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Strengthening Global Development: The Role Of ReverseLogistics In The Circular Economy

Fortalecendo o Desenvolvimento Global: O Papel da Logística Reversa na Economia Circular

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ABSTRACT

This study investigates the contribution of reverse logistics to the circular economy and its impact on global sustainable development. Using a systematic literature mapping approach, 492 articles from the Scopus database focused on reverse logistics and the circular economy were analyzed. This review identifies the main countries and leading authors in the field, as well as highlighting research trends and the most frequent keywords, such as "reverse logistics" and "circular economy". The results confirm the persistent relevance of this topic and highlight how reverse logistics is indispensable for the transition to more sustainable business practices. This article broadens the theoretical understanding of reverse logistics within the circular economy, proposing an integrated model that can serve as a basis for future research and business practices. Thestudy concludes that effective implementation of reverse logistics is crucial to achievingsustainable development goals, providing insights for policymakers, academics and practitioners.

Keywords: Reverse Logistics, Circular Economy, Sustainability, Sustainable Development, Systematic Review

RESUMO

Este estudo investiga a contribuição da logística reversa para a economia circular e seu impacto no desenvolvimento sustentável global. Utilizando uma abordagem de mapeamento sistemático da literatura, foram analisados 492 artigos da base de dados Scopus focados em logística reversa e economia circular. Esta revisão identifica os principais países e autores líderes na área, bem como destaca as tendências de pesquisa e as palavras-chave mais frequentes, como "logística reversa" e "economia circular". Os resultados confirmam a relevância persistente deste tópico e ressaltam como a logística reversa é indispensável para a transição para práticas empresariais mais sustentáveis. Este artigo amplia a compreensão teórica da logística reversa dentro da economia circular, propondo um modelo integrado que pode servir de base para futuras pesquisas e práticas empresariais. O estudo conclui que a implementação eficaz da logística reversa é crucial para alcançar os objetivos de desenvolvimento sustentável, proporcionando insights para formuladores de políticas, acadêmicos e profissionais.

Palavras-chave: Logística Reversa, Economia Circular, Sustentabilidade, Desenvolvimento Sustentável, Revisão Sistemática

INTRODUCTION

The concept of sustainable development has driven various areas of knowledge to seek efficient and innovative solutions to the environmental and social challenges faced globally. In this scenario, reverse logistics and the circular economy have emerged as two essential pillars in promoting sustainable practices. Reverse logistics, as described by Rogers and Tibben-Lembke (2001), involves efficient planning, implementation and control processes for the reverse flow of products, from the point of consumption to the point of origin, with a view to their recovery or proper disposal. On the other hand, the circular economy proposes an economic model that moves away from the traditional "extract, manufacture, use and dispose", emphasizing the reuse and maximization of resources (GEISSDOERFER et al., 2017).

The combination of these two strategies reduces the environmental impact of waste and reinforces sustainability in the life cycle of products. Martinez-Fernández et al. (2019) point out that reverse logistics is crucial to the circular economy, as it facilitates the reintegration of materials into the production cycle, reducing the need for virgin resources and lessening the burden on the environment. Despite the growing research and discussion on these topics, there is a significant gap in understanding how specific reverse logistics practices can be optimized to reinforce circular economy principles, especially in less explored contexts, such as in some regions of Brazil.

This article sets out to explore this gap by reviewing the existing literature and analyzing reverse logistics practices within the context of the circular economy. The research question guiding this study is: Which reverse logistics practices contribute most to the principles of the circular economy, and how can they be better integrated to promote sustainable development?

The aim of this work is therefore to evaluate the field of academic literature on reverse logistics and its interaction with the circular economy, identifying innovative practices and knowledge gaps. To this end, a bibliometric approach will be used with the aid of specialized software to map trends and the main authors and works in the field. In addition, the study aims to contribute to the debate on public policies, especially in regions such as the North of Brazil, where the implementation of sustainable management strategies faces unique challenges due to socioeconomic and geographical conditions (ARRETCHE, 2012; IBGE, 2019).

The structure of this article is outlined as follows: after this introduction, we will present a review of the literature on reverse logistics and the circular economy, followed by a methodological analysis of the data collected and a discussion of the results. We conclude with recommendations for future practices and public policies based on the insights generated by the study.

THEORETICAL BACKGROUND

SUSTAINABLE DEVELOPMENT

The definition of sustainable development, crystallized by the Brundtland Commission in 1987 through the report "Our Common Future", marked a turning point in the global discourse on how to balance economic growth with environmental conservation. This report, launched under the auspices of the UN, presented the first formal definition of sustainable development and proposed the integration of environmental protection into economic development practices (WORLD COMMISSION ON ENVIRONMENT AND DEVELOPMENT, 1987). In 2015, the United Nations continued this dialog with the 2030 Agenda for Sustainable Development, establishing 17 Sustainable Development Goals (SDGs) to address key global challenges by 2030, including eradicating poverty, ensuring quality education, and promoting sustainable patterns of production and consumption (UNITED NATIONS, 2015).

Within this framework, reverse logistics stands out in Goal 12, which focuses on ensuring sustainable consumption and production patterns. This concept describes practices related to the return of products, packaging and materials to the production cycle or supply chain, promoting recycling, reuse and waste reduction. Studies such as those by Moura (2019) highlight reverse logistics as a crucial strategy for achieving sustainability by recovering materials that would otherwise be discarded, contributing to the conservation of natural resources. In addition, Jayaraman and Luo (2007) identified that such practices mitigate environmental impacts and offer significant competitive advantages, reducing operating costs and increasing customer satisfaction through environmentally responsible processes.

Reverse logistics flows can be categorized into product returns, packaging and materials for recycling, each requiring efficient management to maximize benefits and minimize environmental impacts (LE BLANC et al., 2011). However, effective

implementation of this approach faces challenges such as collection, sorting of returned products, and management of processes in the reverse supply chain, requiring creative and collaborative solutions to overcome these barriers (SRIVASTAVA, 2008).

The circular economy, endorsed by McDonough and Braungart (2010), proposes a model of production and consumption that reuses, recovers and recycles materials and products, reducing waste and minimizing environmental impacts. They introduced the concept of "cradle to cradle", suggesting that all materials used in the manufacture of products should be considered safe and healthy nutrients, capable of being fully recycled or reused, eliminating the idea of waste (McDonough & Braungart, 2002).

The circular economy approach also aligns with the theory of complex adaptive systems (TSCA), suggesting that the economy is a complex system that involves the continuous interaction between various actors, such as companies, governments and consumers, who together seek sustainability (GEORGALLIS et al., 2019). In addition, the Ellen MacArthur Foundation (2012) emphasizes that the circular economy is based on the biological principle that waste from one activity can serve as resources for another, encouraging innovation and creating new business opportunities.

These concepts and theories together form a robust framework for understanding and advancing the implementation of sustainable practices that protect the environment and foster economic growth and social well-being. Thus, the link between reverse logistics and the circular economy represents a fertile field for research and public policy development, promoting a more sustainable and resilient future.

LOCAL DEVELOPMENT THROUGH PRODUCTIVE IMPROVEMENT

Research into sustainable local development has become increasingly relevant inthe field of environmental and social sciences, especially when related to the widely debated concept of sustainable development. Since the introduction of this concept by the Brundtland Commission in 1987, academics such as Fenzl (1997) have pointed out the complexity and diversity of interpretations that emerge depending on the interests of those involved. The various interpretations of sustainable development often result in a high level of abstraction and a lack of concrete elements for measuring the

sustainability of development processes, making the need for a more precise operational definition critical.

In the context of local development, the specificities that define the applicable practices and concepts are drawn from a myriad of global experiences. These practices have been justified and confirmed by positive results in various socio-economic indicators, as described by authors such as Mathis (2002), who distinguishes sustainable development from traditional development by its inclusion of the society-nature dynamic. In addition, theorists such as Sachs (1993) and Fischer-Kowalski and Haberl (1993) emphasize the need for harmony between economic efficiency, social equity and ecological precaution, proposing that the consumption of renewable resources should not exceed their renewal capacity, and that the waste produced should be managed within the absorption capacity of ecosystems.

This approach is in line with the thinking of Sandroni (1939), who contextualizes sustainable development within the fields of ecology and administration, focusing on development that does not deplete natural resources or compromise the environment for future generations. In the context of local development, authors such as Franco (1998) propose that promoting sustainable communities capable of developing their local potential and vocations is an effective strategy for sustainable development. Blakely (1994) suggests that it is still premature to formulate a complete theory for local economic development, but emphasizes the importance of synthesizing and reformulating concepts from traditional economic theories in order to adapt them to the local context.

Development indicators, as discussed by Bruyn and Druinen (1999), are essential for understanding and measuring sustainable development. Mathis (2002) stresses the importance of the choice of these indicators, which directly reflects how sustainability is defined and the reference system chosen. These indicators have been used by organizations such as the Club of Rome and the World Watch Institute to measure global sustainability and by local initiatives such as Sustainable Seattle to develop municipal indicators. Bessel (1999) advocates a systemic approach to defining sustainability standards, proposing a set of indicators for different sectors of society thatcan help guide public policies and business actions.

As far as macro indicators are concerned, the United Nations uses measures such as the Human Development Index (HDI) to classify countries according to their level of development, using health, education and income indicators. This systemic

approach allows for a more holistic and integrated understanding of the variables that influence development.

The interconnection between reverse logistics and the circular economy is a practical example of how sustainable development theories and practices can be applied to strengthen production processes, promoting development that is both environmentally friendly and economically viable. This approach reinforces technological improvement, international excellence and supports the continuous search for development that respects and preserves natural resources, in line with the ideal of not compromising the ability of future generations to meet their own needs.

THE OECD'S CONTRIBUTION TO DEVELOPMENT.

Global and regional governance has proved fundamental in guiding economic development and market integration policies, especially in a context characterized by economic interdependence and the challenges of protectionism. Organizations such as the Organization for Economic Cooperation and Development (OECD) play a crucial role in this scenario, facilitating the exchange of information and aligning policies between member countries with the aim of boosting global economic growth. As reported by the Ministry of Economy (BRASIL, 2019a), the OECD and other regional entities such as the Latin American Integration Association (ALADI) and the Southern Common Market (Mercosur) are examples of collaborative efforts to strengthen market agreements and sustainable development policies.

The ALADI, for example, represents an ongoing effort since its conception in the Treaty of Montevideo to promote economic integration through the elimination of tariff and non-tariff barriers, with the aim of establishing a common Latin American market (BRAZIL, 2019c). The classification of member countries into categories based on economic development reflects diversity and the need for policies adapted to different economic and structural realities.

Similarly, Mercosur seeks economic integration through measures that include the free movement of goods, services, workers and capital, as well as the coordination of macroeconomic policies and the harmonization of legislation, in accordance with the Treaty of Asunción (BRAZIL, 2019). These initiatives are fundamental to creating a favorable business environment and stimulating regional economic development.

However, despite the reduction of tariffs and other quantitative restrictions since the creation of the GATT in 1947 and the subsequent formation of the WTO in

1995, new forms of protectionism have emerged, especially through national technical regulations that set complex requirements for imported products, often justified by legitimate objectives such as health and safety (BRAZIL, 2019b). These 'technical barriers to trade' represent a significant challenge to global trade governance.

In response to these challenges, the need for more inclusive and adaptive governance has been widely discussed. Braga (2010) emphasizes the importance of considering social, economic and environmental interrelationships as part of an effective governance strategy that values local production chains and family farming, promoting sustainability and inclusive economic development.

The Ministry of Economy (BRASIL, 2019c) points to an evolution in the concept of public administration, which traditionally emphasized a centralized and bureaucratic role for the state, towards a governance model that engages multiple actors, including the state, the private sector and the third sector. This model recognizes the state as an orchestrator and promoter of development, adopting more flexible and results-oriented management practices that promote greater accountability and transparency.

The concept of governability, as discussed by Huntington in the 1960s and 1970s, highlights the importance of a balance between the demands of public participation and the capacity of government institutions to respond effectively. In timesof intense democratic participation, political systems are tested to their limits, but their ability to adapt and cohere is crucial to maintaining the stability and effectiveness of governance.

Therefore, the discussion on governance and governability reflects on internal administration and politics and on how nations can collaborate on a global and regional scale to tackle common challenges, promoting development that is economically viable, socially inclusive and environmentally sustainable. These joint efforts are vital to overcome technical and protectionist barriers, facilitating a more integrated and fair business environment globally.

METHOD

The application of bibliometric methods in the study of generic algorithms in production planning represents a valuable approach in academic research, allowing for a rigorous quantitative analysis of existing publications. Zupic and Čater (2015) highlight bibliometrics as a methodology that provides a solid basis for researchers to

base their investigations on bibliographic data. The technique stands out for its ability to synthesize vast amounts of information and identify trends and gaps in fields of study. Caputo et al. (2021) complement this view, pointing to bibliometrics as a dynamic tool that compares results using different biometric indicators, thus facilitating a deeper understanding of research dynamics.

Using this method, a survey was conducted of scientific publications on production planning with a focus on generic algorithms, using the Scopus database. The search was broad, covering articles published in English with no restrictions on the year of publication. The keywords used in the search were "logistics reverse" and "economy", resulting in the identification of 492 articles dealing with these interconnected themes. The use of these keywords reflects an attempt to capture the essence of studies linking reverse logistics and the circular economy, crucial aspects in optimizing resources and minimizing waste in production processes.

The subsequent phase of the study involved using VOSviewer software to map the connections and main trends within the identified corpus of literature. This visualization tool is especially useful for discerning patterns and relationships between different publications, authors and themes. The analysis carried out using VOSviewer enabled the creation of co-authorship and keyword co-occurrence maps, illustrating howthe themes of reverse logistics and economics are interconnected and which areas are receiving the most academic attention.

This bibliometric mapping method highlights the most influential works and predominant citations in the field and guides researchers on future research trajectories. Bibliometric analysis therefore serves as a compass that guides the academic community through the complexity and vastness of the existing literature, ensuring that subsequent research efforts are directed in an informed and strategic manner. By revealing the connections between different areas of study and highlighting emerging trends, bibliometrics offers a robust platform for the development of new research that can fill identified gaps and expand existing understanding in the field of production planning and reverse logistics.

This meticulous approach is fundamental to understanding the nuances of production planning where generic algorithms play a crucial role, especially in reverse logistics and circular economy contexts. The use of generic algorithms, known for their ability to find optimal solutions in complex and dynamic environments, has been increasingly adopted to optimize production processes involving multiple variables

and constraints. By mapping how these techniques are applied, bibliometric research reflectscurrent trends and indicates promising areas for future innovation.

In addition, bibliometric analysis provides a clear visualization of how international and interdisciplinary collaboration is shaping the field. Through the maps generated by VOSviewer, it is possible to observe clusters of cooperation between different countries, institutions and disciplines, underlining the global and collaborative nature of reverse logistics and circular economy research. These collaborations are crucial for the advancement of knowledge, as they combine diverse perspectives and specializations, enriching the understanding of challenges and possible solutions.

The mapping also reveals which regions of the world are at the forefront of research into generic algorithms applied to reverse logistics and the circular economy. Often, these perspectives lead to a deeper assessment of sustainability policies and industrial practices adopted in different contexts, encouraging the adoption of best practices and policies based on robust scientific evidence. In addition, the identification of emerging themes in the articles analyzed can guide funding agencies and policymakers to direct resources to areas of high relevance and potential impact.

Therefore, the contribution of bibliometric analysis extends beyond academia, influencing practical and strategic decisions in industries and governments. By providing a consolidated and analytically rich database, this methodology not only empowers researchers with valuable information on the current state of knowledge, but also equips decision-makers with the understanding needed to formulate effective responses to contemporary production and sustainability challenges.

In summary, the application of bibliometrics in the field of production planning with a focus on generic algorithms highlights a synergy between academic research and practical application, highlighting areas of common interest and promoting a virtuous cycle of innovation and implementation. This method therefore not only lights the way for future research, but also provides the necessary tools for research to produce tangible and significant impacts on society and the environment.

RESULTS

This research is crucial for both academia and industry, as it connects directly with current trends and the most relevant debates on capitalist production systems. In particular, the focus on the circular economy and reverse logistics offers a refreshing

perspective for understanding and improving production and consumption practices, challenging the traditional "take-make-discard" model characteristic of a linear economy. Kirchherr et al. (2017) argue that the circular economy proposes a reconfiguration of production and consumption patterns by slowing down, closing and narrowing resource cycles at different scales, aiming for environmental benefits, social equity and economic prosperity. In this context, reverse logistics plays a key role as a strategy for recycling or reducing waste and as an engine for innovation and adding value, transforming used products into valuable new resources.

The relevance of this approach is evidenced by the bibliometric analysis presented, which highlights the main contributors to the literature on the circular economy and reverse logistics. For example, the works of Bouzon, M. (with 439 citations) and Govindan, K. (with 451 citations) have not only been widely accepted in the academic community, but also signal a significant influence on the development of sustainable business practices. Campos L.M.S. and Rodriguez C.M.T., with respective 392 and 430 citations, also contribute significantly to the advancement of this field of study, emphasizing the importance of integrating robust theories with practical applications.

The impact of these authors and their research is reflected in the academic sphere and also in practical implementation within industries seeking to adapt to more sustainable business models. The influence of their findings on industry is crucial to the transition from a linear economic model to a more circular one, where resource efficiency is maximized and environmental impact minimized. This movement is not just a response to regulatory pressures or resource scarcity, but also a business strategy aimed at creating long-term value.

On the other hand, the contribution of authors such as Wang Y., Zhang M., and Kazancoglu Y., despite having fewer citations, is equally important. They bring new perspectives that challenge existing paradigms and suggest new directions for research and practice. The smaller number of citations does not diminish the relevance of their contributions, but highlights the diversity of approaches and the potential for exploring new ideas in the field of circular economy and reverse logistics.

This bibliometric analysis therefore provides an overview of the predominant academic influences and also serves as a guide for future research. Identifying these thought leaders allows new researchers and industry practitioners to understand which aspects of the circular economy and reverse logistics are being explored the most and

which areas still need further investigation. In this way, current research not only enriches existing knowledge, but also paves the way for future innovations that can effectively contribute to a more sustainable and resilient economy. Table 1 below shows the authors who have produced the most articles on the subject.

Table 1 - Authors by publication

Authors	**Documents**	**Quotes**
Bouzon m.	6	439
Campos l.m.s.	5	392
Rodriguez c.m.t.	5	430
Govindan k.	4	451
Singh r.k.	4	127
Wang y.	4	75
Zhang m.	4	79
Agnusdei g.p.	3	23
Flygansvær b.	3	34
Kazancoglu y.	3	181

Source: The authors extracted from VOSviewer (2023)

In addition to the individual contributions of the authors highlighted in the analysis in Table 1 above, it is crucial to explore how interactions and collaborations between these researchers can foster the development of more integrated theories and comprehensive practical solutions for the circular economy and reverse logistics. This aspect of the research emphasizes the importance of academic and industrial networks in propagating innovative ideas and making significant advances in the field.

The interdisciplinary collaboration, evidenced by the co-authorship and cross-citations between these authors' works, suggests a trend towards the convergence of knowledge from different disciplines - such as engineering, operations management, sustainability and social sciences - to tackle the complex challenges posed by the transition to more sustainable practices. This interweaving of disciplines is crucial toaddressing the multiple facets of the circular economy, which include technical aspectsof recycling, reuse of materials and economic, regulatory and behavioral considerations.

In addition, analysis of the geographical distribution of contributions reveals thatcertain regions may be leading the way in research and implementation of circular economy practices, while others may be less well represented. This global panorama suggests potential areas for expanding international research and collaboration, with a

view to sharing knowledge and adapting successful practices to specific local contexts, taking into account cultural, economic and political differences.

Another dimension that deserves attention in Table 1 is the impact of these studies on public policies and legislation. The work of authors such as Govindan and Bouzon can directly influence policymakers in the development of regulations that promote circular business models and reverse logistics practices. Thus, bibliometric analysis highlights key academic contributors and serves as a tool to identify how research can be translated into effective policy action.

In addition, technological advances, particularly in the area of information and communication technologies, offer new opportunities to optimize circular economy processes. The development of digital platforms and the use of big data and artificial intelligence can enable better traceability of materials, more efficient resource management and more innovative product design that facilitates reuse and recycling. The contribution of researchers in this area could be crucial to overcoming some of the technical obstacles that currently limit the wider application of the circular economy.

Finally, considering the emerging trends and challenges identified through the bibliometric analysis, it is possible to suggest future directions for research. Areas such as the social impact of the circular economy, the effectiveness of policies to encourage reverse logistics, and the integration of sustainability criteria into all phases of the product life cycle are fertile fields for future research. These areas enrich the academic debate and provide perspectives for companies and governments in their search for effective sustainable strategies, as can be seen from the number of documents and citations in Table 2.

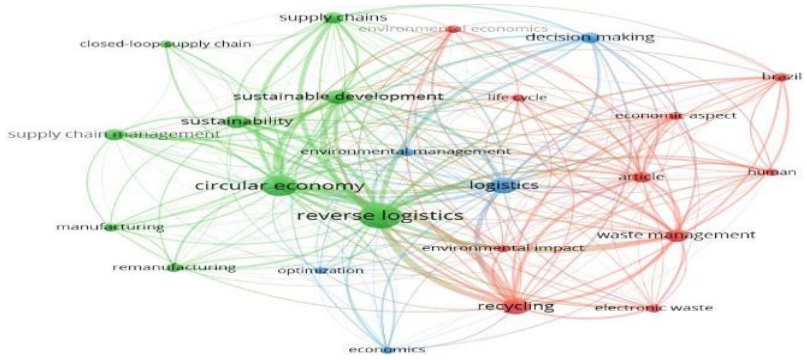
Table 2 - Countries of publication

Countries	**Documents**	**Quotes**
Brazil	43	1151
China	39	1100
United States	29	1299
India	28	1009
United Kingdom	28	1119
France	14	562
Italy	10	274
Denmark	8	472
Iran	7	123
Norway	7	77

Source: The authors extracted from VOSviewer (2023)

The research revealed in Table 2 provides an enlightening overview of the global impact of research into the circular economy and reverse logistics, indicating the productivity of countries in terms of publications and the influence of these studies through citations. This survey clearly demonstrates the growing relevance of these topics, as well as the geographical disparities in academic contribution, which may reflect different levels of adoption and adaptation of sustainable practices around the world.

Figure 1 - The influence of studies on the circular economy and reverse logistics through citations:



Source: The authors extracted from VOSviewer (2023)

Brazil leads the way in terms of the number of citations and documents, with 43 publications and 1151 citations, which highlights the intensity of the research carried out in the country on these topics. However, this high number also raises questions about the depth and scope of the debate on the circular economy and reverse logistics within the country. Although there is a significant amount of research, it is crucial to question whether the dissemination of knowledge is being effectively translated into practice and policy. Brazil's prominent presence can be seen as an opportunity to lead more in-depth discussions and develop innovative strategies that can be shared globally. China, following closely behind with 39 documents and 1100 citations, and the

United States, with 29 documents but leading in citations per document, reflect the importance and scale with which the circular economy and reverse logistics are being incorporated into these countries' research and development agendas. The high citation rate in the United States may indicate a significant influence of its research on the definition of international standards and practices. The comparison between these countries highlights different research styles and focuses, as well as the potential application of their findings in industrial policies and practices.

In addition, countries such as the United Kingdom and India show a robust commitment to these issues, each with 28 documents and more than 1000 citations. Thisinterest reflects the growing global concern about sustainability and the search for solutions that can mitigate the environmental impacts of industrial activities. France, Italy, Denmark, Iran and Norway, although contributing fewer papers, still show significant engagement, which suggests a geographical diversification of interest and expertise in circular economy and reverse logistics.

The need to broaden the scope of these studies is evident, given that the circular economy and reverse logistics are essential for tackling contemporary environmental challenges and promoting more sustainable development. The current focus on sustainable production and consumption must be accompanied by a wider dissemination of knowledge and best practices, ensuring that the innovations and strategies developed are shared and adapted globally. This requires stronger international collaboration and research networks that transcend national borders, facilitating a more dynamic exchangeof ideas and technologies.

The table presented underlines the need for a deeper study of the circular economy and reverse logistics and highlights the importance of a more integrated global debate and policies that encourage research and the implementation of sustainable practices on an international scale. The expansion of this field of study is vital for academic advancement and practical progress towards a more sustainable and economically viable future.

As research into the circular economy and reverse logistics continues to expand globally, it becomes imperative to understand the impact of these discussions beyond academic and industrial boundaries, directly influencing society and environmental policy on a wider scale. This perspective suggests the need to explore how the innovations and knowledge generated by this research are being integrated into the everyday practices of communities and government policies to promote systemic change.

One of the aspects that deserves attention is the application of these concepts in emerging and developing economies. Countries like Brazil and India, which figure prominently in the publications and citations table, face unique challenges due to their rapid industrialization and population growth. This positions them as natural laboratories for the implementation of circular economy practices, which can offer

solutions to critical issues such as waste management, resource efficiency and poverty reduction through new business models based on the reuse and recycling of materials.

Additionally, the transfer of knowledge between developed and developing countries could be explored further. Although countries such as the United States and the United Kingdom have high citation rates, indicating an influential knowledge base, the applicability of their research in different geopolitical and economic contexts needs to be assessed. This highlights the need to adapt practices and strategies to suit local conditions, a crucial aspect for the effective implementation of circular economy initiatives.

Another important consideration is the role of education and training in shaping future generations of researchers and professionals who will deal with sustainability issues. The amount of research produced in countries with high academic activity suggests a strong educational infrastructure in relevant areas. However, it is vital that education in circular economy and reverse logistics is incorporated into all levels of education, from primary to higher education, to cultivate a mindset that values sustainability from an early age.

Collaboration between academia, industry and government also needs to be strengthened. Strategic partnerships can accelerate innovation and the implementation of practical solutions that benefit all parties involved. For example, applied research projects can be co-funded by companies and government bodies, ensuring that the results are both academically rigorous and economically viable and socially relevant.

Finally, assessing the social impacts of this research is crucial. The circular economy is not just about environmental and economic efficiency; it also involves deep ethical and social considerations. Including local communities in the planning and execution of circular economy projects can help ensure that the benefits of these initiatives are distributed fairly and that the solutions are culturally sensitive and widely accepted.

The analysis of bibliometric data reveals the need for more research and grants the opportunity to shape a sustainable future through a holistic approach that integrates science, technology, public policies and community practices. This promising path could potentially lead to a significant transformation in the way resources are used and reused, contributing to a more sustainable and equitable world.

CONCLUSION

The bibliometric analysis carried out in this study revealed that the circular economy and reverse logistics are topics of growing interest in academic and industrial circles. Brazil and China emerge as leaders in terms of the volume of publications and citations, showing a strong commitment to these topics. The research highlighted the importance of circular economy strategies for environmental sustainability and for economic prosperity and social equity. Reverse logistics, identified as a crucial component of the circular economy, is recognized for its ability to add new value to already used products, emphasizing reuse and recycling as pillars for a more sustainableeconomic model.

This study answered the research question of how the circular economy and reverse logistics are being addressed in the academic and industrial literatures, and achieved the objectives of mapping relevant scientific production and understanding the geographical distribution of research. It was possible to identify the main contributors, research trends and emerging practices that are shaping the field.

This article contributes to the literature by providing a comprehensive analysis of the current state of research in circular economy and reverse logistics, offering a detailed overview of academic leaders and their influences. Practice also benefits, as the findings can guide companies and public policies in implementing more effective sustainable strategies, based on robust scientific evidence.

For the practical implementation of the findings, it is recommended that industries adopt business models that integrate reverse logistics into product design, facilitating disassembly and recycling. Governments should consider policies that encourage the circular economy, such as subsidies for recycling technologies and laws that require sustainable production practices. In addition, it is vital to promote partnerships between universities and industries to foster continuous innovation and the application of research to solve practical problems.

Limitations of this study include the reliance on data from publications that may not fully capture the practical application of the theories discussed. In addition, the analysis focused predominantly on publications in English, which may have excluded valuable contributions in other languages.

Future research should explore how circular economy and reverse logistics strategies are implemented in different cultural and economic contexts, particularly in

emerging economies. It would also be relevant to investigate the long-term impact of these practices on companies' sustainability metrics. In addition, future studies could focus on developing quantitative indicators to measure the effectiveness of circular economy policies. Finally, more research is needed to explore the integration of digital technology to support circular economy processes and reverse logistics, especially in areas such as artificial intelligence and blockchain.

This study has paved the way for a deeper understanding of the circular economy and reverse logistics, highlighting the need to continue exploring these vital topics for global sustainable development.

REFERENCES

ARRETCHE, M. Democracy, federalism and centralization in Brazil. Rio de Janeiro: FGV/Fiocruz, 2012.

BLAKELY, E. **Planning local economic development**: Theory and practice. Thousand Oaks, California: SAGE Publications, 1994.

BRASIL. Ministério da Economia. Planning, development and management. Brasília: s/e, 2019. Disponível em: http://www.planejamento.gov.br/. Acesso em: jan. 2019.

BRASIL. Ministério da Economia. Accounting and Fiscal Information System for the Brazilian public sector - SICOFIN. Brasília: STN, 2019.

BRASIL. Ministério da Indústria, Comércio Exterior e Serviços - MDIC. Foreign trade. Brasília: MDIC, 2019. Disponível em: http://www.mdic.gov.br/. Acesso em: fev. 2019.

BRUYN, S.; DRUINEN, M. **Sustainability and indicators**. In: AMAZÔNIA: Discussion document prepared for kick-off meeting of Amazônia 21. Caracas: s/e, 1999.

FENZL, N. Studies on parameters capable of measuring the sustainability of a development process. In: XIMENES, T. (Ed.). Perspectives of sustainable development: A contribution to Amazonia 21. Belém: NAEA/UFPA, 1997. p. 52-89.

FISCHER-KOWALSKI, M.; HABERL, H. Metabolism and colonization. Modes of production and the physical exchange between societies and nature. **Innovation in Social Research**, 1993.

FRANCO, A. de. **The reform of the state**. In: SEMINÁRIO SOCIEDADE E REFORMA DO ESTADO - Proceedings. São Paulo: Ministry of Federal Administration and State Reform, 1998.

ELLEN MACARTHUR FOUNDATION. Towards the Circular Economy: Economic and Business Foundations for an Accelerated Transition. 2012. Disponível em: https://www.ellenmacarthurfoundation.org/assets/downloads/publications/TCE_Ellen-MacArthur-Foundation_2012.pdf.

GEISSDOERFER, M.; SAVAGET, P.; BOCKEN, N. M.; HULTINK, E. J. The circular economy - A new sustainability paradigm? **Journal of Cleaner Production**, v. 143, p. 757-768, 2017.

GEORGALLIS, P.; IOANNOU, I.; PAPADOPOULOS, A. Circular economy: Origins, approaches, and management. **Sustainable Production and Consumption**, v. 20, p. 20-32, 2019.

JAYARAMAN, V.; LUO, Y. Creating competitive advantages through new value creation: A reverse logistics perspective. **Academy of Management Perspectives**, v. 21, n. 2, p. 56-73, 2007.

KIRCHHERR, J.; REIKE, D.; HEKKERT, M. Conceptualizing the circular economy: An analysis of 114 definitions. **Resources, Conservation and Recycling**, v. 127, p. 221-232, 2017.

LE BLANC, I.; MEUNIER, D.; RÉMOUSSENARD, C. Designing reverse logistics networks: A state of the art literature review. **Omega**, v. 39, n. 6, p. 558-568, 2011.

MARTINEZ-FERNÁNDEZ, M.; TJAHJONO, B.; ROMERO, D. Implementing circular economy: A systematic review of the literature. **Journal of Cleaner Production**, v. 208, p. 908-923, 2019.

MATHIS, A. Instruments for regional sustainable development. Adcontar: **Journal of the Center for Administrative and Accounting Studies**, v. 3, n. 2, p. 19-28, 2002.

MCDONOUGH, W.; BRAUNGART, M. Cradle to Cradle: Remaking the way we make things. North Point Press, 2002.

MCDONOUGH, W.; BRAUNGART, M. **Cradle to Cradle**: (Re)inventing the way we do business. Rio de Janeiro: Campus Publishing, 2010.

MOURA, L. F. Reverse logistics as a strategic tool for sustainable development: A concise review. **Revista Cidade Sustentável**, v. 3, n. 1, p. 19-29, 2019. Disponível em: https://periodicos.ufsm.br/rcs/article/view/36579/23049.

PIKE, A.; RODRÍGUEZ-POSE, A.; TOMANEY, J**. Local and regional development**. London: Routledge, 2016.

SACHS, I. **Transition strategies for the 21st century**. In: BURZTYN, M. (Ed.). To think about sustainable development. São Paulo: Brasiliense, 1993. p. 87-89.

SANDRONI, P. **Dictionary of Economics**. Rio de Janeiro and São Paulo: Editora Record, 1939.

SÃO PAULO. Secretaria do Meio Ambiente, Infraestrutura e Logística. Disponível em: https://semil.sp.gov.br/educacaoambiental/prateleira-ambiental/desenvolvimento-sustentavel/. Acesso em: 2023.

SRIVASTAVA, S. K. Network design for reverse logistics. **Omega**, v. 36, n. 4, p. 535-548, 2008.

TATICCHI, P.; TONELLI, F.; CAGNAZZO, L. A systematic literature review of circular economy: Current status and future directions**. Journal of Cleaner Production**, v. 178, p. 703-722, 2018.