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Evaluating the nexus of HRM and sustainability in green supply chains: a comprehensive literature review

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Abstract

Background: Sustainability is paramount across all fields, especially in supply chains. The role of human resources is crucial in achieving organizational sustainability standards. However, the impact of human resources on supply chain sustainability has been underemphasized.

Purpose: This paper explores the critical nexus between Human Resource Management (HRM) and sustainability within green supply chains, identifying gaps in the current body of knowledge and emerging trends.

Study design/methodology/approach: A systematic literature review was conducted, emphasizing sustainability in supply chains and its intersection with HRM's "green" aspects. Web of Science and Scopus databases served as the primary sources. The research involved documentation and content analysis, leading to the development of guidelines for future studies.

Findings/conclusions: The study reveals a significant yet underexplored interaction between green HRM and supply chain sustainability. It highlights the need for more focused research in this area, providing a foundational framework for future studies.

Limitations/future research: The study primarily focuses on the conceptual linkage between HRM and green supply chains, suggesting the need for empirical research to further validate and expand upon the findings. Future research should investigate specific HRM practices that effectively contribute to sustainable supply chains.

Keywords

green human resources, sustainability, supply chains, systematic literature review, bibliometric analysis

Introduction

Companies are responsible for the environment and their communities in today's business landscape. Their social obligation is to lead in preserving the environment and maintaining a natural balance. This responsibility requires businesses to align their operations and management strategies with environmental concerns and actively engage with their customers and society to achieve this goal. Adopting green management and green management approaches by the businesses' concept of environmental sustainability would ensure the conservation of the

natural environment and make the world more livable. Although the idea of "sustainable development" takes its place in the literature, the concept of "sustainable" is defined by Heinberg and Lerch (2010) as "that which can be maintained over time." Another definition of sustainability offered by Chapin, Torn and Tateno (1996) is "the ability of ecological systems to maintain their functions, processes, and productivity in the future."

Sustainability is inherently a collaborative endeavor involving multiple stakeholders and interconnected activities. It draws upon various frameworks and approaches, including the triple bottom line model, systems thinking, resource-based strategies, corporate responsibility and stakeholder theory. Within the intricate tapestry of sustainability, one constant remains—the pivotal role of human beings in driving and shaping sustainability efforts to varying degrees.

Over time, sustainability has been applied to disciplines such as economics, marketing, tourism and management, resulting in new concepts. Sustainability, associated with human resource management (HRM) since the 2010s, is changing HRM's perception. Throughout history, human resource practices have been referred to as personal affairs, personnel management, human resource management, and strategic HRM. Understanding Strategic HRM has increased the strategic significance of human resources, elevating the importance of HR practices for organizations to a new level.

According to the strategic management approach, human resources is a strategic tool that gives a competitive advantage. The concept of "what employers want" is fundamental in this view, and the firm is accountable to its shareholders (Kramar, 2014). However, as the sustainability concept has been applied to HRM, it has been understood that the problem of the classic view is not as significant as the problem of "what do employees need" and "what do society/external stakeholders wish" (Prins, Beirendonck, Vos & Segers, 2014).

While sustainable human resource management (HRM) strongly emphasizes achieving financial goals, it equally underscores the importance of considering the broader impacts of organizational policies on society and the environment. In essence, sustainable HRM seeks a harmonious convergence of financial success with the subjective well-being of stakeholders (Mariappanadar, 2014). Within this synergy, organizations achieve success across multiple dimensions—organizational, social, economic, and ecological. Sustainable HRM is committed to enhancing employee welfare by mitigating the adverse effects of rigid organizational structures on individuals.

The success of these efforts seems possible with the support of human resources, which is also the focal point of the sustainability activities carried out by businesses. The unit that can provide the help of human resources in an organized manner, the HRM unit, is an essential driving force in sustainability efforts.

Environmental challenges in businesses stretch back to the 1990s, when environmental management systems such as ISO 14001, the world's most widely used environmental management system, were developed. With this growing trend, the number of green organization studies has expanded, and it has been recognized that to become a green company, organizations require the assistance of HRM practices such as training, performance evaluation, and rewarding mechanisms (Jabbour & Sousa Jabbour, 2016).

As society's ecological awareness expands, organizations must shoulder greater responsibility for their environmental impact. This heightened awareness has triggered interest and research on green management and environmentally responsible organizations (Farrukh, Raza, Ansari, & Bhutta). A review of studies on GHRM reveals that green human resources management, green recruitment (Pham & Paillé, 2019), green personnel procurement and green candidate selection (Adjei-Bamfo, Bempong, Osei & Kusi-Sarpong, 2020), green employees, green employee behavior, and corporate social responsibility (He, Morrison & Zhang, 2021), and environmental sensitivity are emphasized. The concept of green is added to traditional HRM practices.

Due to these challenges, organizations were forced to shift their supply chains (SC) into a more environmentally friendly structure and adopt sustainable supply chain management because of environmental awareness, public pressures, and legal regulations in almost every field. These conditions have led organizations to design less polluting production systems, reduce waste, manage environmental risks, and act socially responsibly.

Accordingly, some research questions were formed to uncover the insights and shed light on pertinent domains:

Q1. Which channels are connecting GHRM, SC, and sustainability?

Q2. Who are the most influential actors in the GHRM, SC, and sustainability domains?

Q3. What are the major and guiding topics for GHRM, SC, and sustainability?

Q4. Where is the GHRM and sustainability of SC research heading?

These questions will bring out a clear understanding of the nature of GHRM, SC, and sustainability concepts' relations. As a result, giving a visual representation of the current situation will provide valuable knowledge to the scientific community. The study's sections are as follows: an overview of GHRM and SC concepts, methodology, findings, and discussion. The paper concludes with offerings to future researchers.

1. Literature review

1.1. Green human resources management

Nowadays, organizations must focus on social and environmental issues and economic and financial factors to continue their activities. Sustainable human resources management has become one of the fundamental business strategies in organizations where the human resources department plays an active role in creating an ecological culture to deal with these issues (Ahmad, 2015). The basis of green human resources management, which is relatively new in business literature, is based on environmental activities to protect the environment and the future. Green human resources management is vital in adapting environmental practices to organizational policies and procedures. Green human resources management could ensure that ecological sustainability policies are implemented by increasing employees' loyalty and making better contracts in line with the environmental policies of the enterprises by raising the training and awareness of the personnel in this aspect. Human resource management is the department responsible for managing and developing employees in the enterprise. With the advantage of having an essential role in achieving the social responsibility goals of enterprises, human resources managers can increase the enterprise's positive effects while reducing the business's negative impact on society and the environment (Rezaei-Moghaddam, 2016). The green human resource goals are accomplished and developed by each employee's commitment and responsibility in the actions carried out to ensure the enterprise's sustainability (Rani & Mishra, 2014). Green human resources practices can provide more effective and lower costs, better employment contracts, and higher organizational commitment (Jyoti, 2019). In addition, green human resources incorporate environmentally friendly management practices for the sustainable use of resources. Examples include flexible working hours, teleconferencing, recycling, online education, and energy-efficient workspaces (Bangwal & Tiwari, 2015).

Views on the GHRM literature can be broadly categorized into three groups. The common feature of these groups is long-term and durable results for sustainability. Although the authors describe sustainability and its relationship with HRM in different ways, these groups are categorized according to the outputs of these approaches. The first focuses on economic outcomes and creating a *sustainable competitive advantage*. Known as 'talent generation,' this group focuses on the internal effects of HRM policies. Accordingly, GHRM should focus on "long-term business successes rather than short-term corporate goals" and positive employee outcomes (Wilkinson, Hill, & Gollan, 2001). The second group is *improving social and ecological health*. This group focuses on broader performance outcomes related to economic, ecological, or social issues. Accordingly, HRM practices ensure the achievement of desired financial goals by contributing positively to environmental and social/human outputs (Branco & Rodrigues, 2006). These external outputs are related to human and social issues such as family community well-being, employee health, government policies, and expenditures (Mariappanadar, 2014). The third group, *communicators*, connects management practices, including ecological and social outcomes and HRM practices (Kramar, 2014).

Although GHRM is a new concept in literature, it has received increasing attention recently. Traditional HRM functions are reinterpreted and defined with an environmentalist consciousness and a green perspective, together with the concept of HRM, which has found a domain of expansion, mainly under sustainable HRM. In this regard, the roles of GHRM are explained in the literature as follows.

Green job analysis: The GHRM function is used to restructure businesses by long-term environmental goals, to assign responsibilities and duties related to environmental protection to each work step and the employee who performs that

step, and thus to bring more environmentally friendly job descriptions and business processes to the enterprise (Chaudhary, 2019).

Green recruitment: It recruits qualified employees who are equipped and sensitive to carry out environmentally friendly business processes and practices determined by businesses in line with green business analysis and business designs (Pham & Paillé, 2019). The first prominent dimension of green recruitment is the selection of candidates with high environmental awareness; the second is the creation of an environmentally friendly employer image by using the ecological image in reputation management, and the third is the determination of green criteria to make the business attractive for employees with environmental sensitivity (Tang, Chen, Jiang, Paillé & Jia, 2018).

Green education and development: The adoption and internalization of the strategic goals set forth by the businesses is a requirement for success, and it is the goal of all environmental education and development initiatives undertaken by the company to ensure that its employees readily adopt its environmental policies and practices, put them into practice, and even develop habits out of them (Teixeira, Jabbour, Sousa Jabbour, Latan & Oliveira, 2016).

Green talent management is a further idea related to green development. Green talent management actively encourages the growth and retention of green talent by boosting employee engagement through effective and efficient leadership practices, effective communication, inclusivity in decision-making, institutional support for employee well-being, and motivating green talent team members to develop clear ecological initiatives to advance environmental sustainability. It is a concept that conveys the actions taken in support of and with a purpose toward this path (Joshi & Dhar, 2020).

Green performance management: The term refers to the setting by the enterprise of environmental and sustainability-focused, continuously updated green targets, measuring whether these targets are achieved or not, removing the factors that make it difficult or hinder achieving the green targets in line with this measurement, and encouraging the elements that support achieving the green targets. The GHRM function focuses on preserving and sustaining the competencies acquired in reaching green targets (Luu, 2020). To create green performance indicators, a set of green performance evaluation criteria that considers environmental events, environmental responsibilities, lowering carbon emissions, and communicating ecological concerns and policies must be established for all members of an organization (Tang et al., 2018).

Green wage management: To fill the green jobs it has created in line with the goals it has determined in line with the strategic objectives of the enterprise and ensure the continuity of their motivation in line with environmental goals, green wage management is the management function of the wages, tangible rewards, and intangible rewards that the company applies to attract and retain the green-collar employees that it plans to hire or that it has already acquired (Jamal et al., 2021).

1.2. Sustainable supply chains

The supply chain encompasses all activities and information flows associated with the production and transformation of products, from the raw material stage to the end user (Londe & Masters, 1994). Supply chain management (SCM) integrates these activities through improved supply chain relationships to achieve a sustainable competitive advantage. SCM includes planning, sourcing, production, and distribution logistics. Contrary to traditional SCM, which focuses on economic and financial business performance, sustainable supply chain management (SSCM) is characterized by explicitly integrating environmental or social objectives that extend the economic dimension to the triple bottom line approach [25]. From a microeconomic perspective, SSCM emerged from bringing together the three pillars of sustainability (economic, social, environmental) with core business practices such as procurement, logistics, information management, and marketing (Morali & Searcy, 2013). Sustainable supply chain management refers to coordinating and managing material, information, and capital flows among businesses along the supply chain while considering the goals of the three sustainable development pillars resulting from stakeholder and customer needs. Members of sustainable supply chains are expected to uphold social and environmental standards, retain their competitiveness by satisfying client needs, and adhere to all applicable economic standards to remain a part of the chain (Seuring & Müller, 2008). Organizations are being held increasingly accountable for the economic, social, and environmental effects of their internal operations and the actions of their suppliers

(Koberg & Longoni, 2019). Supply chains are inherently complex structures (Vafadarnikjoo, Tavana, Chalvatzis & Botelho 2022) because they force companies to find efficient solutions for numerous sustainability issues at various upstream and downstream channel levels to satisfy each party's demands while enhancing the overall sustainability performance of all supply chains (Altintas & Trick, 2014; Vidal & Croom, 2018).

A sustainable supply chain management approach can be found in a supply chain's purchasing, production, distribution, packaging, and logistical procedures. Therefore, the reliability of the first link in sustainable supply chain management depends on whether the material being purchased is recyclable or reusable and satisfies environmental design specifications, as well as whether the provider qualifies within the category of a "green supplier" (Zhu, Sarkis & Lai, 2008).

The last link of the sustainable supply chain management approach is the concept of reverse logistics. Improving the product and developing a closed-loop supply chain system through renewal activities such as recycling, remanufacturing, reuse, and disposal is possible.

Suitably qualified human resources, as one of the most essential components of intellectual capital, is required to reach the goals outlined by the organization in the pursuit of sustainability (Jabbour & Santos, 2008). Therefore, it is critically important for a business to manage its human resources in line with the sustainability paradigm to achieve sustainability-oriented change (Preuss, Haunschild & Matten, 2009).

Next section includes the methodology part. But, before this, it is crucial to explain the necessity of bibliometric analysis in multidisciplinary scientific areas. Bibliometric analyses offer significant perspectives into the body of knowledge pertaining to a certain subject or area. Finding important gaps in these studies can help future researchers push the bounds of theory and advance our body of knowledge. Future researchers could fill in the following possible gaps that could be found in bibliometric analyses:

Harmonization of the fields of study: Interdisciplinary research is beneficial to many subjects; nonetheless, bibliometric studies may show a lack of cross-disciplinary integration. In order to give a more thorough grasp of a subject, future researchers can investigate methods to close gaps between other academic disciplines (Falagas, Karavasiou & Bliziotis, 2006; Tarkowski 2007; Xie, Zhang & Ho, 2008).

Geographical discrepancies: The distribution of research may exhibit geographic biases that can be identified by bibliometric analysis. Future researchers could help by addressing these disparities, doing out studies with a range of geographical viewpoints, and advocating for a more comprehensive understanding of the topic (Lin, 2012; Zhuang, Liu, Nguyen, He & Hong, 2013)

Technological developments: Since technology is advancing quickly, bibliometric research might not be able to include the most recent developments. In the future, scholars can distinguish and investigate new approaches, technologies, and patterns that may have emerged following the most recent bibliometric analysis.

Niche or emerging subfields: While bibliometric analyses can reveal prevailing themes, they may also reveal undiscovered or developing subfields within a discipline. Subsequent investigators may explore these domains to offer hitherto implicit insights and viewpoints.

Studies on cross-cultural variances: Gaining insight into how cultural context shapes theories and research can be a productive topic of investigation. Researchers in the future can do cross-cultural investigations to find differences in theoretical perspectives and deepen our knowledge of how culture affects a given topic.

Shifting dynamics in longitudinal analyses: Studies using bibliometrics frequently offer a moment in time view of the literature. It will be possible for researchers in the future to perform longitudinal analyses to follow the development of theories and research trends across time, identifying changes, patterns, and the emergence of new paradigms (Li, Zhang, Wang & Ho).

Converging theory and practice: Theoretical developments and their real-world applications might not always align. Subsequent academics may concentrate on converting theoretical understandings into workable plans, structures, or answers to practical problems.

Representation gaps: Studies using bibliography may point to deficiencies in the representation of various viewpoints, such as those based on gender, race, or other demographic characteristics.

Methodological critique: The methodological strategies employed in the body of current work can be evaluated critically by future researchers. Assessing the rigor of research methodologies,

making recommendations for enhancements, and advocating for increased standards of study design and analysis are all part of this (Van Raan 2005; Liu, Zhang & Hong).

Each research may make addition to theoretical frameworks, produce a more nuanced understanding of the issues they investigate, and progress knowledge by filling in these possible gaps.

2. Methodology

This research collected bibliometric data from studies, including the effects of green human resources practices on sustainable supply chains. For this purpose, Paul et al. (Paul, Lim, O'Cass, Hao & Bresciani, 2021) suggested SPAR-4-SLR steps were followed. These steps can be briefly summarized as assembling, arranging, and assessing.

In the Assembling part, there are decisions such as determining the search terms to be used in the research and which databases to use. This research aimed to explore the effects of green human resources on the sustainability of supply chains, so the search terms were formed as follows:

Table 1 Search Terms

Database	Web of Science (WoS)	Scopus
Search terms	TS=("green human resource*" AND "supply chain*" AND susta*)	TITLE-ABS-KEY ("green human resource*" AND "supply chain*" AND susta*)
N	89	40

Source: the authors

Previous studies were examined to compile studies directly related to the researched content, and the concepts of supply chain and sustainability were searched in all parts of the relevant texts, together with green human resources or GHRM in their simplest form. Asterisks were used in terms, and different conjugations of words were also included in the set. Using Scopus and Web of Science, two databases with the highest scientific competence, were deemed appropriate for database selection. As a result of the first search, 89 studies were found in the WoS database and 40 in the Scopus database. In the field of academic research, two of the best known and most extensively utilized bibliographic databases are Scopus and Web of Science (WoS). Both have advantages and disadvantages, but for a variety of reasons, many researchers see them as the "best": comprehensive coverage, peer-reviewed content, citation analysis, global reach, indexing quality journals, integration with other tools, usage in bibliometrics and rankings, user-friendly interfaces, etc. Surely there are many more databases with similar eligibilities, but it is requisite to put a limit. So, these two databases are considered most suitable ones for this research in today's conditions (Urío, Redondo & Gavilan, 2022; Grosu, Chelba, Melega, Botez & Socoliuc, 2023).

The studies identified in the first stage section were subjected to some sorting according to various criteria (type of publication, language, and content). In bibliometric studies, it is a general perception that the papers to be considered should consist of articles as a type of filter (Emrouznejad, Parker & Tavares, 2001; Kumar, Sharma, Rao, Lim & Mangla, 2022). It was decided to examine the published articles and the studies in early access status. In addition, considering the difficulty of reviewing studies written in different languages, limiting the language criterion to English was deemed appropriate. When these criteria were used, 32 studies were observed in the Scopus database and 59 in the WoS database. Articles not directly related to human resource management and bibliometric studies were excluded after manually controlling the data set. Due to this process, the number of studies to evaluate was determined to be 46 for the WoS database and 30 for the Scopus database. After classifying 23 studies in both databases were combined to keep them from being included in the data set repeatedly, 53 studies were finally reached.

Table 2 Arranged Data

Database	Web of Science (WoS)	Scopus
Type	Article (Published and Early Access) n:59	Article (Published and Early Access) n:32
Language	English n:59	English:32
Manual Check	n:46	n:30
Combined	N:53	

Source: the authors

The 53 studies in the data set were obtained from sorting in the arranging section, and bibliometric analysis was conducted using the R-based Biblioshiny package on this set. Its simplicity and benefits for visualizing content analysis were the main factors for using Biblioshiny (Moral-Muñoz, Herrera-Viedma, Santisteban-Espejo & Cobo, 2020). In the next section, quantitative and content analysis findings are reported.

3. Findings

3.1. Quantitative analysis

This section of the study provides an overview of the studies that include the context of sustainability in green human resources and supply chains. Along with the scores that establish the relative effects of these actors, this part provides for the distribution of the studies by years, nations, sources, and authors.

Studies that include the context of green human resources' effect on supply chain sustainability have been put forward since 2016. "Green human resource management and green supply chain management: linking two emerging agendas" by Jabbour and Sousa Jabbour (2016) is one of the most influential articles in forming this domain. This article gives a detailed roadmap on which dimensions the two contexts can interact. It is seen that the number of studies published in the years following this publication has gradually increased, and a necessary accumulation has been formed to conduct a systematic literature review (Paul, Lim, O'Cass, Hao & Bresciani, 2021).

Table 3 Main Information

Timespan	2016:2022
Documents	53
article	47
article; early access	6
AUTHORS	
Authors	182
Authors of single-authored documents	6
Collaboration Index	3.17

Source: the authors

It has been noted that most studies have multiple authors. It is anticipated that researchers from different areas of expertise should have worked together in a multidisciplinary domain.

When the distribution by years is examined, it is seen that the number of studies published in the pertinent domain has reached double digits since 2020. The numbers might rise, given that 2023 is still in progress.

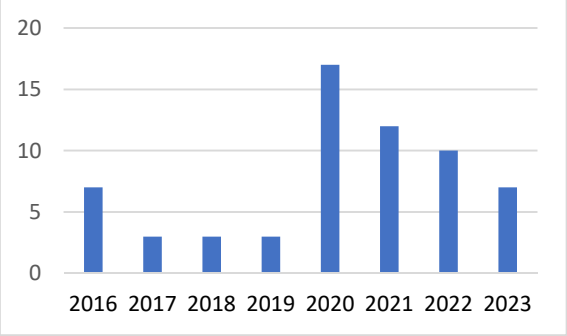

Figure 1 Annual production
Source: the authors

The significant increase in the importance of human resources due to the current COVID-19 epidemic's severe pressure on supply chains and changing consumer preferences with anxiety may cause a giant leap in the 2020s (Awijen, Zaied & Nguyen, 2022; Gordon-Wilson, 2021).

The origin of the published studies was determined based on the addresses specified by the authors. Accordingly, India and China have the most publications in this context.

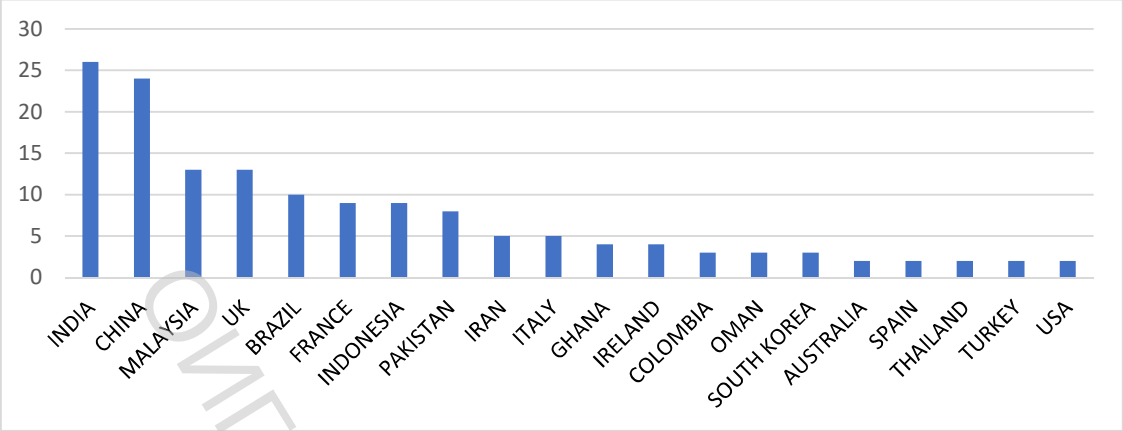

Figure 2 Production by country
Source: the authors

Table 4 Collaboration network

Node	PageRank	Betweenness	Cluster
France	0.150595161	8.571428571	3
China	0.133358497	2	2
United Kingdom	0.132577334	1.428571429	1
Brazil	0.097401974	5	1
India	0.096860896	0	1
Malaysia	0.089428298	0	2
Pakistan	0.089428298	0	2
Italy	0.060818571	0	3
Spain	0.060818571	0	3
Ghana	0.051421271	0	2

Source: the authors

Apart from the number of publications, the scores of the network structure created by researchers from different countries as another indicator that determines the effects of countries in the context of green human resources, supply chain, and sustainability are discussed. Table 4 gives the countries in the top 10 PageRank and betweenness rankings

Studies originating in France take the lead in the PageRank table, which indicates the weight and relative importance of the established connection in the network, and in the betweenness ranking, which ranks the nodes that act as a bridge between directly connected nodes. When the cooperation network is examined, three different clusters are observed. The first of these clusters, which includes the United Kingdom, Brazil, and India, is remarkable in that it indicates cooperation between quite different geographies.

The citations of the published studies are also an indicator that should be examined in terms of the level of influence the countries have on the domain in line with the research.

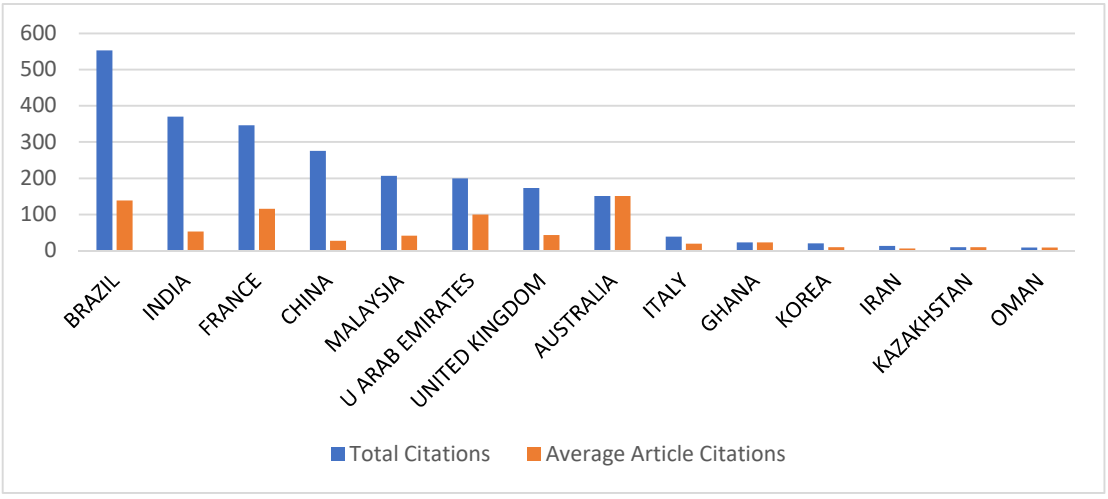

Figure 3 Most cited countries
Source: the authors

Considering the total citations, it is seen that Brazil takes the first place. In the continuation of the ranking, the countries that stand out in terms of criteria, such as the number of publications and PageRank, are India, France, and China.

Table 5 shows the h-index of the top 10 academic journals, including studies published in green human resources, supply chains, and sustainability, according to the total number of citations and publications.

Table 5 Source impact

Element	h_index	TC	NP
Journal of Cleaner Production	11	1526	11
Benchmarking-An International Journal	3	116	3
Business Strategy and the Environment	3	78	6
International Journal of Manpower	2	53	2
International Journal of Production Economics	2	102	2
Journal of Asian Finance Economics and Business	2	41	2
Supply Chain Management-an International Journal	2	81	2
Sustainability	2	53	2
Uncertain Supply Chain Management	2	8	3
Journal of Cleaner Production	11	1526	11

Source: the authors

In Table 5, *The Journal of Cleaner Production*'s h-index is ranked first according to the total number of citations and publications.

The ranking of the researchers working in green human resources, supply chains, and sustainability according to the h-index, total citations, and number of publications is given in Table 6.

Table 6 Author impact

Element	h_index	TC	NP
Jabbour, C.	6	779	6
Jabbour, A.	4	582	5
Mangla, S.	4	204	4
Raut, R.	4	116	5
Luthra, S.	3	145	3
Narkhede, B.	3	106	3
Afum, E.	2	108	2
Agyabeng-Mensah, Y.	2	108	2
De O J	2	179	2
Gardas B	2	91	2
Gedam V	2	25	3
Guerci M	2	329	2
Latan H	2	179	3
Longoni A	2	329	2
Luzzini D	2	329	2
Priyadarshinee P	2	71	2
Rajiani I	2	32	2
Sarache W	2	26	2
Trujillo-Gallego M	2	26	2
Tseng M	2	4	2

Source: the authors

C. Jabbour and A. Jabbour ranked first in the h-index, total citations, and total number of publications presented as contribution indicators. Subsequently, Mangla, S. and Raut, R. became the names that contributed the most to the domain, with four publications each.

3.2. Content analysis

After the documentation phase, which includes a review of the data set's fundamentals, analyses of the dendrogram, co-occurrence network, and thematic evolution were conducted, allowing for a content analysis of the studies. These analyses aim, among other things, to develop a schema of the domain by highlighting the connections between the studies searched. It is also possible to predict the potential shapes that the concepts under consideration will take in the future by examining the variations in their relationships over time.

When conducting content analysis, it must be decided whether to consider the terms used in the first place. Since search terms form the basis of research, they should be analyzed together to observe their interaction with other concepts and, therefore, should be included in the analysis.

Keywords in an article are an imprint created about the subject, content, and scope of the pertinent study. In this respect, it is possible to have information about the article's subject by exploring the keywords of a survey. There are many more keywords, but in terms of visual presentation, the top ten keywords with the highest score were included in Fig. 4.

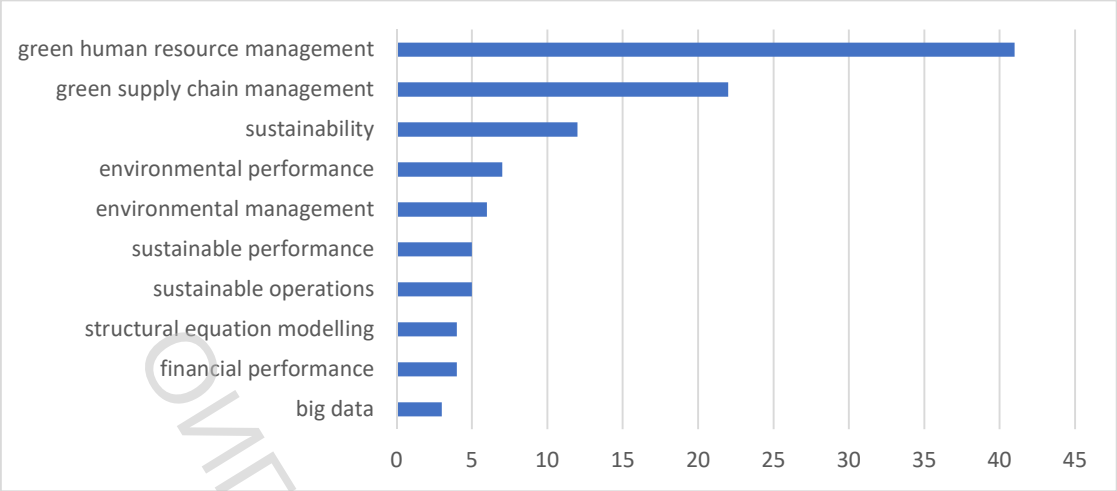

Figure 4 Top ten keywords
Source: the authors

While the usage levels of the keywords are provided in Fig. 4, how these words are grouped and which concepts the sub-dimensions of these groupings consist of are shown with the conceptual structure map that includes multidimensional scaling analysis. Multidimensional scaling analysis is an exploratory data analysis method that preserves the relationship between the phenomena under investigation and reduces the dimensions for localization, analysis, and classification of the variables of the universe where the connection occurs. In the results obtained from the multidimensional scaling analysis, the analyzed keywords are distributed across the plane, and the relative position of each keyword reflects the convergence between the keywords. More convergent words form a cluster. To the extent that a keyword is close to the middle of the cluster, it forms the basis for the relevant context (Hoffman & Leeuw, 1992). Multidimensional Scaling analysis (MDS) was performed to examine the content structure. MDS is a data analysis method of exploring the underlying forms of categorical data (Abdi & Valentin, 2007). MDS functions as a principal component analysis for categorical data.

It was deemed appropriate for the software to automatically calculate the number of dimensions due to the absence of antecedent information about the number of dimensions. Thus, a five-dimensional structure was obtained in the context of green human resources, supply chains, and sustainability.

Cluster analysis is created by statistically processing the network structure according to the frequency of combining keywords to get a smaller and simpler view. The basis of cluster analysis is to treat high-frequency keywords as a class, and after calculating the statistics of these classes, the related categories are combined. The program does this until each keyword is included in the corresponding category. The tree dendrogram is formed according to the MDS findings. The dendrogram created for the compiled data set is shown in Fig. 5.

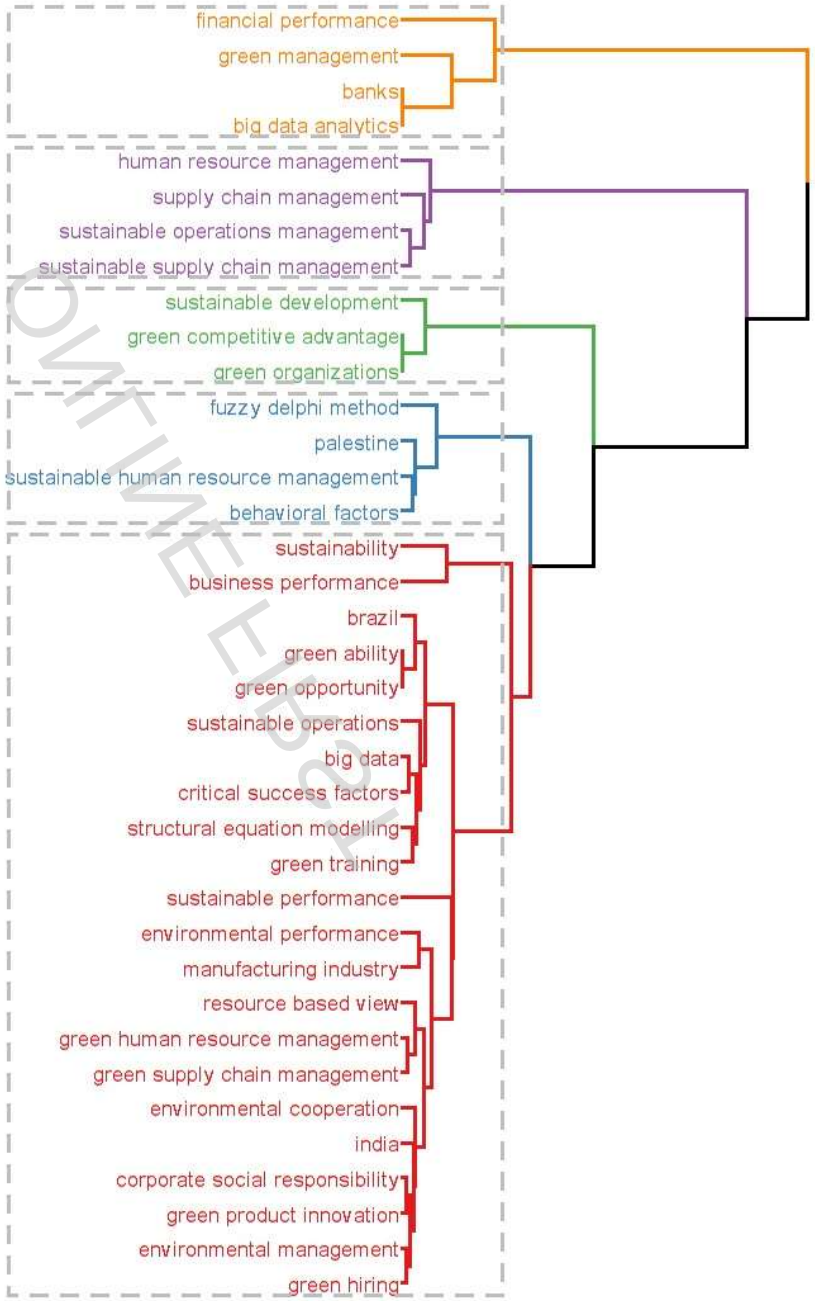

Figure 5 The data set dendrogram
Source: the authors

It is observed that the green human resource management and green supply chain management expressions cluster with the resource-based view expression in the dimension highlighted in red, one of the dimensions where the keywords are divided into groups based on their usage. One of the research's fundamental concepts, sustainability, was also observed in this dimension.

The visual of the co-occurrence network analysis performed to calculate the relative importance and weight of the keywords in the data set and the combination of keywords is presented in Fig. 6.

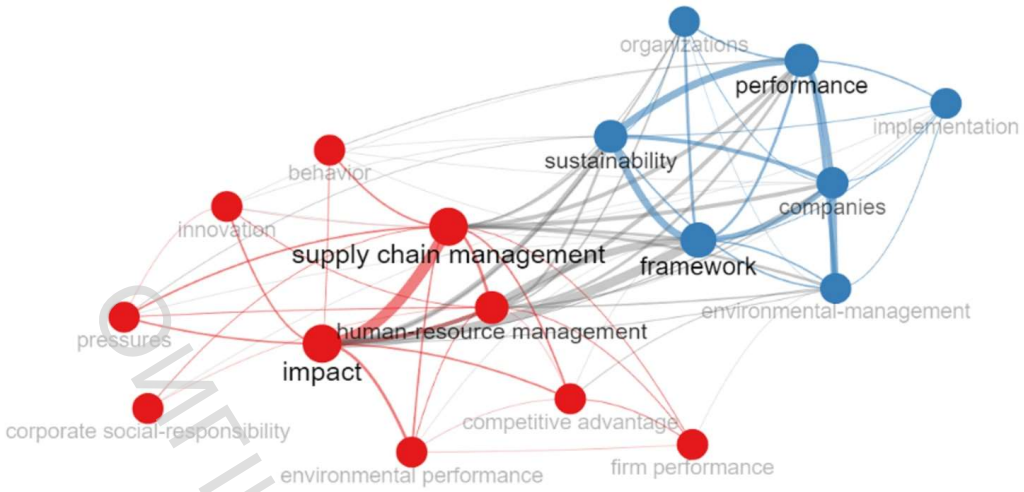

Figure 6 Co-occurrence network analysis
Source: the authors

The sizes of nodes and labels increase proportionally to their PageRank values. The density of the relations between the nodes is effective on the thickness of the bridges established.

Statistical information about the network is given in Table 7, created by ranking the keywords according to Pagerank. The first ten keywords with the highest score are included.

Table 7 Collaboration network

Node	PageRank	Betweenness	Cluster
green human resource management	0.268371815	339.8312514	1
green supply chain management	0.128263465	27.87787501	1
sustainability	0.065537312	59.22314818	2
sustainable operations	0.036785947	0.625	3
financial performance	0.035618166	17.35576887	2
green ability	0.03125	0	4
green opportunity	0.03125	0	4
sustainable performance	0.028904805	0.086956522	1
environmental performance	0.027351124	0	1
green management	0.02535212	0	2

Source: the authors

As stated before, as a result of the search terms remaining in the analysis, the concepts with the highest impact on the network were green human resource management, supply chain, and sustainability. In addition, another aspect that demands attention is the concept of financial performance being at the top. It is possible to argue that the relative intelligibility of measuring economic outputs (Drake & Fabozzi, 2010) and the fact that it is one of any organization's primary goals are essential for this concept.

The changing rules of thematic content, power and structure, evolutionary relationships, and tendencies that have formed in the literature over time can be revealed with the thematic evolution analysis, which is another step in the research. Using thematic evolution analysis can obtain outputs such as visualizing the development in the field, the direction of this development, and making future inferences about the trends in the area (Cobo, López-Herrera, Herrera-Viedma & Herrera, 2011).

Each node in the thematic diagram represents a topic, and the node size varies in proportion to the keywords included in the theme. Connections between nodes express the evolutionary aspect of the concepts under consideration. These connections have existed throughout the observed timeline, which suggests that the ideas have remained crucial to the domain. The thickness of

these lines indicates the number of shared keywords. In other words, the line widens as the connection between the subjects strengthens (Cobo et al., 2011).

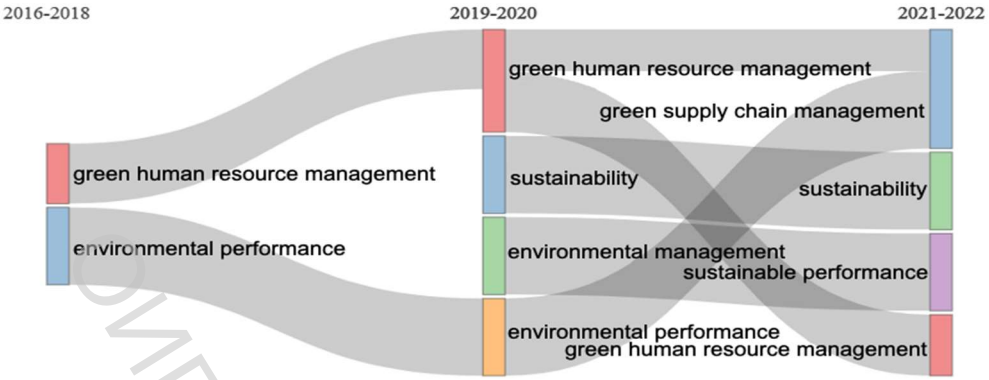

Figure 7 Thematic evolution analysis
Source: the authors

Three time periods were established by proportionally dividing the number of publications by the years. While the concepts of green human resource management and environmental performance gained prominence in 2016–18, sustainability and ecological management became important in the second period, which spans 2019–2020. Environmental performance was replaced by green supply chain management in the most recent period, 2021–2022, which was bolstered by green human resource management. "Sustainable performance" has evolved from "environmental management."

3.3. Integration of articles on green human resources and sustainable supply chains

We integrate the findings from relevant articles that delve into various aspects of green human resources (GHR) and sustainable supply chains (SSC). The table below summarizes critical details about these articles, including their titles, authors, publication dates, and the aspects they address within the context of GHR and SSC.

Table 8 Content list of the dataset

		Green human resources aspects			Aspects of sustainable supply chains		
#	Author	Hiring	Training and involvement	Performance	Environmental	Social	Economic
1	Gedam et al. (2023)		x			x	x
2	Graham et al. (2023)		x		x		
3	Rizzi, Gigliotti and Annunziata (2023)		x		x	x	x
4	Maskuroh, Widyanty, Nurhidajat, Wardhana and Fahlevi, (2023)	x	x		x		
5	Setyaningrum and Muafi (2023)	x	x	x	x		
6	Feng and Sheng (2023)		x	x	x	x	
7	Naseer, Song, Adu-Gyamfi, Abbass and Naseer, (2023)	x	x	x	x	x	x
8	Rajabpour, Fathi and Torabi, (2022)	x	x	x		x	
9	Chen, Tsai and Oen (2022)	x	x	x		x	
10	Trujillo-Gallego, Sarache, and Sousa Jabbour (2022)		x		x		x
11	Jawaad, Hasan, Amir and Imam, (2022)	x	x		x	x	x
12	Fiorini, Jabbour, Latan, Sousa Jabbour and Mariano (2022)			x	x		x
13	Saeed, Rasheed, Waseem and Tabash (2021)	x	x		x		
14	Aldaas, Mohamed, Hareeza Ali and Ismail (2022)	x	x	x	x		

15	Dian, Pambudi, Leonardus, Sukrisno and Kundori (2022)	x	x	x	x		
16	Kara and Edinsel (2022)	x	x	x	x	x	x
17	Gedam, Raut, Priyadarshinee, Chirra and Pathak (2021)	x	x	x	x		
18	Zhu and Yang (2021)		x	x	x	x	x
19	Acquah et al. (2020)	x	x	x	x	x	x
20	Trujillo-Gallego et al., (2021)	x	x	x	x	x	
21	Gedam, Raut, Sousa Jabbour, Narkhede and Grebinevych (2021)	x	x	x		x	
22	Imran, Alraja and Khashab (2021)	x	x	x			x
23	Marrucci, Daddi and Iraldo (2021)	x	x	x	x	x	x
24	Khaleeli, Faisal and Anwar (2021)	x	x	x			x
25	Stefanelli et al. (2021)	x	x	x	x		
26	Tulsi and Ji (2020)	x	x	x		x	
27	Raut, Gardas, Luthra, Narkhede and Kumar Mangla (2020)	x	x	x	x		
28	Ali et al. (2020)		x		x		x
29	Ghouri et al. (2020)	x	x	x	x		x
30	Muduli et al. (2020)		x		x	x	
31	Agyabeng-Mensah et al. (2020)	x	x	x	x	x	x
32	Sittisom and Mekhum (2020)	x	x	x	x	x	
33	Yu et al. (2020)		x	x	x	x	
34	Khan, Tao, Ahmad, Shafique and Nawaz (2020)		x		x		x
35	Tseng et al. (2020)	x	x	x	x	x	x
36	Ogbeibu et al. (2020)	x	x	x	x		
37	Wongleedee (2020)			x			x
38	Lee (2020)	x	x	x	x		
39	Thakur and Mangla (2019)		x		x	x	x
40	Raut et al. (2019)		x		x	x	x
41	Singh and El-Kassar (2019)		x	x	x	x	x
42	Longoni, Luzzini and Guerci (2018)	x	x	x	x		x
43	Zaid et al. (2018)	x	x	x	x	x	x
44	Chiappetta Jabbour, Mauricio and Jabbour (2017)	x	x	x	x		
45	Nejati, Rabiei and Jabbour (2017)		x	x	x	x	
46	Mishra (2017)	x	x	x	x	x	
47	Rajiani, Musa and Hardjono (2016)	x	x		x	x	x
48	Mohtar and Rajiani (2016)		x		x		
49	Jabbour and Sousa Jabbour (2016)	x	x	x	x	x	x
50	Teixeira et al. (2016)		x		x	x	
51	Bhardwaj (2016)		x		x	x	
52	Gholami et al. (2016)	x	x	x		x	
53	Guerci et al. (2016)	x	x	x	x		

Source: the authors

This table presents a comprehensive overview of recent scholarly research at the intersection of green human resources (GHR) and aspects of sustainable supply chains (SSC) (Gedam, Raut, Agrawal & Zhu, 2023; Gholami, Rezaei, Saman, Sharif & Zakuan, 2016; Jabbour & Sousa Jabbour, 2016; Teixeira et al., 2016). We will focus on the essential findings and trends specific to these two dimensions:

Green human resources aspects:

Hiring and training: Several articles (e.g., #2, #8, #9) emphasize the importance of hiring and training practices in GHR. They explore how organizations can recruit and nurture talent, focusing on sustainability and ensuring employees possess the necessary skills and knowledge to contribute to sustainable supply chains.

Employee engagement: Article #2 stands out as it delves into the influence of employee engagement in supporting the implementation of green supply chain management (GSCM) practices. This highlights the critical role of engaged employees in driving sustainability initiatives within supply chains.

Performance: GHR practices aim to enhance employee performance, and some articles (e.g., #1, #3, #4) discuss how GHR impacts individual and organizational performance, especially in sustainable supply chains.

Aspects of sustainable supply chains:

Environmental aspect: Many articles (1, 3, 5) address the environmental dimension of SSC. They explore how organizations can reduce their environmental footprint through sustainable supply chain practices, such as eco-friendly sourcing, reduced emissions, and waste management.

Social aspect: Some articles (3, 7……) discuss the social dimension of SSC, focusing on issues like labor practices, ethical sourcing, and community engagement. These aspects highlight the importance of considering social responsibility within supply chains.

Economic aspect: Sustainability is not just about environmental and social concerns but also economic viability. articles like 1 and 7 emphasize the economic aspect, exploring how sustainable supply chain practices can lead to cost savings and improved financial performance.

Emerging trends and convergence:

several articles (11, 16) explore the interplay between GHR and SSC. They investigate how GHR practices impact various aspects of sustainable supply chains, demonstrating the interconnectedness of these dimensions.

Collaboration between GHR and SSC is a recurring theme, with studies (1, 7) highlighting

the need to align human resource practices and supply chain sustainability objectives.

4. Discussion

4.1. Practical Implications

In line with the above findings, we can emphasize some practical implications in our study. Organizations should recognize that sustainability is a multidimensional effort involving environmental responsibility, social ethics, and economic viability (Payán-Sánchez, Labella-Fernández & Serrano-Arcos, 2021; Tulsi & Ji, 2020; Zaid, Jaaron & Bon, 2018). The existing literature emphasizes the importance of adopting an integrated approach to sustainability that encompasses both Green Human Resources Management (GHRM) and aspects of Sustainable Supply Chains (SSC) (Chen, Jayaraman & Chen, 2021). This integrated approach involves managing products, processes, value chains, and resources to meet present needs without compromising the ability of future generations to meet their own needs (Acquah, Agyabeng-Mensah & Afum, 2020; Gholami et al., 2016; Mani & Delgado, 2019; Trujillo-Gallego, Sarache & Sellitto, 2021). However, the supply chain literature has focused less on social sustainability (Kaufman & Ülkü, 2018). There is a need for more research and exploration regarding assessment and evaluation mechanisms for sustainable supply chain management (Shan & Wang, 2018). Integrating environmental considerations into research and practice is crucial for a systematic and comprehensive green supply chain management approach. Organizations should recognize that sustainability is not a standalone concept but a multidimensional effort involving environmental responsibility, social ethics, and economic viability (Mishra, 2017; Muduli et al., 2020; Raut et al., 2019; Tulsi & Ji, 2020).

Organizations must invest in strategic talent management practices to enhance sustainability. Hiring individuals committed to sustainability, providing targeted training and development programs, and fostering a culture of continuous learning is vital. Such efforts ensure employees possess the skills and knowledge to drive sustainability initiatives (Akhtar, Winsborough, Lovric & Chamorro-Premuzic, 2019; Gedam, et al., 2023; Gedam, Raut, Sousa Jabbour, Narkhede & Grebinevych, 2021; Ghouri, Mani, Khan, Khan, & Srivastava, 2020; Leone, Davis, Velasquez & Nagle-Roides, 2021; Pellegrini, Rizzi & Frey, 2018; Thakur & Mangla, 2019).

Employee engagement is crucial for successful sustainability efforts, and organizations should prioritize strategies that engage employees in sustainability practices. This can be achieved by creating opportunities for employees to contribute ideas and involving them in decision-making processes (Gedam et al., 2023; Graham, Cadden & Treacy, 2023; Payán-Sánchez et al., 2021; Teixeira et al., 2016). Additionally, recognizing and acknowledging employees' contributions towards sustainability goals is essential. Studies have shown that employee engagement positively impacts organizational sustainability, including its economic, social, and environmental dimensions (Chakraborty & Ganguly, 2019; Nandan & Jyoti, 2020; Ruiz-Pérez, Lleo & Ormazabal, 2021). Organizational culture, leadership behavior, rewards, support to employees, and internal communication are critical dimensions of organizational culture that drive employee engagement and impact business sustainability (Pellegrini et al., 2018; Yu, Chavez, Feng, Wong, & Fynes, 2020). Furthermore, frontline employees' perceptions of human resource practices, such as internal sustainability orientation and supervisory support, influence their propensity to adopt sustainable behaviors (Bradley, 2018). By designing HR practices and strategies that promote employee engagement and commitment, organizations can enhance and support organizational change for sustainability (Gholami et al., 2016; Tulsi & Ji, 2020).

Green human resources practices are crucial in improving individual and organizational performance related to sustainability. Companies should align their performance management systems with sustainability objectives to leverage the potential of green HR practices (Dian, Pambudi, Leonardus, Sukrisno & Kundori, 2022; Teixeira et al., 2016; Trujillo-Gallego et al., 2021; Zaid et al., 2018). This can be achieved by setting clear performance metrics aligned with sustainability goals and rewarding employees for their sustainability achievements. Research has shown that green HRM policies, employee engagement in green activities, and sustainability communication positively impact business and sustainability performance. Additionally, green practices, such as green human resource management and green supply chain management, have positively and significantly affected sustainability performance (Zhu, 2023). Therefore,

integrating green HR practices into performance management systems can contribute to achieving sustainable organizational performance (Ali, Salman, Yaacob, Zaini & Abdullah, 2020; Ghouri et al., 2020; Ogbeibu et al., 2020; Setyaningrum & Muafi, 2023; Singh & El-Kassar, 2019).

The convergence of GHRM, SC, and sustainability is critical for firms that want to implement ecologically and socially responsible practices into their operations. There are several canals that connect these three domains.

Collaboration and integration:

Cross-functional teams: Cross-functional teams comprised of professionals from human resources, supply chain management, and sustainability can help to improve collaboration and practice integration.

Integrated reporting: One way to assist align goals across GHRM, SC, and Sustainability is to develop integrated reporting systems that take environmental, social, and governance concerns into account in addition to standard financial indicators.

Elements of a sustainable supply chain:

In order to encourage suppliers to embrace sustainable practices, like ethical sourcing, cutting back on carbon emissions, and supporting fair labor standards, GHRM can work with supply chain teams.

Green Procurement: Including environmentally friendly and sustainable suppliers in the supply chain guarantees the sourcing of goods and services.

Training and employee engagement:

Programs for training: It is ensured that staff members, especially those in supply chain positions, are aware of and supportive of sustainability goals by including sustainability training into employee development programs.

Incentive programs: Linking employee performance metrics related to sustainability goals can motivate individuals to actively contribute to green initiatives.

Corporate social responsibility (CSR):

CSR strategy: GHRM and SC can collaborate on defining and implementing CSR strategies that align with sustainability objectives, covering areas such as community engagement, social impact, and environmental stewardship.

Stakeholder engagement: Engaging with stakeholders, including employees, customers, and communities, can enhance the effectiveness of sustainability initiatives.

Technology and innovation:

Digitalization: Leveraging technology and data analytics in both HRM and supply chain processes can contribute to identifying opportunities for sustainability improvements and measuring performance.

Innovation programs: Encouraging innovation within the organization can lead to the development of sustainable practices and solutions in both HRM and supply chain operations.

Metrics and assessment of performance: KPIs (Key Performance Indicators): Establishing common KPIs to assess the social and environmental effects of supply chain and HR operations guarantees that sustainability objectives are regularly tracked.

Benchmarking: Organizations can evaluate their sustainability progress and pinpoint areas for development by benchmarking against industry standards and best practices.

Regulatory compliance: Teams dedicated to compliance Creating groups to keep an eye on and guarantee adherence to labor and environmental laws can facilitate the integration of sustainability into supply chain and human resource management procedures.

Organizations can develop a more comprehensive approach to sustainability by promoting cooperation and alignment across various channels, which will include supply chain management, human resources, and general operations.

As a result, organizations committed to sustainability in their supply chains should integrate green human resources into their fundamental strategies. This holistic approach is aligned with environmental, social and economic objectives and improves overall business performance and competitiveness. By applying the practical results outlined here, organizations can pave the way for a sustainable future while continuing to adapt to emerging challenges (Nikolić, Lazarević & Jaganjac., 2022) and opportunities.

5. Conclusion, limitations, and future research opportunities

In this research, a systematic literature review of studies, including the effects of green human resources practices on the sustainability of supply chains, was carried out. Articles written in English in the Web of Science and Scopus databases that include green human resources, supply chain, and sustainability were compiled for this purpose. It

was determined that 53 studies meet the pertinent criteria and are directly related to the topic, of which 47 were published articles, and 6 were early access. Various content analyses were performed on this data set.

The date of the first study in the context of green human resources, supply chain, and sustainability corresponds to 2016. The number of studies in the field reached double digits for the first time in 2020.

Information on the contributions of countries, journals, and authors to the domain regarding the number of publications, h-index, and total citations were obtained. Regarding the number of publications, India and China rank first, while France and China take the first place in cooperation. When ranked according to the citations received, Brazil and India took the first two places. It can be seen that India and China, which have question marks (Huang & Wang, 2010; Sachin & Rajesh, 2022) about sustainability, take the lead in the field. It can be considered a favorable situation that these two countries, which have more than 34% of the world's population, are at the forefront of studies on sustainability.

The academic journal that gave the most coverage to the studies published in the pertinent context was the *Journal of Cleaner Production*. Although 11 studies in the data set were published in this journal, they also rank first in total citations and, consequently, the h-index. The domain's most influential researchers were Jabbour and Sousa Jabbour (2016).

In the content analysis, concepts such as environmental performance, environmental management, financial performance, and big data came to the fore, besides the search terms. The images of green human resources management, supply chain, and sustainability are in the same dimension, according to the tree dendrogram, based on the conducted factor analysis. Additional concepts that support this dimension include resource-based views, green hiring, green training, sustainable performance, and green ability. The supply of human resources, their development, and the use of their skills by the strategies determined are necessary for organizations to achieve their sustainability goals, so examining these functions alongside the sustainability of supply chains is essential.

The concept of financial performance comes to the forefront as both the PageRank value and the betweenness value in the created network, the necessity for organizations to use their financial resources effectively to maintain their existence. The following distinction should be made: should organizational or environmental sustainability be prioritized? Organizations, of course, seek to maximize their interests. They are, however, not independent of the environment in which they operate due to the system's approach. Discussions continue on how organizations should set their priorities to continue working without harming the environment while meeting their goals (Adams, 2003; Gugushvili, 2021).

The concept of *environment*, which stood out in the first two time periods of the thematic evolution analysis, has recently given way to the images of "green supply chain" and "sustainable performance." As in any new domain, general topics are typically the first to be covered while the knowledge develops and touches on more specific subjects over time. However, the effects of green human resources on the sustainability of supply chains are far from being processed in all its dimensions. It can be predicted that both green human resources and the sub-dimensions of the supply chain will gain more weight in the future.

One of its limitations is that the study is rooted in the framework of sustainable supply chains and green human resources. However, the requirement for setting a limit to enable analysis can be used to justify this limitation. The databases used in the research, Web of Science and Scopus, are the most reliable sources at this time, but using different databases can generate more nuanced and comprehensive results.

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