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(RESEARCH ARTICLE)

Food bank in the context of humanitarian assistance supply chain: Systematic research

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Abstract

This article presents a Systematic Bibliographic Research intending to collect, select, examine, understand, and synthesize the current publications on Food Bank in the context of the humanitarian assistance supply chain and, thus, establishing a scientific theoretical foundation on the subject. The analyzes performed were both quantitative and qualitative. The results indicate the evolution of publications in the last ten years, the main journals, among other quantitative data. Qualitatively, the articles were classified according to categories and subcategories defined in a specific protocol. Therefore, the results represent a synthesis of the main publications on the current state of knowledge about the Food Bank and intend to contribute to the identification of opportunities and trends for the development of future research.

Keywords: Food bank; Humanitarian logistics; Humanitarian supply chain; Food security.

1. Introduction

There are different types of Food Bank and this fact has encouraged the development of research in different countries. The American model, for example, consists of a Nation's Food Bank Network, formed by a centralized Food Bank that redistributes food to other local Food Banks, through partnerships with distribution organizations. In South Africa, a study by Warshawsky [1], studied the feasibility of applying the American Food Bank model to minimize food insecurity in poor areas of the region. In Portugal, Fernandes [2] proposed the redefinition of a Food Banks logistical processes, based on the identification of gaps that could contribute to improving the inefficiencies of the processes. In Canada, Tarasuki *et al.* [3], surveyed to define standards and relationships between five Food Banks located in the cities of Halifax, Quebec, Toronto, Edmonton, and Vitoria. In Spain, González-Torre and Coque [4], carried out an empirical study that aimed to identify the impact of Food Banks in the supply chains to which they belong. According to Bacon and Baker [5], in the United States, Canada, and Australia, Food Banks operate widely to obtain food and funds so that they can distribute fresh food or provide ready-made food. The authors also report that in the United Kingdom, the Trussell Trust is the largest Food Bank, which distributes food directly to more than 400 community Food Banks that operate as fresh food distributors. Arcuri [6] relates food insecurity and food waste in Italy through a framework, in which food redistribution is the key to these two sides of the same coin.

Considering the multiple approaches to Food Bank available in the literature, this article aims to conduct a systematic bibliographic search to collect, select, examine, understand and synthesize current publications on Food Bank in the context of the humanitarian assistance supply chain and, in this way, to establish a scientific theoretical foundation on

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the subject. Searches of articles were carried out in databases, based on a protocol that established the definition of categories, classification of articles according to these categories, and quali-quantitative analysis of the articles.

This article is structured, as follows: section 1 of this article, Introduction; section 2, Methodology; section 3 presents the Results of the Systematic Bibliographic Research and respective analyzes; section 4 presents the Final Considerations.

2. Methods

According to Biolchini *et al.* [7], Systematic Bibliographic Research is developed in order to gather and evaluate the available evidence pertaining a focused topic. In this article it was adopted because it requires greater scientific rigor in its execution, allowing reproducibility.

Three phases were defined for the development of this Systematic Bibliographic Research: Input, Processing, and Output.

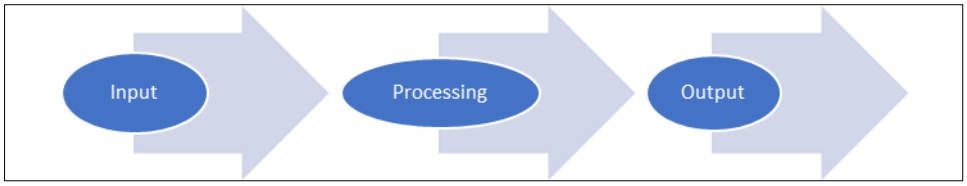

Figure 1 Phases of Development of Systematic Bibliographic Research

2.1. Input

Objective, search period, primary sources, search strings, inclusion criteria, and categories for the classification were defined in the input phase as described in Table 1.

Table 1 Inputs for Systematic Bibliometric Research

Input	
Objective	Collecting, selecting, examining, understanding, and synthesizing current publications on Food Bank in the context of the humanitarian assistance supply chain.
Search Period	2010 to 2020
Fontes Primárias	Scopus base
Search Strings	"Food bank", "Food security", "Logistic", "Supply chain"
Inclusion Criteria	Food Bank's supply chain. Journal articles, peer-reviewed.
Categories for the classification	Approach; methodology; area; food segment; decision level; level of centralization of the donations; logistical processes; stakeholders; type of food; type of coordination; goal; contributions.

2.2. Processing

For the Classification of Articles, some categories and respective subcategories were defined, as detailed in Table 2.

Table 2 Classification of Articles

Categories	**Subcategories**
Methodology	A – Survey B – Conceptual C – Case study D – Modeling and Simulation
Approach	A – Qualitative B – Quantitative C – Qualitative and Quantitative
Research Area	A – Nutrition B – Engineering C – Agronomy
Food security	A – Hunger reduction B – Minimizing food waste C – Resilience D – Conceptual
Decision level	A – Strategic B – Tactical C – Operational
Optimization	A – Deterministic B – Heuristics C – Stochastic D – Hybrid
Application	A – Donation B – Distribution C – Donation and Distribution
Logistic Processes	A – Process mapping B – Transport C – Storage D – Packaging E – Movement
Program	A – Food bank B – Comparison between Programs C – Other Programs
Food Type	A – Nonperishable B – Perishable C – Undefined
Coordination	A – Governmental B – Private C – NGO
Purpose	A – Non-profit B – For-profit
Contributions	A – Positives B – Negatives

Based on Table 2, the analyzes of the articles were carried out and the results were obtained in a quali-quantitative method.

2.3. Output

In the Output Phase, the resulting articles were registered and, based on the analyzes, it was possible to establish a synthesis of the results and conclude on the knowledge stage about Food Banks in the context of the humanitarian assistance supply chain. The analyzes were performed graphically to facilitate visualization and to promote better interpretation and direction for future research.

3. Results

The research was carried out according to the defined protocol and resulted in 54 articles. The analysis of the results was divided into two: preliminary analysis and classificatory analysis.

3.1. Preliminary analysis

The preliminary analysis had as its focus the quantification of publications, listed by year, by author, by affiliation, by country, and by journal. In Figure 2, we identify how these articles were distributed in the period between 2010 and 2020.

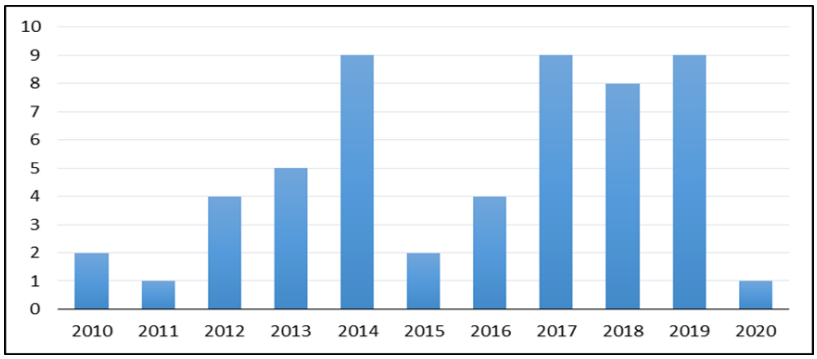

Figure 2 Articles Published in the 2010-2020 Period

The graph in Figure 2 shows a trend of growth in publications in recent years, concentrating 57% of publications as of 2016. However, conclusions about the year 2020 cannot be made, as it has not been analyzed in its entirety.

Considering the authors of the articles, it is possible to notice that the two authors who published the most, have three articles each, they are Ahmed Ghoniem and Julie S. Ivy. We can also conclude that the institutions most evidenced in research about the topic in question are the University of Massachusetts and North Carolina State University.

Figure 3 Represents the geographic distribution of the authors

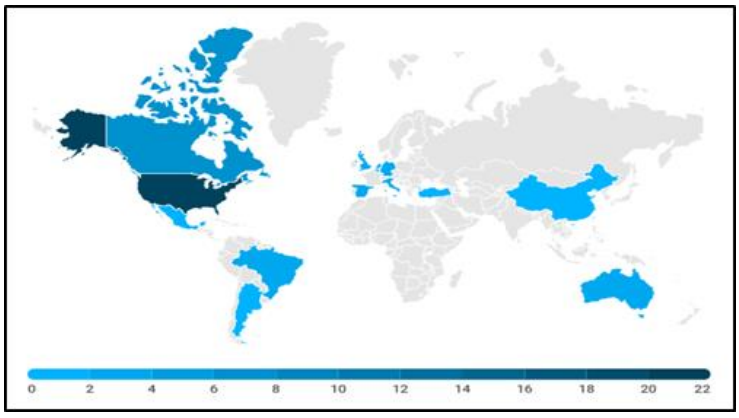

Figure 3 Geographical distribution of publications

From Figure 3 it is possible to conclude that the United States presented the largest number of publications, according to the research protocol developed, obtaining a total of 21 articles. Canada appears in second place, with six publications. Italy, the United Kingdom, Brazil, and Israel each have three publications. According to the geographic distribution, it is observed that North America concentrates the majority of publications, while in other regions the publications are dispersed. Other countries with the lowest number of publications are Australia, Germany, Spain, Turkey, Mexico, Belgium, Netherlands, Argentina, and China.

3.2. Classificatory Analysis

The second stage of analysis consisted of classifying the selected articles in the defined categories and subcategories to synthesize scientific knowledge about Food Bank in the context of the humanitarian assistance supply chain.

3.2.1. Categories: Methodology, Approach, and Research Area

Figure 4 shows the result of the classification of articles in the categories methodology (1) and its respective subcategories (A, B, C, D), approach (2) and its respective subcategories (A, B, and C), and research area (3) and its respective subcategories (A, B, C, D).

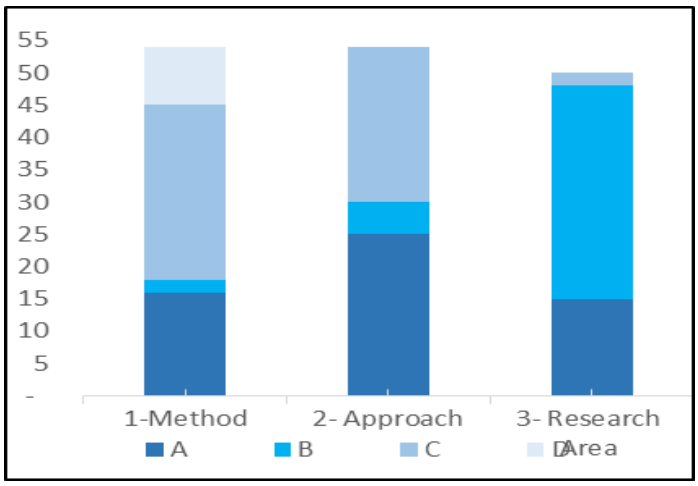

Figure 4 Results of the Methodology, Approach, and Research Area Categories

As shown in Figure 4, in the methodology category the highlights are for the subcategories: case study, C, which corresponded to 50% of the analyzed publications, and, conversely, the conceptual subcategory, B, which was found in only 4% of the publications. Concerning the approach category, most publications fall into the subcategories qualitative, A, or quali-quantitative, C. Similarly, in the category of the research area, the subcategory agronomy, C, is represented by only 4% of scientific works, while the engineering subcategory, B, represents 61% of the publications examined.

3.2.2. Category: Food Security

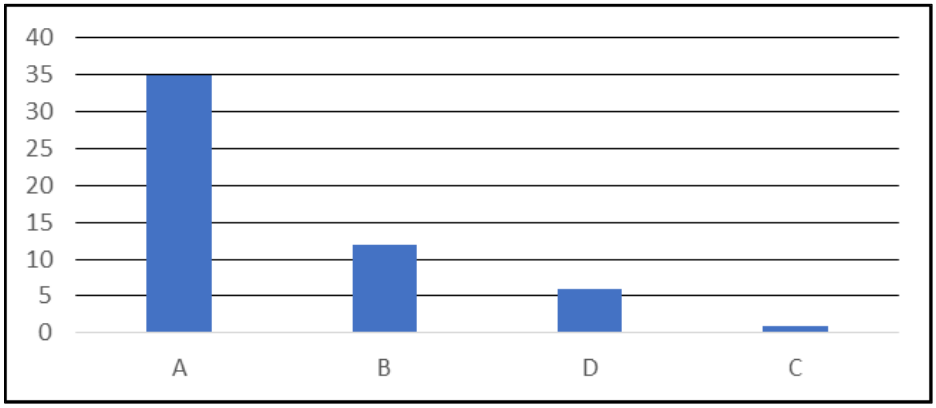

Figure 5 Results of the Food Security Category

In this category, the articles were examined for their contribution to food security. The articles were then classified into the subcategories: reduction of hunger, minimization of food waste, resilience, and conceptual. Figure 5 presents the results for this category.

The subcategory hunger reduction was evidenced in 35 articles. Minimizing food waste was addressed in 12 articles. Six articles conceptually addressed food security, however, when the focus is resilience against disasters, only one article was found, and this one considers both resilience and the reduction of hunger.

3.2.3. Category: Decision Level

Figure 6 presents the result of the analysis of the articles regarding the category decision level and its respective subcategories.

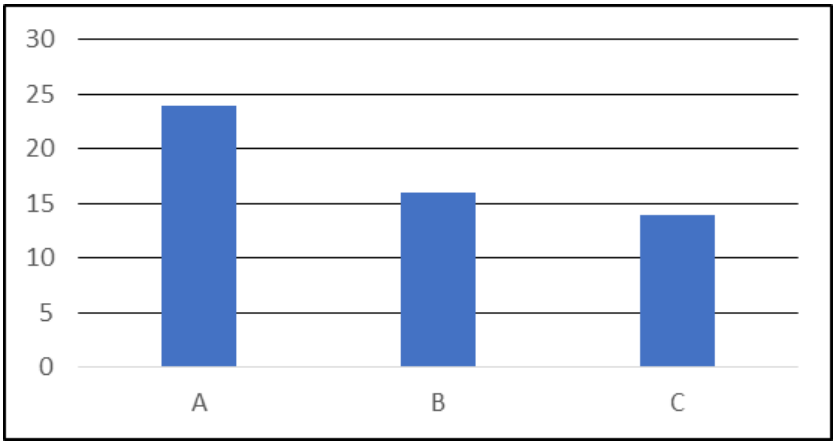

Figure 6 Results of the Decision Level Category

The analysis of the articles revealed that most publications are classified at the strategic level, A, totaling 24 articles. These articles analyze the policies of the Food Bank, the social function of the Food Bank, the functioning of the Food Bank as a system or network of organizations acting together, among others. At the tactical, B, and operational levels, C, 16, and 14 articles were classified, respectively. Many of these articles report the application of management or optimization tools in the search to reduce food waste or define a more equal distribution of donations.

3.2.4. Categories: Optimization and Application

In this step, the results were obtained together for the optimization and application categories. Thus, the first articles were selected in the optimization category, highlighting them in the subcategories of methods: deterministic, A, heuristic, B, stochastic, C, and, hybrid, D. The resulting articles were then selected in the application category to verify the subcategories: donation, distribution, or both. Figure 7 shows the results of this classification.

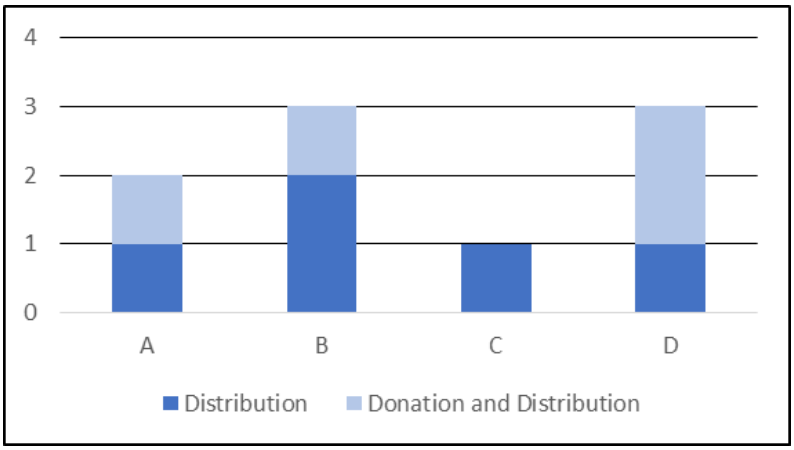

Figure 7 Result of the Optimization and Application Categories

Only nine articles presented applications of optimization methods, with a predominant emphasis on distribution, which begins at the Food Bank and ends at the beneficiaries. Three articles presented the development of heuristic methods, B, two articles applied deterministic methods, A, three articles reported the development of hybrid, deterministic, and heuristic methods, D, and one article presented the development of the stochastic method, C. Of the analyzed articles, four carried out studies covering the entire supply chain, which starts with donations and ends with food distribution.

3.2.5. Category: Logistic Processes

The articles were analyzed to obtain a classification in the subcategories mapping of logistics processes, A, transport, B, storage, C, packaging, D, and handling, F. The results are shown in Figure 8.

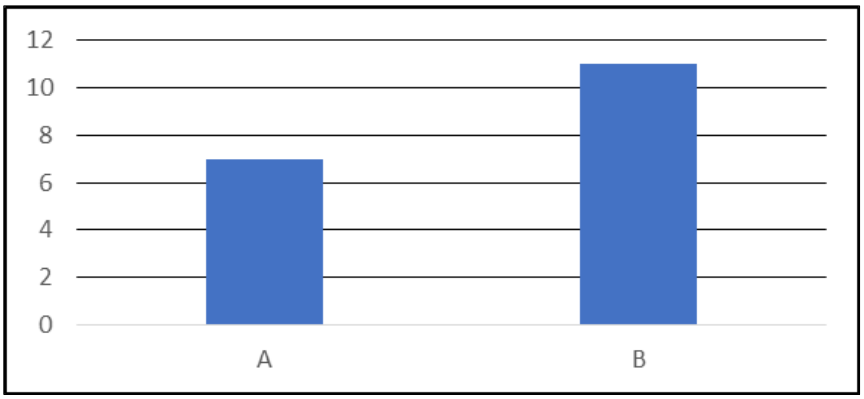

Figure 8 Result of the Logistic Processes Category

In this category, 18 articles were selected, with emphasis on the subcategories: processes mapping and transportation. The seven articles classified in processes mapping emphasized the operational activities of the Food Bank, while the articles in the transportation subcategory gave greater prominence in the distribution of food.

3.2.6. Category: Programs

The purpose of the analysis of this category is to verify the framing of the articles concerning different programs that deal with the issue of food security. Thus, the subcategories were defined as food bank, A, comparative between programs, B, and other programs, C. In Figure 9, it is possible to see the results.

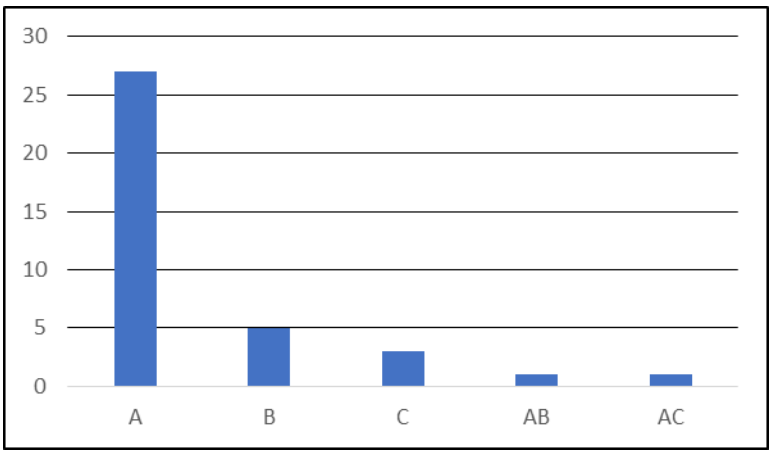

Figure 9 Results of the Program Category

37 articles were found in this category and the analysis of the subcategories indicates that the most significant program in the context of food security is the Food Bank. Fewer articles were found that only compare programs, B, and articles that report other programs, C, articles that address the Food Bank in conjunction with other programs, AC, articles that compare the Food Bank and other programs, AB.

3.2.7. Category: Food Type

In the category of food type, publications were analyzed to promote classification in the subcategories of perishable, A, non-perishable, B, or undefined foods, C. The results are shown in Figure 10.

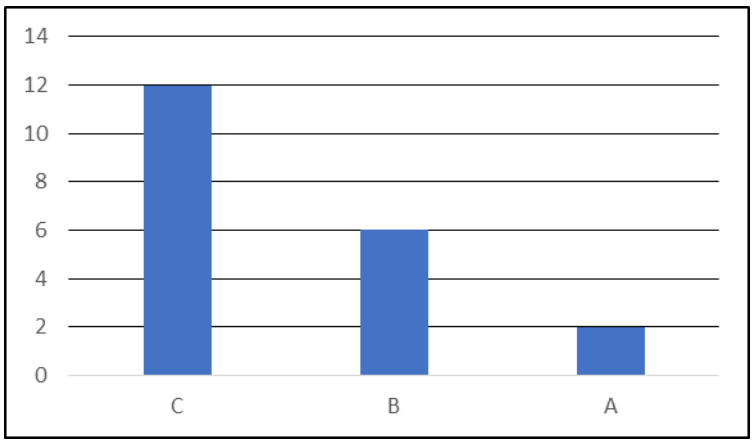

Figure 10 Result of the Food Type Category

According to Figure 10, only 20 articles were in this category. Most of the articles do not distinguish between perishable or non-perishable food, which could be noticed in 12 publications. Six articles discuss non-perishable and only two articles report perishable food. The others did not fall into this category.

3.2.8. Category: Coordination

In this stage, the articles were analyzed to classify the coordination of the Food Bank in the subcategories: government agencies, A, private agencies, B, or NGOs, C. The results are shown in Figure 11.

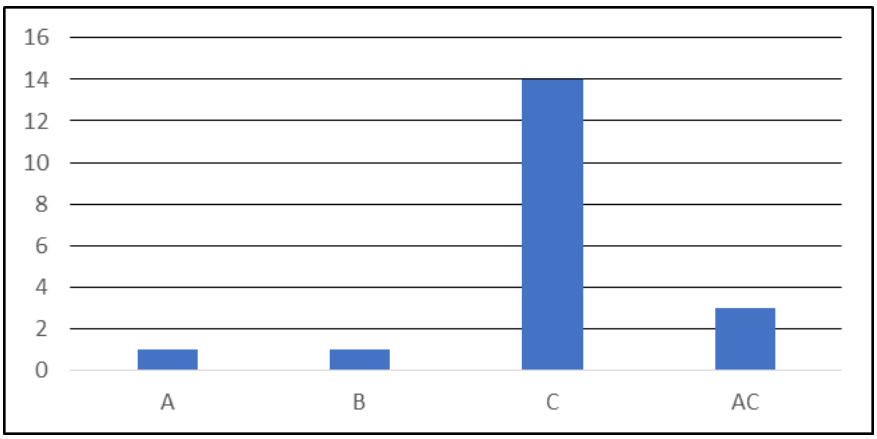

Figure 11 Result of the Coordination Category

It was possible to conclude that most of the articles analyzed report that the coordination of the Food Bank is carried out by NGOs. This analysis also made it possible to identify which private agencies and government agencies are poorly portrayed by the articles. However, some Food Banks are coordinates by NGOs and government agencies, at the same time. The other articles do not report the coordination.

3.2.9. Category: Purpose

In this category, the articles were analyzed to identify the purpose of the Food Bank under study: for-profit, A, non-profit, B.

In the purpose category, 16 publications were selected and the majority, 13 articles, reported non-profit Food Banks. Regarding the other analyzed publications, this category is not applied.

3.2.10. Category: Contributions

In this category, the contributions of the articles were analyzed to verify whether the indications were positive or negative concerning the Food Bank. We can see the results in the graph shown in Figure 12.

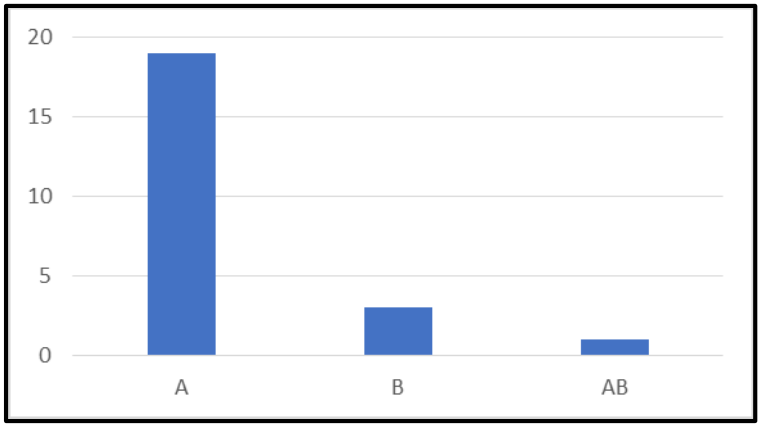

Figure 12 Result of the Contributions Category

Of the 23 articles selected in this category, we can see that there are many more articles that report positive aspects of Food Banks. Only one article analyzes the positive and negative sides and three articles present some negative indications about Food Banks. Among the negative indications, the following reports were identified: environment conducive to a high level of contamination of perishable foods, lack of ability to deal with the causes that lead people to social inequality and, consequently, hunger, lack of predictability regarding food donation, among others.

3.3. Summary of Classification of Articles

Table 3 presents the summary of the classification of articles, according to the definition presented in Table 2, all the classified papers are in the Appendix I - Systematic research articles and the first column represents the number of the article in Appendix I.

Table 3 Summary of Classification of Articles

Paper	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13
P [1]	A	C	B	A	B	-	-	-	A	-	-	-	-
P [2]	C	A	B	A	A	-	-	B	A	C	-	-	A
P [3]	A	C	A	A	A	-	-	-	-	-	-	-	-
P [4]	C	A	B	A	A	-	-	-	-	C	-	-	-
P [5]	A	C	B	A	C	-	-	-	A	C	C	A	A
P [6]	C	C	A	A	B	-	-	-	AC	-	-	-	-
P [7]	C	C	B	D	B	-	-	A	A	-	AC	-	AB
P [8]	D	B	B	A	B	D	B	-	A	-	-	-	-
P [9]	C	C	B	A	A	-	-	-	A	-	-	-	-
P [10]	D	C	B	B	B	A	C	B	A	-	B	-	-
P [11]	C	A	C	A	A	-	-	A	A	-	-	-	B
P [12]	D	B	B	B	B	B	C	B	-	-	-	-	-
P [13]	D	B	B	B	B	D	C	B	-	-	-	-	-
P [14]	C	C	B	B	A	-	-	-	-	-	-	-	-
P [15]	D	B	B	B	B	B	B	B	-	-	-	-	-
P [16]	A	C	B	A	A	-	-	-	A	-	-	-	-
P [17]	C	A	-	A	A	-	-	-	B	-	-	-	-
P [18]	A	A	B	A	C	-	-	-	C	B	C	B	A

P [19]	A	C	A	A	B	-	-	-	A	C	C	A	A
P [20]	B	A	B	B	A	-	-	-	B	-	-	-	A
P [21]	A	C	A	D	C	-	-	-	A	C	-	-	B
P [22]	A	C	A	A	A	-	-	-	-	-	-	-	-
P [23]	C	A	B	A	A	-	-	A	A	-	A	A	A
P [24]	C	A	A	A	A	-	-	-	C	B	-	-	-
P [25]	C	A	-	A	A	-	-	-	-	-	-	-	-
P [26]	C	A	B	D	C	-	-	A	A	-	-	-	A
P [27]	C	A	B	C	A	-	-	-	A	C	C	A	A
P [28]	C	A	B	A	A	-	-	-	A	C	C	A	-
P [29]	A	C	A	D	C	-	-	-	A	-	-	-	B
P [30]	C	A	B	A	A	-	-	A	A	-	C	A	-
P [31]	C	C	-	A	A	-	-	-	-	-	-	-	-
P [32]	A	A	A	A	C	-	-	B	A	A	C	A	A
P [33]	C	C	C	B	A	-	-	-	A	-	-	-	-
P [34]	C	A	A	A	A	-	-	-	A	-	-	-	-
P [35]	C	C	A	A	B	-	-	-	-	-	-	-	-
P [36]	D	C	B	B	B	A	B	B	A	-	-	-	-
P [37]	D	C	B	B	B	C	B	B	-	-	-	-	-
P [38]	C	A	A	A	A	-	-	A	A	B	C	A	A
P [39]	C	A	A	A	A	-	-	-	A	C	-	B	A
P [40]	D	B	B	B	B	B	B	B	-	-	-	-	-
P [41]	C	C	B	B	B	-	-	-	B	B	C	-	A
P [42]	A	C	B	D	C	-	-	A	A	C	C	B	-
P [43]	A	C	B	A	C	-	-	-	B	-	AC	-	A
P [44]	C	A	B	A	C	-	-	-	A	B	C	A	A
P [45]	B	A	-	D	A	-	-	-	-	-	-	-	-
P [46]	A	C	B	A	C	-	-	-	C	C	C	A	A
P [47]	A	A	A	A	C	-	-	-	B	A	C	A	-
P [48]	A	A	B	A	C	-	-	-	-	C	-	-	A
P [49]	D	C	B	B	B	D	C	B	-	-	-	-	-
P [50]	A	C	A	A	C	-	-	-	-	-	-	-	-
P [51]	C	A	B	A	B	-	-	-	-	-	-	-	-
P [52]	C	A	A	A	A	-	-	-	AB	-	-	-	A
P [53]	C	A	B	A	C	-	-	-	A	B	C	A	A
P [54]	C	A	B	A	A	-	-	B	A	C	AC	A	A

4. Final Remarks

According to the protocol defined for the development of this article, 54 articles were selected for investigation. Quantitative analysis shows an increasing trend in publications in recent years; however, it is still not possible to define an elite of researchers, considering that only two authors stood out, with three articles each. On the other hand, the authors' affiliation highlights the prominence of the University of Massachusetts and North Carolina State University, as well as a large concentration of publications in North America and, to a lesser extent, geographically distributed in different regions of the world.

The classification of articles into categories and subcategories provided a good understanding of the current state of knowledge related to the Food Bank in the context of the humanitarian assistance chain. Summarizing, the results

indicate greater development of case studies, with qualitative or quali-quantitative approaches, concentrated in the area of Engineering. In the context of food security, there are more reports of research developments related to hunger reduction, as well as a tendency to promote combined studies, with a focus on reducing hunger and minimizing food waste. The Food Bank is the most cited program among the programs that work to promote food security. Other programs described in the articles report policies to fight hunger, food security implementation programs, cash transfer programs (financial aid for food purchases), support programs for family farming, school lunch programs, etc. Most articles are classified at the level of strategic decision, with emphasis on the performance of the Food Bank as a system of interrelated organizations. Optimization is still little explored in the context of Food Banks. In this category, heuristic or hybrid methods (deterministic and heuristic) have greater relevance, with a predominance of applications in food distribution. Few articles were revealed that set out to carry out a systemic analysis of the Food Bank's supply chain, from donors to beneficiaries. In the category of logistical processes, were only found articles that emphasized mapping of logistical processes and transport. Most articles did not distinguish between perishable or non-perishable food. Government agencies are pointed by most of the articles as responsible for the coordination of the Food Bank and, therefore there are also a greater number of articles whose purpose is not for profit. The positive reports about the performance of the Food Bank are superior to the negative reports. In this context, we can mention articles that report that the Food Bank assists in directing food that would be wasted, acts as a central element between donors and beneficiaries, with an emphasis on coordinating the collection, storage, and distribution of donations, and contributes to the provision of food safety for people in situation of social vulnerability.

By the trends reported above, we have identified a set of opportunities for the development of new research. First, we showed great potential for the development of quantitative research, with an emphasis on modeling, simulation, and optimization, due to the potential of the models and methods to contribute to the minimization of food waste and reduction of hunger. These tools can assist studies that involve the entire Food Bank supply chain and make it possible to model the logistical processes involved in the Food Bank's assistance chain, such as transportation, storage, handling, and packaging. There is a gap in the analyzed literature that indicates an opportunity to develop research at the tactical and operational levels of the Food Bank, with an emphasis on temporary Food Bank studies. This modality of Food Bank can contribute to resilience in situations of disasters or complex emergencies. It is suggested that the next studies identify the type of food donated, as this information influences the type of treatment that must be given in the logistics processes, such as packaging, handling, transport, and storage. Finally, it is recommended to conduct studies that aim to reducing the contamination of perishable foods in the Food Banks, as well as analyzing the processes that involve the donation of food, seeking to minimize the unpredictability of supply and understand the representativeness of the Food Bank in addressing issues related to food security for people in situation of social vulnerability.

5. Conclusion

This article presents a systematic research with the aim of collecting, selecting, examining, understanding and synthesizing current publications on the Food Bank in the context of the humanitarian assistance supply chain. This context is of extreme importance today, especially at this time of pandemic where many people lost their livelihoods and increasingly need to depend on humanitarian aid networks to feed themselves on a daily basis. Due to the shortage of works in this area, this review can show possible paths, for other authors as well as encourage research to make the food bank supply chain more efficient.

Compliance with ethical standards

Acknowledgments

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Disclosure of conflict of interest

All authors have no conflict of interest.

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