes in its public institutional configuration and its local/intraregional socio-political-economic dynamics. This makes the process of national development quite unpredictable, unstable, and subject to the synthesis of a problematic double orientation—of a personalistic character of the heads of government and decision-makers and their alliances with arms of exogenous multipolar forces—which removes the ground of the feet of public planners while it increases the sociological debate. Despite continuing to be an instigating object of theoretical and applied constructs in that area, the topic of development was fragmented in the debate, leading to subtopics related to certain social conditions, sectorial policies, and specific critical circumstances. In this study, we focused on poverty, sanitation, and disaster as corresponding to such sub-themes, without detracting from the many others that spread across the vast Brazilian sociological field and its multiple sub-specialties.

Considering the illustrative panorama of how the mentioned subtopics have become denser and articulated in the last two decades, based on the keywords of open-access articles, which represent the basic ideas of their respective findings, it was identified that the debate on poverty issues is denser, both in the volume of publications and in the interweaving of its basic central thoughts, of what exists around sanitation and disasters. The last two, in addition to being more recent for sociological studies or associated with them, are more pulverized in terms of the content of their main ideas, which constitute many subgroups, with a small incidence and external links. However, it was noted that studies oriented toward the sub-theme of disasters are more incisively connected to those dedicated to poverty than the studies on sanitation.

This indicates that the theoretical or applied research efforts on the disaster sub-topic, summarized in the respective published open-access articles, have expressed their affiliation with a more distant and comprehensive social and sociological debate on poverty in Brazil, while the field of sanitation studies walks relatively alienated in terms of this, parameterized by other problems, such as those related to public health consequences and infrastructural aspects. Since the SDGs indicate the need for intersectoral articulation in the elaboration of public policies to face the challenges of poverty, sanitation, and disasters, the same is to be expected in the sociological knowledge production agenda.

Finally, the dataset presented is just an illustration of novel ways of organizing the debate on sub-themes of the development field in which sociology participates, and there was no intention of taking the expression of connections between keywords as a comprehensive view of the whole debate. They are just useful clues to indicate the directions of such debate, which patterns emerged and are driving the open-access research articles in the field. Notably, in this area, there is still a significant production in the form of publication of books in physical format, articles without open access (mainly due to issues related to double-blind peer-review), and articles without a DOI registration or included in the main citation databases. Several journals have started the inclusion of their studies in such indexed systems only in recent years, which leads to a disproportionally higher number of keywords in the recent decade compared with the previous one (see Supplementary Section 1). The debate contained in these collections could not be included in this study. Possible associations occurring in the body of the text, but not in the keywords, would require more sophisticated computational methods of Natural Language Processing and thus were left for future studies.

Therefore, the datasets based on electronic platforms have not only created promising possibilities for collecting and systematizing different types of variables, able to decipher the directions of the Brazilian sociological field at a large scale, but also revealed their limits when the database itself is fragmented in the retrieval of works in this national context and knowledge area (Silva et al., 2022).

Author contributions

NV contributed to the study design, data collection criteria, and sociological analysis. AV contributed to the data collection, systematization, and analysis from the complex system approach. MB contributed to the data analysis from the complex systems approach. All authors contributed to writing 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/frsc.2023.1184532/full#supplementary-material

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