ABSTRACT

**Purpose** – The purpose of this paper is to present a discussion concerning how supply chains have evolved through the introduction of environmental concerns into the managerial field.

**Design/methodology/approach** – The authors have reviewed several of the most relevant research results regarding Green Supply Chains and analyzed the status of cooperation among authors and countries.

**Findings** – The authors set a discussion on the concept of the Green Supply Chain, along with its practices, drivers, motivations and barriers, presenting a modern review regarding the cooperation network among the main authors and countries.

**Originality/value** – Although research regarding Green Supply Chains has been intensively developed recently, there are several unexplored research avenues in which practitioners and scholars could advance. In order to support future studies concerning Green Supply Chains, ten research questions were elaborated.

**Keywords** - Green Supply Chain Management; Sustainable Supply Chain Management; Circular Economy; Sustainable Operations; Eco-innovation
RESUMO

**Objetivo** - O objetivo deste artigo é apresentar uma discussão sobre como as cadeias de suprimentos têm evoluído através da introdução de questões ambientais no campo gerencial.

**Design / metodologia / abordagem** - Os autores revisaram vários dos resultados de pesquisas mais relevantes sobre Cadeias de Suprimento Verde (Green Supply Chains) e analisaram o status da cooperação entre autores e países.

**Resultados** - Os autores discutem o conceito de Green Supply Chain, suas práticas, motivações, motivações e barreiras, apresentando uma revisão moderna sobre a rede de cooperação entre os principais autores e países.

**Originalidade / valor** - Embora a pesquisa sobre Cadeias de Suprimento Verde tenha sido intensamente desenvolvida recentemente, existem vários caminhos de pesquisa inexplorados nos quais os profissionais e acadêmicos podem avançar. Para subsidiar estudos futuros sobre Green Supply Chain, foram elaboradas dez questões de pesquisa.

**Palavras-chave** - Green Supply Chain Management; Gestão Sustentável da Cadeia de Suprimentos; Economia circular; Operações Sustentáveis; Ecoinovação

1 INTRODUCTION

Increasing awareness of environmental issues has in the recent past become a worldwide concern (Wang et al., 2021). Consumers and governments have come to require more environmentally responsible actions from supply chains (Gong et al., 2019). At the same time, companies have also become more sensitive to environmental topics, such as pollution, global warming and waste (Demir et al., 2018; Gong et al., 2019).

Effective management of supply chains can provide significant operational advantages (Luthra, Garg and Haleem, 2016; Santos, Lannelongue and Gonzalez-Benito, 2019). Green Supply Chains contribute to the mitigation of environmental impacts without jeopardizing performance (Rani et al., 2019).

The earliest academic interest regarding green supply chains can be found in the early 1990s (Badi and Murtagh, 2019; Zhu and Sarkis, 2006).

The research question motivating this paper is: what are the forthcoming research possibilities regarding Green Supply Chains? Therefore, this paper aims to:

1. Conceptualize Green Supply Chains  
2. Evidence the most cited papers on the Green Supply Chain theme  
3. Analyze the structure of cooperation which exists among authors and countries regarding Green Supply Chains  
4. Provide a future research agenda in order to nurture upcoming research in Green Supply Chains

2 ENVIRONMENTALLY SUSTAINABLE SUPPLY CHAINS

Srivastava (2007) points out that the definition of “Green Supply Chains” encompasses a large variety of concepts, in a spectrum that ranges from green purchasing to reverse logistics. Sarkis, Zhu and Lai (2011) explain that Green Supply Chains are developed when environmental concerns fit into organizational practices.
The process of “greening” supply chains refers to ecological initiatives which are integrated into supply chain practices and may bring some benefits (operational and financial advantages, for instance) while also mitigating environmental and social impacts (Acquah, Agyabeng-Mensah, and Afum, 2020).

For Jabbour, Arantes and Jabbour (2013) there are four relevant themes to take into account when analyzing Green Supply Chains: i) the support of an Environmental Management System in order to facilitate green supply chain actions; ii) level of collaboration within the supply chain to support environmental actions; iii) the practices adopted regarding Green Supply Chains; and iv) understanding the drivers and barriers to the adoption of Green Supply Chains.

The scope of Green Supply Chain management may range from reactive to more proactive practices (de Oliveira et al., 2018. Srivastava, 2007). It can be an achievable option to reduce environmental impact and boost operational performance (Vialle et al., 2017). Additionally, it may help companies to access the market (Agyabeng-Mensah et al., 2020).

3. RESEARCH METHODS

This paper was developed using the Scopus database, with our search covering the last 15 years (2006-2020), in order to assess how research into “Green Supply Chains” has evolved over the years. Additionally, the structure of cooperation among authors and countries were analyzed.

The Scopus database was chosen since it covers a wide range of journals and recent papers (Carvalho et al., 2020; Vieira and Gomes, 2009). Furthermore, Scopus is one of the most prestigious research databases in the world ((Chadegani et al., 2013; Mongeon and Paul-Hus, 2016).

The search string used to identify articles was “Green Supply Chain” OR “Green Supply Chains”. The results were limited to:

- Date range: 2006 - 2020
- Document Type: “article” or “review”

The results using these filters returned more than 1800 cited papers. Figure 1 demonstrates the growth in citations of these papers over the last 15 years, which reached 13,236 citations in 2019, and 13,190 by September 2020.

Figure 1 - Citations Overview

Source: Scopus database (2020)

Next, the VOSviewer® software was used to create a map based on bibliographic data using two units of analysis: Author (Figure 2) and Country (Figure 3).
The software created twelve clusters when considering authors as the unit of analysis. In each cluster, there is a highlight for a “central” author. Thus, Joseph Sarkis, Qinghua Zhu, Kannan Govidan, Charbel José Chiappetta Jabbour, Kee-hung Lai and Sunil Luthra emerge as some of the authors who have developed relevant research networks.

Source: VOSviewer® (2020)
Figure 3 - Network visualization by country

The software created nine clusters when considering countries as the unit of analysis. The larger the circle, the more relevant this country is regarding research conducted on this theme. Thus, the USA, China, India, the UK, Iran, Brazil, Malaysia, Indonesia, Hong Kong, Taiwan, Denmark, Malaysia and France are among the countries highlighted in this regard.

The number of documents (papers) ranked by author, citations and total link strength are indicated below (Table 1, Table 2 and Table 3, respectively), showing the top 5 authors in each category. According to the VOSviewer® Manual (2020), the total link strength attribute illustrates the total strength of the co-authorship links of a given researcher with other researchers.
Joseph Sarkis and Qinghua Zhu appear in all three categories, leading the rankings (first and second place, respectively). The only representative from South America is Charbel Jose Chiappetta Jabbour.

Next, the number of documents (papers) organized by country, citations and total link strength are indicated below (Table 4, Table 5 and Table 6, respectively), this time showing the top 5 countries in each category.
China leads these rankings when analyzing the number of documents (papers) and the total link strength, whereas the USA is the leader in terms of number of citations, which may indicate papers with greater diffusion among researchers in the field.

Finally, Figure 4 indicates the top 10 most cited papers on the “Green Supply Chain” theme. A complete literature review by Samir K. Srivastava is the most cited paper on this subject. Joseph Sarkis and Qinghua Zhu appear in four of the top 10 papers.
4 FINAL CONSIDERATIONS AND RESEARCH AGENDA

The debate and discussion currently surrounding environmental concerns in business and management are not going to cease to exist. Although research regarding Green Supply Chains has been intensively developed in recent years, there are a number of unexplored research avenues in which practitioners and scholars could advance. In order to support future studies concerning Green Supply Chains, the following research questions may be considered.

RQ1. What are the factors that affect resilience in green supply chains in emerging economies? Does this differ from the situation in more developed economies?
RQ2. What are the specific barriers to adopting Green Supply Chain practices following the COVID-19 pandemic?
RQ3. How can different theories be combined to explain organizational behavior regarding Green Supply Chains?
RQ4. How can different methods be combined to better understand Green Supply Chain barriers and drivers?
RQ5. How can Green Supply Chains be connected to the Circular Economy, comparing different organizational realities?
RQ6. What is the role of Green Supply Chains in improving ESG (Environmental, Social and Governance) scores?
RQ7. How will Green Supply Chains evolve to embrace Industry 4.0?
RQ8. How can experiments (as a research method) support the advancement of Green Supply Chain practices?
RQ9. What are the main impacts (e.g. financial, operational, reputational) for Green Supply Chains following the COVID-19 pandemic?
RQ10. Will Green Supply Chains shrink after COVID-19? What can companies do to face this new challenge?
REFERENCES

ACQUAH, I.S.K., AGYABENG-MENSAH, Y., AFUM, E. (2020) Examining the link among green human resource management practices, green supply chain management practices and performance. *Benchmarking: An International Journal*, Vol. ahead-of-print No. ahead-of-print. https://doi.org/10.1108/BIJ-05-2020-0205

AGYABENG-MENSAH, Y., AHENKORAH, E., AFUM, E., NANA AGYEMANG, A., AGNIKPE, C. AND ROGERS, F. (2020) Examining the influence of internal green supply chain practices, green human resource management and supply chain environmental cooperation on firm performance, *Supply Chain Management*, Vol. 25 No. 5, pp. 585-599, doi: 10.1108/SCM-11-2019-0405.

BADI, S., MURTAGH, N. (2009) Green supply chain management in construction: A systematic literature review and future research agenda. *Journal of Cleaner Production*, 223, 312–322.

CARVALHO, L.S., STEFANELLI, N.O., VIANA, L.C., VASCONCELOS, D. S. C. AND OLIVEIRA, B. G. (2020), Green supply chain management and innovation: a modern review, *Management of Environmental Quality*, Vol. 31 No. 2, pp. 470-482.

CHADEGANI, A., SALEHI, H., YUNUS, M. M., FARHADI, H., FOOLADI, M., FARHADI, M., & ALE Ebrahim, N. (2013). A comparison between two main academic literature collections: Web of Science and Scopus databases. *Asian Social Science*, 9(5), 18-26.

DEMIR, L., AKPINAR, M.E., ARAZ, C., ILGIN, M.A. (2018) A green supplier evaluation system based on a new multi-criteria sorting method: VIKORSORT. *Expert Syst. Appl.*, 114, 479–487.

GONG, R.F., XUE, J., ZHAO, L.J., ZOLOTOVA, O., XI, X.Q., XU, Y. (2019) A Bibliometric Analysis of Green Supply Chain Management Based on the Web of Science (WOS) Platform. *Sustainability*, 11, 3459.

JABBOUR, A.B.L.S.; ARANTES, A.F.; JABBOUR, C.J.C. (2013) Green supply chain management: mapping the territory *International Journal of Environment and Sustainable Development*, Vol. 12, No. 2, p.145–167.

LUTHRA, S., GARG, D., HALEEM, A. (2016). The impacts of critical success factors for implementing green supply chain management towards sustainability: an empirical investigation of Indian automobile industry. *Journal of Cleaner Production*, 121, 142-158.

MONGEON, P., PAUL-HUS, A. (2016). The journal coverage of Web of Science and Scopus: a comparative analysis. *Scientometrics*, 106(1), 213-228.

DE OLIVEIRA, U. R., ESPINDOLA, L. S., DA SILVA, I. R., DA SILVA, I. N., & ROCHA, H. M. (2018). A systematic literature review on green supply chain management: Research implications and future perspectives. *Journal of Cleaner Production*, 187, 537–561. https://doi.org/10.1016/j.jclepro.2018.03.083

RANI, S., ALI, R., AGARWAL, A. (2019) Fuzzy inventory model for deteriorating items in a green supply chain with carbon concerned demand. *OPSEARCH*, 56(1), 91-122.

SANTOS, H., LANNE_LONGUE, G., GONZALEZ-BENITO, J. Integrating green practices into operational
performance: Evidence from Brazilian manufacturers. *Sustainability* 2019, 11, 2956

SARKIS, J. ZHU, Q., LAI, K. (2011) An organizational theoretic review of Green supply chain management literature. *International Journal of Production Economics*, v. 130, p. 1-15.

SRIVASTAVA, S. K. (2007) Green supply chain management: a state-of-the-art literature review. *International Journal of Management Reviews* 9, p. 53-80.

VANALLE, R.M.; GANGLA, G.M.D.; GODINHO FILHO, M.; LUCATO, W.C. (2017) Green supply chain management: An investigation of pressures, practices, and performance within the Brazilian automotive supply chain. *J. Clean. Prod.*, 151, 250–259.

VAN ECK, N. J., WALTMAN, L. (2020) *VOSviewer Manual*. Access in September/2020. Available at: https://www.vosviewer.com/getting-started

VIEIRA, E. S., GOMES, J. A. (2009). A comparison of Scopus and Web of Science for a typical university. *Scientometrics*, 81(2), 587.

WANG, W., ZHANG, Y., ZHANG, W., GAO, G., ZHANG, H. (2021) Incentive mechanisms in a green supply chain under demand uncertainty, *Journal of Cleaner Production*, https://doi.org/10.1016/j.jclepro.2020.123636.

ZHU, Q., SARKIS, J. (2006) An inter-sectoral comparison of green supply chain management in China: drivers and practices. *Journal of Cleaner Production* 14 (5), 472-486.
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|--------------------------------------------------|------------|------------|
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| 2. Development of hypotheses or research questions (empirical studies) | ✓ | ✓ |
| 3. Development of theoretical propositions (theoretical work) | ✓ | ✓ |
| 4. Theoretical foundation / Literature review     | ✓          | ✓          |
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