Human Resource Development Quarterly

WILEY

LITERATURE REVIEW OPEN ACCESS

Green Human Resource Management and ISO 14001: Toward Environmental Sustainability in Organizations

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Received: 23 July 2024 | **Revised:** 7 February 2025 | **Accepted:** 11 September 2025

Funding: This work was supported by E.O. was funded by an FCT - Portuguese Foundation for Science and Technology Ph.D. fellowship (ref. 2022.12305.BD) and N.R. was funded by an FCT - Portuguese Foundation for Science and Technology under project (Ref. UIDB/04928/2020).

Keywords: bibliometric analysis | climate change | environmental management | green human resource management | ISO 14001 | PRISMA statement | research trends | sustainable development

ABSTRACT

The current climate change scenario imposes urgent challenges to different economic sectors around the world, requiring companies to adopt new strategies to achieve sustainable development goals (SDGs) while enhancing environmental awareness. In this sense, green human resource management (GHRM) and International Organization for Standardization (ISO) 14001 can lead to a reduction in the environmental impact caused by business activities. The growing need for decision-makers to ensure a company's competitive position in the market invites managers to integrate people management as an active component of corporate sustainability efforts. By demonstrating a commitment to sustainability, companies can contribute to economic growth, individual well-being, and environmental preservation. The purpose of this study is to analyze current knowledge on GHRM and ISO 14001 and their intersection, providing directions for future research. The literature review was conducted using the PRISMA methodology and bibliometric analysis (performance analysis and scientific mapping) with data from Web of Science and Scopus. The final dataset comprised 520 articles on GHRM and 12 about GHRM and ISO 14001. The results show the growth of the topics in the academic community, especially in countries located in East, South, and Southeast Asia and in Brazil. The most studied economic sectors are tourism, hospitality, and manufacturing. Future research trends indicate a greater inclusion of people in the corporate ecological objectives of different economic activities. The integration of GHRM and ISO 14001 seems to help mitigate climate change and promote sustainable development. The conclusions highlight the importance of implementing GHRM, especially in ISO 14001 organizations, to obtain the active participation of employees in environmental preservation. These ecological practices seem to strengthen the company's image, making it more attractive and helping them to retain talent. This study provides insights for academics, professionals, and policymakers and is a pioneering study in investigating two themes simultaneously.

1 | Introduction

The current crisis related to climate change poses pressing challenges to the subsistence of industrial economic activities on a global scale; for example, it threatens important sectors including manufacturing (Chen et al. 2023), agriculture (Ojo and Baiyegunhi 2021; Albugami et al. 2024), tourism (Chapungu et al. 2024), and hospitality (Ngin et al. 2020), among several others. These events pose significant risks to financial and economic stability (Chabot and Bertrand 2023), emphasizing the

need for planning and adaptation capable of providing more effective responses to this issue (Araos et al. 2016). Faced with this scenario, adapting to the new reality and creating strategies become essential to achieve sustainable development and mitigate these effects, especially when including human resources who are indispensable to organizations (Abbas and Dogan 2022). Additionally, companies must recognize that compliance with environmental standards is under increasing pressure from stakeholders. This ensures that the company maintains an adequate market position and minimizes its environmental impact (Gao et al. 2019). The demand for governance strategies oriented toward an Environmental Management System (EMS), such as ISO 14001, responds to stakeholder expectations regarding environmental performance (Camilleri 2022), and can provide an ideal context for the development of ecological strategies focused on people management (Khan and Johl 2019; Al-Swidi et al. 2022).

In this context, green human resource management (GHRM) has emerged as a new concept in management that aims to reduce the ecological footprint through practices, policies, and goals that aim to align the behavior of employees with the environmental objectives of the organization (Renwick et al. 2013; Amrutha and Geetha 2020). Among its benefits, environmental performance (Shakil et al. 2023), competitive advantage (Mustafa et al. 2023), and economic performance (Carballo-Penela et al. 2023) stand out at the organizational level, and at the individual level, worker well-being (Martínez-Falcó et al. 2024) and satisfaction (Freire and Pieta 2022), for example. GHRM adopts processes that accompany employees throughout their journey in the company (Renwick et al. 2013). These subterfuges aim to guide employees' behavior through training, for example, toward greater care and awareness in the use of natural resources, energy management, more efficient recycling, and better waste management (Zaidi and Azmi 2022). Currently, there is no consensus on the dimensions of GHRM; however, some stand out in this multidimensional concept, namely green work design; green recruitment and selection; green training and development; green performance management; green compensation and rewards; green health and safety; green labor relations; and green grievance management (Dubey et al. 2024; Tanova and Bayighomog 2022; Yong, Yusliza, and Fawehinmi 2020).

In synergy, ISO 14001 provides the necessary conditions where the engagement and active participation of employees make the process more effective (Jabbour et al. 2008). This is a voluntary and certifiable international standard that regulates and formalizes EMS in companies, structuring processes around policies, objectives, and audits to help organizations minimize their impact on the environment, comply with relevant legislation and regulations, and promote continuous operational improvements in their environmental management practices (Camilleri 2022; ISO 2023). There are similarly other standards such as ISO 14002, ISO 14004, ISO 14005, and ISO 14006, which extend the guidelines and address more specific aspects of EMS (Camilleri 2022). In addition to these, ISO 37101 also ensures coherence with the sustainable development policy of communities by establishing requirements with a holistic approach for a management system oriented toward the sustainable development of communities and cities (Ruggiero et al. 2024). ISO 14001 has proven effective in helping companies respond to institutional pressure by proactively addressing environmental concerns (Ofori et al. 2023). Among its benefits are a better competitive advantage and improved technical efficiency among highly polluting industries (Song et al. 2024), as well as demonstrating organizations' commitment to the environment (Huang et al. 2024).

Numerous academics around the world have dedicated themselves to studying GHRM, whether at an organizational or individual level (Cooke et al. 2020; Pham, Tučková, and Phan 2019; Renwick et al. 2013; Roscoe et al. 2019; Shafaei et al. 2020; Zaid et al. 2018). Similarly, academic curiosity about the effect of ISO 14001 on organizations (Guoyou et al. 2012; Opoku-Mensah et al. 2023; Riaz and Saeed 2022; Seroka-Stolka and Fijorek 2022), especially financial performance (Ferrón-Vílchez 2016; Heras-Saizarbitoria et al. 2011; Lee et al. 2017), has been the subject of investigations. However, there are gaps in the literature that require more information on this subject (Renwick et al. 2013), such as the need for human resource management studies related to sustainability (Murillo-Ramos et al. 2023), the inclusion of industrial initiatives related to environmental management (Dubey et al. 2024), analyzing competitive advantage strategies (Mishra 2017), and even identifying trends to solve environmental problems (Sharma et al. 2022).

Therefore, examining the intersection of these two elements simultaneously is crucial for economic health (Tanova and Bayighomog 2022), people's well-being (Chiarini 2017), and the promotion of sustainable development (Zhao et al. 2023). Furthermore, exploring issues that contribute to the environment is one of the objectives of the 2030 Agenda (United Nations 2020). There is evidence that highlights the importance of studying both GHRM and ISO 14001 as key elements for improving environmental performance (Arocena et al. 2021; Khan and Muktar 2020). Organizations with environmental management system standards, such as ISO 14001, are recognized for implementing green initiatives across various functional areas, fostering greater employee participation (Panigrahi et al. 2019). Nevertheless, there is no clear evidence in the literature exploring the integration of GHRM and ISO 14001 together as strategies for sustainable development, especially with regard to analyzing the performance of publications and the scientific mapping of these elements together (Camilleri 2022; Dubey et al. 2024; Sartor et al. 2019; Yong, Yusliza, and Fawehinmi 2020; Yong, Yusliza, Jabbour, and Ahmad 2020). This gap highlights the limitation of knowledge due to the absence of a literature review and bibliometric framework for joint research in this field. In particular, there is no consolidated scientific mapping that examines the relationships between research components, intellectual interactions, and structural links between investigation constituents (Cobo and Herrera 2011). Currently, there are results only at a single GHRM level (Dubey et al. 2024; Murillo-Ramos et al. 2023) or exclusively for ISO 14001 (Salim et al. 2018). Current knowledge on the topic still lacks an in-depth performance analysis to examine the contributions and evaluate different components of the topic more analytically (Donthu et al. 2020).

Considering these aspects, it is essential to answer the main question of this research: how does the literature describe the way organizations adapt to environmental challenges through

GHRM implementation and ISO 14001 certification in organizations, and what are these effects on contributing to sustainable development? Thus, four central questions guide this study, namely:

Q1. *What is the current state of knowledge about GHRM and ISO 14001, and what does the existing literature say?*

Q2. *What is the current performance of these publications related to the theme and how can they contribute to organizations?*

Q3. *What is the current scientific map of the intellectual structure of these elements?*

Q4. *How can this knowledge contribute to future research and help promote sustainable development?*

Clarifying these aspects and addressing these gaps is of vital importance and is the purpose of this study. In light of this, this work rigorously employs an adaptation of the PRISMA methodology (Page et al. 2021) and a set of bibliometric analyses (Van Eck and Waltman 2010) with the aim of using appropriate tools to provide answers to the needs identified. The use of this methodology is extremely relevant to ensure a fair and clear assessment of the issues that require attention (Gusenbauer and Haddaway 2020).

With this support, it becomes possible to follow guidelines that ensure the development of a reliable and enlightening literature review, as well as robust bibliometric analyses. In addition, it enables subsequent replication and suggests future directions (Khan and Muktar 2020). Similar to this study, this methodological approach has already been adopted to better understand the GHRM field (Bahuguna et al. 2023; Dubey et al. 2024; Farrukh et al. 2022), the ecological creativity of employees in the hotel sector (Choudhary and Datta 2023), as well as in mapping research trends for sustainable and agile human resources in SMEs (Papademetriou et al. 2023), as well as to present existing management system standards debated in the literature such as ISO (Ronalter et al. 2023). Therefore, the final set of data from 520 GHRM articles and 12 ISO 14001 articles was rigorously analyzed using the techniques established in the methodology.

To this end, this article has been structured as follows: the following sections, namely Sections 2–4, deal with the theoretical framework, the methods, and the results and discussion, respectively. Finally, the fifth section of this article is dedicated to the conclusions.

2 | Background

2.1 | Green Human Resource Management

The interest in discussing human resource practices integrated with environmental objectives in organizations has emerged since the late 1990s (Renwick et al. 2008). These authors established solid foundations for a more in-depth discussion of the concept of green human resource management (GHRM), which was the subject of analysis between 2007 and 2019 by Yong, Yusliza, and Fawehinmi (2020), Yong, Yusliza, Jabbour, and Ahmad (2020). However, Renwick et al. (2013) expanded on their initial investigations, consolidating GHRM as a formal field of research as early as 2011 by highlighting specific practices and objectives that align people management with environmental sustainability. Since then, this tool has been the subject of research to align human resources practices with the ecological objectives of organizations (Dubey et al. 2024; Farrukh et al. 2022; Khateeb and Nabi 2023; Paulet et al. 2021).

The benefits of GHRM are not limited to environmental outcomes. Recent studies have also highlighted gains such as improved competitive advantage for companies in the market (Kim et al. 2023), the development of environmentally responsible production (Sánchez-García et al. 2025), and improved environmental behavior among employees (Qi et al. 2024), for example. Integrated into organizations' traditional human resource management (HRM) strategies, GHRM can be understood as a set of organizational practices, policies, goals, and objectives guided by an ecologically oriented model, essentially focused on environmental sustainability (Farrukh et al. 2022). Current literature distinguishes these practices as being green dimensions, also known as recruitment and selection—conducting a selection of candidates aligned with sustainability; job/task design—structuring roles with an environmental focus; training and development—continuous training for green competencies; employee motivation and retention—actively engaging for green practices; and pay and reward—providing rewards that incentivize sustainable actions, as highlighted in the literature (Renwick et al. 2008; Renwick et al. 2013; Tang et al. 2018; Choudhary and Datta 2021). These practices can promote gains both at the individual level, for example through the employee's bond with the organization (Shoaib et al. 2021) or, as Ren et al. (2021) report, at the organizational level through improved financial performance.

Recent scientific evidence highlights how these dimensions are studied, serving as either antecedents or consequences, and suggesting new perspectives and approaches for future research (Tanova and Bayighomog 2022). When studied as an independent variable, GHRM has provided valuable insights into various aspects of organizational behavior, particularly in the hospitality sector (Tanveer et al. 2023), such as teamwork behavior (El Baroudi et al. 2023), perception of organizational support for the environment, and employee intention to leave the company (Karatepe et al. 2022). This includes voluntary or involuntary pro-environmental behaviors and proactivity performance (Darvishmotevali and Altinay 2022; Zafar et al. 2023), employee organizational citizenship behavior regarding the environment (Hameed et al. 2020), green innovation in the workplace context (Munawar et al. 2022), and green and non-green outcomes in the tourism sector (Tandon et al. 2023). In the manufacturing sector, researchers included large companies in Malaysia to test the dependent variable and understand the relationship between stakeholder pressure, relative advantage, and top management commitment as predictors of GHRM (Yong et al. 2022). Only relative advantage, the degree to which an innovation is considered better than the existing idea, was not a supported hypothesis. Marrucci et al. (2023) reinforced the extent to which institutional pressures, as potential predictors, are also capable

of increasing the organization's performance, especially for these companies to adopt GHRM. In this regard, it has also been found that market pressure through green public procurement increases the practice of environmental certification, especially with the involvement of GHRM and the influencing mechanism of top management support (Ma et al. 2021). These findings emphasize the need to understand how the literature is organized to provide organizations with actionable insights for adapting to environmental challenges.

In this regard, Bahuguna et al. (2023) state that the field is still developing, despite numerous discoveries. These same authors highlight the need for new researchers to conduct more intensive research aimed at gaining a deeper understanding of the subject. The bibliometric analyses by Tutar et al. (2023) revealed a daily increase in research trends in the areas of GHRM and corporate social responsibility, although they focused on 21 years of publications exclusively on sustainable human resource management. Building on this approach, the methodology was successfully applied in the hospitality and tourism sector, demonstrating its effectiveness for these findings (Choudhary and Datta 2023). New findings indicate that knowledge about GHRM is at an early stage and has a global reach, although most academic research is concentrated in Asian societies (Farrukh et al. 2022). Interest is growing around emerging themes such as green human resource management, corporate social responsibility, innovation, environmental performance, circular economy, and sustainable development (Dubey et al. 2024). However, Khan and Muktar (2020) suggest that future studies should consider new bibliometric analyses using other databases and more information about this field, as well as carrying out other studies to explore the relationships between different elements. This corroborates the motivation to find significant and innovative evidence, in addition to mapping scientific knowledge on the intercession of GHRM and subtopic ISO 14001.

2.2 | International Organization for Standardization

The International Organization for Standardization (ISO) is an institution dedicated to the standardization of products and services, present in around 162 countries. Among its standards aimed at ensuring reliability, ISO 14001 stands out, recognized for being an environmental management system (EMS) that establishes requirements to better manage environmental aspects, improve ecological performance, and contribute to compliance with applicable legislation (ISO 2023). Its principal objective is to help organizations minimize environmental impacts through a management structure with a continuous improvement cycle, strategic adaptations, and certification that increases credibility with stakeholders (Camilleri 2022; ISO 14001 2004). The standard applies the concept of Plan-Do-Check-Act (PDCA), promoting planning, implementation, monitoring, and continuous action to achieve environmental objectives in line with organizational policy (ISO 2023). In addition to ISO 14001, the ISO family includes other standards such as ISO 14018, ISO 14046, and ISO 14068, which broaden environmental management by addressing performance, water footprint, and carbon neutrality and helping companies to strategically address environmental issues (Camilleri 2022).

Obtaining ISO 14001 is undeniably important for reducing carbon emissions in European countries (Ofori et al. 2023). Thus, this certification has been found to be a potentially moderating variable in the relationship between stakeholder pressure and environmental competitiveness when tested in key sectors such as food, chemical, energy, fuel, and service industries (Seroka-Stolka and Fijorek 2022). In these companies, one of the main objectives is environmental improvement, which is more likely to be achieved in those that have facilities that integrate ecological performance management standards and elements into their activities (Yin and Schmeidler 2009). According to Bansal and Hunter (2003), companies that certify early demonstrate considerable environmental legitimacy and a strong international presence, which reflects their commitment to corporate social responsibility and quality. This is supported by findings from similar studies, which suggest that adopting this certifiable standard can result in operational efficiencies through better use of resources and waste management systems (Camilleri 2022). Its effectiveness was demonstrated by Ahmed et al. (2024), who showed how ISO 14001 guidelines can establish a framework and improve environmental performance in the New Zealand meat industry. Furthermore, it has been shown that the application of ISO 14001 supports sustainable development, especially in contexts where legal mechanisms are weak, such as in Poland's energy sector (Fortuński 2008).

Despite the advantages provided by ISO 14001 highlighted in the literature, including the improvement of companies' financial performance (Wu et al. 2020), it is important to consider its limitations, such as its financial integration into organizational planning (Abisourour et al. 2021). Authors argue that ISO 14001 can negatively impact financial performance (Wang and Zhao 2020), although its adoption increases market value, especially in multinationals (Margaret et al. 2024). Although a meta-analysis carried out by Erauskin-Tolosa et al. (2020) confirms the positive influence of ISO 14001 on corporate environmental performance, and similar results have been identified in various economic sectors, such as in the nations of the Shanghai Cooperation Organization (Opoku-Mensah et al. 2023); the Spanish auxiliary fishing industry (Peiró-Signes et al. 2020); in certified Danish organizations (Mosgaard et al. 2022); in the performance of Spanish hotels (Cavero-Rubio and Amorós-Martínez 2020); the internalization of Environmental Management Systems in Europe (Daddi et al. 2022), including mapping the growth trend of certifications in countries and sectors with potential for adoption, such as Africa, Asia, and Australia (Marcel et al. 2021). In the face of the divergences pointed out by the current literature, other research has been conducted with the aim of identifying the main World Development Indicators (WDI) that influence the number of companies with ISO 14001 certifications (Toporowicz et al. 2021). Among other elements, the workforce and population are related to the number of certifications. This highlights the importance of further understanding this topic (Sartor et al. 2019).

2.3 | Green Human Resource Management and International Organization for Standardization

While Balasubramanian et al. (2021) argue that the ISO 14001 standard is fundamental to the effective performance of

organizations, it is equally crucial to consider human intervention, particularly in integrating sustainability into corporate operations and strategies (Murphy et al. 2020). For example, this involvement motivates CEOs through compensation tied to environmental practices, making them more likely to enhance companies' environmental performance (AlShaer et al. 2023). In terms of employees, the green behaviors acquired at work are extended to their homes, contributing to a more amplified dimension (Arimura et al. 2021). The human factor is important in implementing certification, as the literature highlights the role of female executives in driving the adoption or renewal of ISO 14001 certifications in organizations (Saeed et al. 2022). In this sense, some authors believe that gender diversity in the top management of companies is necessary to promote greater support for the adoption of global sustainability initiatives (Mungai et al. 2020).

Jabbour (2015b) investigated the relationship between green training, now known as an integral part of the green human resource management (GHRM), and maturity in environmental management. The results showed that a positive relationship existed in the Brazilian context. Similar effects occurred where the relationship between environmental training, sustainable purchasing, and cooperation with customers was positive (Teixeira et al. 2016). In the same direction, the relationship between GHRM and corporate social responsibility (CSR) was investigated by Freitas et al. (2020), who used ISO 14001 certification as a control variable. Evidence highlights the importance of human resource management (HRM) in involving and empowering employees, actively contributing to the environmental and strategic objectives of organizations (Amrutha and Geetha 2020). Similarly, it is remarkable how ISO 14001 provides the means for organizations to demonstrate their environmental management potential to demanding customers around the world, thus attracting greater interest in their products or services (Darnall and Carmin 2005). Thus, it is crucial to see how employee involvement and active participation drive HRM in ISO 14001 companies (Jabbour et al. 2008). Equally, understanding how this norm influences organizations (Maletič et al. 2015); how the literature has addressed this aspect (Salim et al. 2018); and how these elements can help sustainable development seems to be a cross-cutting theme in academic discussion (Sartor et al. 2019).

More recently, the literature has highlighted how certified companies have provided a convenient context for the development of studies exploring the effects of GHRM (Freire and Pieta 2022; Gim et al. 2022; Khan et al. 2020; Ojo et al. 2022). Although both elements are important for organizations, this symbiosis does not seem to be fully explored in the literature, making it essential to identify, examine, and map scientific documents that address people management practices with an ecological bias. Particular attention should be given to those implemented by companies adopting an environmental management system standard (Jabbour 2015a). Currently, no clear evidence has been found regarding the state of knowledge, publication performance, scientific mapping, and contribution to future research on how organizations adapt to environmental challenges through GHRM and ISO 14001 in a single study. It is therefore imperative to fill this gap to contribute to sustainable development.

3 | Methods

To achieve this study's objectives and answer the research questions, established methodological techniques were applied, including a literature review guided by the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) statement and a set of bibliometric analyses. PRISMA is widely recognized in the field of management for investigating emerging themes (e.g., Kumawat et al. 2025) and aspects that influence environmental performance (e.g., Khaw et al. 2024). Bibliometric analysis, especially performance analysis and scientific mapping, seeks to process a large volume of scientific publications in order to organize, clarify, and group a specific academic field, as well as highlight emerging themes on a given topic (Van Eck 2011; Waltman and Van Eck 2013) and is an effective technique in the field of people management (Farrukh et al. 2022). This study explored some of these methodologies to answer the research questions, with the stages highlighted in the conceptual model shown in Figure 1.

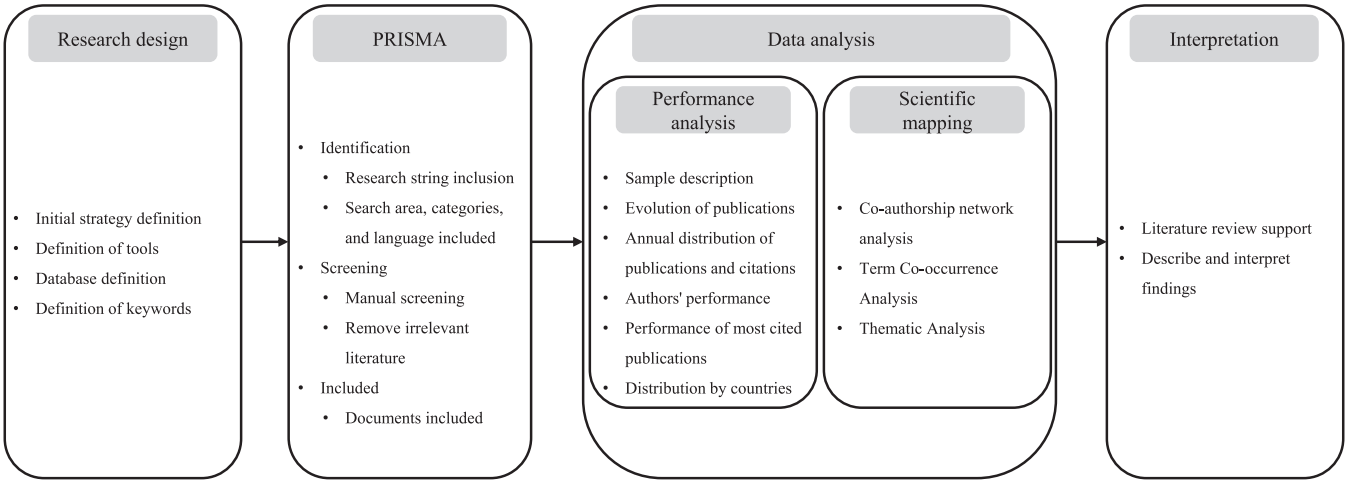

FIGURE 1 | Methodological conceptual model used in the study, encompassing the research design, the adapted application of PRISMA, the bibliometric analysis of the data, and the interpretation of the results.

3.1 | Initial Strategy Definition

Before applying the PRISMA model, strategies were implemented to ensure rigorous and reliable data collection. Given the incomplete and potentially unstable coverage of some databases, such as Google Scholar (Harzing 2013), this study took the precaution of extracting data exclusively from two globally recognized and credible sources, specifically, Web of Science (WOS) and Scopus (Gusenbauer and Haddaway 2020; Zhu and Liu 2020). This approach has also been used in similar GHRM studies, including research on hospitality (Choudhary and Datta 2023); literature reviews (Khan and Muktar 2020; Tutar et al. 2023; Xie and Lau 2023); and even in the field of pro-environmental behaviors (Zaidi and Azmi 2022), demonstrating its robustness, versatility, and relevance across these research areas.

Initially, a strategic procedure was adopted to select the keywords to be included later in PRISMA, ensuring that only those directly reflecting GHRM and the subtopic of GHRM and ISO 14001 were considered. Thus, to increase the accuracy of this research, efforts were made to implement the use of a multilingual controlled vocabulary (Guimarães et al. 2022). This procedure seeks to identify broader terms, homographs, and possible synonyms in order to retrieve information that could be inadvertently forgotten. However, due to the specific nature of the topics covered, this resource could not be applied in this study. To compensate for the lack of controlled vocabulary, an alternative approach was adopted to ensure data comprehensiveness.

To identify relevant keywords, a preliminary search was conducted in scientific databases to map the main terms and keywords used in bibliometric studies on these topics. This initial step allowed for an analysis of how different authors define the "search string" related to these topics, guaranteeing a more consistent selection of keywords for PRISMA. After identifying a set of scientific articles, the methodological sections of these studies were analyzed to identify patterns in the formulation of search strings. This process allowed for the extraction of the most recurrent terms and provided insights into the conceptual and terminological variations used by researchers. This approach strengthened the definition of keywords to guide the subsequent stages of the study.

3.2 | Search Strategy

PRISMA proposes a set of guidelines that contribute to conducting a credible and reproducible literature review (Page et al. 2021). In this study, an adaptation of this model was used, applying three important stages, namely: (I) identification, for data collection and to verify the source of information in the review studies; (II) screening, to define the inclusion and exclusion criteria; and (III) inclusion, to select and analyze articles, ensuring transparency in the methods used to include articles and compile results. This stage aimed to guide the literature review and produce data for bibliometric analysis.

In the first identification stage for "search string 1", priority was given to the term "green human resource management" and its acronym, as well as expressions such as "green human resource management practices", which were identified in the previous phase. Additionally, the search strategy "green human resource$" and "green human resource management practice$" was considered, using the dollar sign ($) after "resource" and "practice." This approach aims to retrieve singular and plural forms, such as "resources" or "resource", for example. For "search string 2", the full term "International Organization for Standardization 14001" and its acronym were included to cover the scope of the search (see Figure 2). This procedure ensured greater scope and relevance of the topics investigated, as well as considering existing linguistic variations. The search criteria included terms in the title, abstract, or keywords. In the categories filtered by platforms, "Article" or "Early Access", and documents in the English language were restricted, eliminating gray literature such as books and conference proceedings (Adams et al. 2017).

To process the data, Excel files in CSV format were extracted in two sequential phases. In the first phase, articles about GHRM were obtained from WOS ($n = 643$) and Scopus ($n = 545$), and in the second about GHRM and ISO 14001 from WOS ($n = 12$) and Scopus ($n = 10$). With the support of a code created to run on the RStudio software, the WOS and Scopus datasets were merged, resulting in $n = 1188$ and $n = 22$ for search string 1 and 2, respectively. The simultaneous collection of data from both sources (WOS and Scopus) required the creation of new code in the RStudio software to guarantee proper processing, including the exclusion of duplicate entries generated during the merging process. Figure 2 shows the total amount of duplicate data that was excluded for both topics covered (GHRM, $n = 534$; ISO 14001, $n = 10$). Once these steps had been completed, a total of GHRM, $n = 654$ and ISO, $n = 12$ went on to the next stage.

In the second stage of manual screening, the data obtained was considered, and an exhaustive reading of the titles, abstracts, and keywords was carried out in order to check that all the articles included referred specifically to the proposed topics. When the information presented in these sections was insufficient for this assessment, the articles were read in full. This procedure was essential in order to remove articles which, despite containing the search terms in the titles, abstracts, and keywords, were not directly related to the themes. For example, articles that cited GHRM or ISO 14001 in their discussion but did not directly address the topics in the research. Thus, 134 articles were removed for the GHRM topic, while no articles were excluded for the GHRM and ISO 14001 subtopic.

In the third stage of inclusion, the final selection of articles was conducted, and those meeting the criteria were incorporated into the database for analysis. At this stage, the screened studies were evaluated in detail to ensure they met all established criteria and contributed directly to the research objectives. For the articles included, relevant data was obtained, including the year of publication, authorship, number of citations, country of origin, and main keywords, for example. This process facilitated the construction of a robust database, ensuring methodological consistency and the scientific relevance of the results to support the literature review and bibliometric analysis.

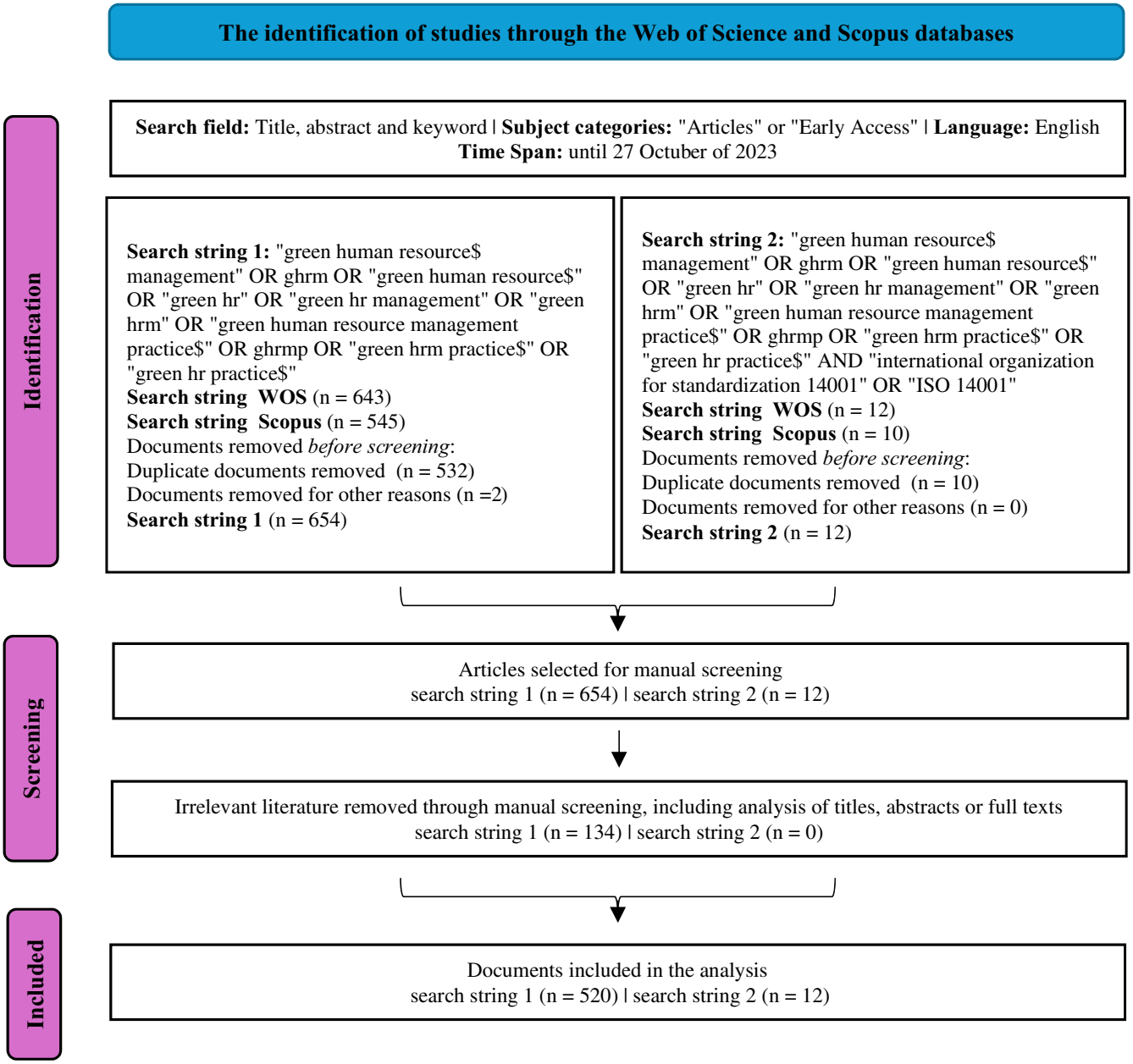

FIGURE 2 | Adaptation of the PRISMA 2020 flowchart describing the process of identifying, screening, and including publications.

3.3 | Data Analysis

The final set of merged data was 520 GHRM articles and 12 ISO 14001 subtopic articles. This data was used for the analyses proposed by the study, namely performance analysis (sample description with keywords plus—automatic terms generated by database algorithms (e.g., WOS/Scopus) and authors' keywords—provided by the authors themselves in the articles; evolution of publications; annual growth rate; annual distribution of publications and citations; authors' performance and their collaborations; publications performance; and distribution of publications by country) and scientific mapping (co-authorship network; term co-occurrence analysis; and thematic analysis) as in other studies of this kind (Khaw et al. 2024; Santos and Ortega 2025). Thus, it was possible to support the development of a new research agenda.

For the performance analysis, we sought to observe the metrics on publications, covering information on the topics approached. According to Donthu et al. (2021), performance evaluation plays a crucial role in bibliometric studies by providing a methodological basis for measuring both the volume and relevance of publications and their results. These evaluations assess the scientific quality and influence of published articles, providing evidence that guarantees consistency in a given scientific field (Albort-Morant and Ribeiro-Soriano 2016; Bouyssou and Marchant 2011). This study used the number of publications fractionalized (NPF) as a metric of author performance. Although there are other methodologies for carrying out this assessment, this work opted to use fractionalized counting. This indicator adjusts the count of scientific publications to the proportional contribution of each author, ensuring a more equitable analysis (Waltman and Van

Eck 2015). NPF is calculated by dividing the total credit for a publication equally among all associated co-authors (Aria and Cuccurullo 2017). The analyses were carried out using the Biblioshiny application, a web-based interface to the bibliometrix R package for RStudio, as proposed by Aria and Cuccurullo (2017).

For the scientific mapping, analyses were carried out that provide a clear visualization of the research field investigated (Cerver-Romero et al. 2020). According to Ramy et al. (2018), intricate patterns can be clarified, revealing the relationships between scientific literature, associated authors, and collaboration networks. Co-authorship network and term co-occurrence, as well as trend mapping, demonstrate existing collaborations between authors and growing themes (Van Eck and Waltman 2014). Co-authorship network analysis represents authors as nodes interconnected by edges, where the weights of the edges indicate the frequency and strength of their academic collaborations (Van Eck and Waltman 2010). Similarly, term co-occurrence identifies the most frequent terms (represented by nodes) found in the titles and abstracts of articles, detecting patterns and associations between terms (Van Eck and Waltman 2023). Following the same principle, the thematic map is presented as a two-dimensional diagram constructed by plotting themes according to their median centrality and density values organized into four quadrants on a Cartesian plane, organized by motor, niche, peripheral, and basic themes (Aria and Cuccurullo 2017; Aria et al. 2022). The aim of this analysis was to help differentiate the current literature and suggest a future path on the topic under investigation.

The analyses in this study were supported by a widely recognized software for research of this kind, VOSviewer V1.6.19 (Van Eck and Waltman 2023) and the Biblioshiny application, a web-based interface for the bibliometrix R package for RStudio (Aria and Cuccurullo 2017). The combined use of these technological resources proved to be effective in achieving the objectives proposed by this study.

TABLE 1 | Main information about the data included in the sample.

Main information about the data	GHRM	GHRM and ISO 14001
Timespan	2011–2023	2014–2023
Sources	191	10
Documents	520	12
Annual Growth Rate %	5326	0
Document Average Age	265	4,17
Average citations per doc	34,88	76,42
References	31,180	951
Document contents		
Keywords Plus (ID)	757	57
Author's Keywords (DE)	1119	53
Authors		
Authors	1350	43
Authors of single-authored docs	36	0
Authors collaboration		
Single-authored docs	44	0
Co-Authors per Doc	352	3,75
International co-authorships %	1923	8333
Document types		
Article	516	12
Article; early access	3	0
Review; early access	1	0

Note: GHRM: Green Human Resource Management; ISO 14001: International Organization for Standardization 14,001.

4 | Results and Discussion

4.1 | Performance Analysis

4.1.1 | Sample Description

The results presented in Table 1 provide a summary of the bibliometric analysis. This analysis covered 520 publications about GHRM and 12 publications related to GHRM and ISO 14001, extracted from the Web of Science and Scopus databases. The publications about GHRM cover the time span from 2011 to 2023, while the publications related to GHRM and ISO 14001 cover the time span from 2014 to 2023. The 520 GHRM documents were published in 191 journals, while the GHRM and ISO 14001 subtopic involved 10 journals. The GHRM domain showed an annual growth rate of 53.26%, while no significant growth rate was observed for the subtopic. Publications in the GHRM domain had an average age of 2.65 years, in contrast to 4.17 years for GHRM and ISO 14001. This annual growth in GHRM research may be related to the need for organizations to adopt green practices to improve environmental performance and respond to sustainability requirements in order to mitigate climate change (Appiah Kissi et al. 2024; Vázquez-Brust et al. 2023; Zihan and Makhbul 2024). On the other hand, the results highlight the lack of studies about GHRM and ISO 14001 together, indicating that these are topics that need more attention in the literature.

In terms of citation impact, the GHRM documents received an average of 34.88 citations per publication and totaled 31,180 references. The GHRM and ISO 14001 publications, although lower in number, showed greater citation intensity, with an average of 76.42 citations per document and 951 total references. Keywords plus are generated automatically by the algorithms in the WOS and Scopus databases (Garfield 1990; Garfield and Sher 1993). Meanwhile, the authors' keywords are defined by the authors of the article themselves, intentionally representing the main themes and concepts covered in the study. The analyses showed a multitude of keywords, with the GHRM research presenting 1119 authors' keywords and 757 keywords plus, while GHRM and ISO 14001 reflected 53 authors' keywords and 57 keywords plus.

According to the results, the topic of including environmental practices, policies, and targets in people management attracted the attention of 1350 authors, 36 of whom produced individual scientific publications. On average, each document has 3.52 collaborating authors. The rate of international collaboration is 1.9%. In contrast, the subtopic has 43 authors who set out to carry out research that included GHRM and ISO 14001, but no scientist published alone. For the subtopic, each publication had an average of 3.75 collaborating authors and 8.3% international authorship. Regarding document types, the GHRM dataset comprised 516 articles, including 3 early access articles and 1 review. In contrast, all 12 GHRM and ISO 14001 documents were scientific articles. These results present and describe the performance of different research constituents in the field of the topics investigated. The results are shown in Table 1.

4.1.2 | Evolution of Publications

The evolution of publications over the time span points to a significant increase in the annual scientific production of both themes, with a particular emphasis on the growing academic interest in the GHRM theme (Figure 3). The number of annual publications increased significantly after 2016, peaking between 2017 and 2018 (Figure 3). This corroborates the current embryonic state of the subject in the literature, which requires greater attention from researchers (Camilleri 2022; Cooke et al. 2020; Farrukh et al. 2022; Tanova and Bayighomog 2022). This result can be explained by the failure to meet the Millennium Development Goals, adopted in 2000, which were replaced by the 2030 Agenda for Sustainable Development, established on September 25, 2015, at the United Nations Summit for Sustainable Development Goals (SDGs) (UNESCO 2015). The new emphasis on environmental, social, and economic sustainability has led researchers to further explore the role of GHRM in helping to achieve these goals and has fostered the creation of new strategies to mitigate climate change (Abbas and Dogan 2022; Chabot and Bertrand 2023). On the other hand, the GHRM and ISO 14001 subtopic has seen a more modest evolution, with publications appearing consistently after 2014. The limited output in this area can be attributed to the narrower scope of research on the topics together, which requires further investigation.

This becomes more evident when observing the publications that have appeared in the literature during this time span. Some authors observed that managers could leverage employee behaviors (Alnajdawi et al. 2017) to develop strategies that promote a green and sustainable workplace (Cheema and Javed 2017; Yong and Mohd-Yusoff 2016). Additionally, efforts were made to improve GHRM aimed at fostering progress toward environmental sustainability in the workplace (Renwick et al. 2015), especially as companies are perceived as elements embedded in a sociopolitical context and external factors, such as pressure from stakeholders to improve environmental performance, affect the company by shaping its people management practices (Guerci et al. 2016). The general trend indicates a substantial and consistent growth in the number of publications over the period analyzed, although between 2011 and 2015 the number of publications varied between 0 and 1, probably due to the new concept and the absence of clear definitions on the topics.

4.1.3 | Annual Distribution of Publications and Citations

The results of the references about GHRM showed a maximum total of 3935 citations reached in the year 2020, followed by the previous year with 3262 (Figure 4). In that specific year, most of the publications dealt with aspects related to improving the environmental performance of organizations (e.g., Mousa and Othman 2020; Obeidat et al. 2020; Singh et al. 2020; Umrani et al. 2020; Yong, Yusliza, and Fawehinmi 2020; Yong, Yusliza, Jabbour, and Ahmad 2020; Yusoff et al. 2020). This scenario coincides with the COVID-19 pandemic, a historic global event. The pandemic has stimulated potential investments in improving the environmental performance of organizations. A considerable reduction in the consumption of electricity, paper, and CO_2 emissions associated with work trips and meetings during this period may have been decisive (Ahmad et al. 2023; Sporer 2021).

In contrast, the subtopic registered a peak of 563 citations in 2016 (Figure 4). These results suggest a close relationship with the challenges posed by the international sustainability commitments made in the 2030 Agenda (UNESCO 2015). Research trends on these topics may reveal interest in sustainable practices applied to a wide range of economic sectors. Additionally,

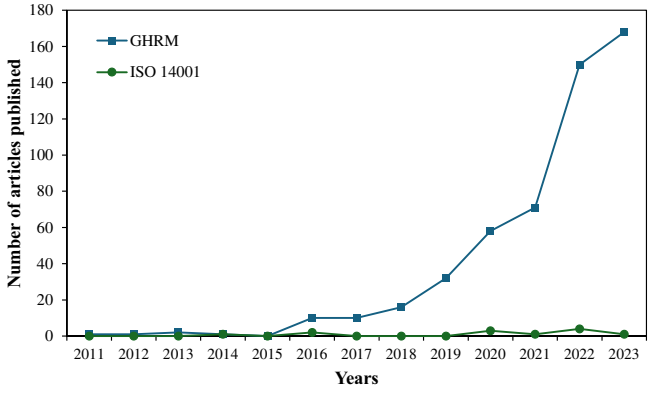

FIGURE 3 | Evolution of the annual number of articles published per year.

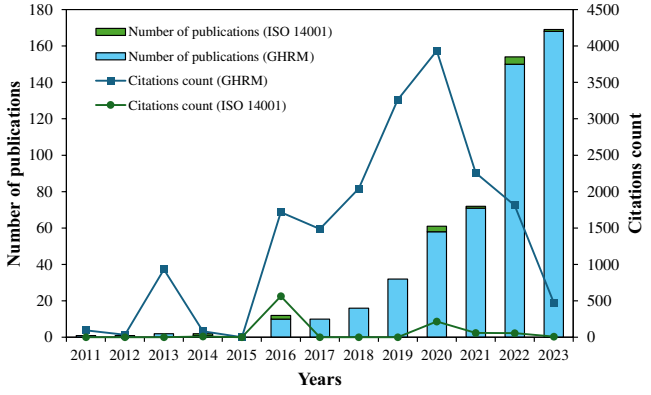

FIGURE 4 | Annual distribution of the number of publications about GHRM and ISO 14001 and citation counts.

the intersection between GHRM and ISO 14001 had the second highest number of citations (216) in 2020, highlighting the increasing attention given to the alignment between human resource management and environmental management systems within organizations. These findings underscore the importance of adopting innovative strategies that integrate human resource management and environmental management systems to combat climate change (Chen et al. 2023).

4.1.4 | Authors' Performance

The analysis of authors' performance in a given field of study offers a clear and relevant overview of individual contributions, as well as their impact on the academic community (Devi et al. 2024). However, it is essential to adopt approaches that recognize the contributions of all authors, regardless of their position in authorship. This ensures a more balanced and comprehensive assessment of their influence on the advancement of scientific knowledge (Waltman and Van Eck 2015). Thus, the analysis of the performance of the authors of this study in Table 2 considered the metric that adjusts the publication count to the proportional credit of each co-author—number of publications fractionalized (NPF)—ensuring a fairer and more balanced assessment of individual contributions.

Table 2 shows the five authors with the highest number of publications included in the GHRM dataset are Richa Chaudhary, currently affiliated with the Indian Institute of Technology, Patna (NPF 5.00/*h*-index 5), followed by Trong Luu, from Swinburne University of Technology (NPF 5.00/*h*-index 4); Charbel Jabbour, from NEOMA Business School (NPF 4.33/*h*-index 14); Mohd Yusliza, from Universiti Malaysia Terengganu (NPF 3.23/*h*-index 10); and Qasim Nisar, from Taylor's University Malaysia (NPF 2.48/*h*-index 5). The five authors with the highest number of publications included in the GHRM and ISO 14001 subtopic are Charbel Jabbour, with his current affiliation to NEOMA Business School (NPF 1.033/*h*-index 3); Carla Freire, from the University of Minho (NPF 0.500/*h*-index 1); Ana Jabbour, from EM Normandie Business School (NPF 0.500/*h*-index 1); Pietra Pieta, from the University of Minho (NPF 0.500/*h*-index 1); and Adriano Teixeira, from the São Paulo State University (NPF 0.400/*h*-index 2), as can be seen in Table 2. The results found in these analyses allow future researchers to identify the authors with the most consolidated knowledge on both topics, facilitating the creation of strategies that integrate the topics investigated to help mitigate climate change (Albugami et al. 2024).

The articles written by Richa Chaudhary (NPF 5.00) investigate the influence of GHRM on talent attraction, focusing on psychological mechanisms and sustainable organizational practices, and their impact on employees' ecological behaviors (Chaudhary 2018, 2019a, 2019b, 2019c, 2021). It is notable that between 2018 and 2021, Richa Chaudhary predominantly highlighted the relevance of adopting environmentally sustainable practices in the organizational context through people. On the other hand, Charbel Jabbour (NPF 1.033), the author with the highest performance in the GHRM and ISO 14001 subtopic, corroborates the literature on the subject by highlighting the integration of ecological people management practices and the green supply chain (Chiappetta Jabbour and Jabbour 2016; Teixeira et al. 2016). Their articles focus on the crucial role of green training in improving environmental practices in certified Brazilian organizations, highlighting the importance of this alignment in achieving effective organizational sustainability (Dias-Angelo et al. 2014). These findings align with research by Tanova and Bayighomog (2022), which highlights how GHRM influences behavior changes that promote environmental preservation. This is particularly evident

TABLE 2 | The top 5 remarkable authors according to the NPF.

Authors	Current affiliation	Country	NP	NPF	TC	TC/NP	FPY	*h*-index
GHRM								
Richa Chaudhary	Indian Institute of Technology, Patna	India	5	5.00	355	71	2018	5
Trong Luu	Swinburne University of Technology	Australia	5	5.00	258	52	2018	4
Charbel Jabbour	NEOMA Business School	France	16	4.33	2200	138	2012	14
Mohd Yusliza	Universiti Malaysia Terengganu	Malaysia	15	3.23	1085	72	2017	10
Qasim Nisar	Taylor's University Malaysia	Malaysia	11	2.48	188	17	2021	5
GHRM and ISO 14001								
Charbel Jabbour	NEOMA Business School	France	3	1.033	574	191	2014	3
Carla Freire	University of Minho	Portugal	1	0.500	10	10	2022	1
Ana Jabbour	EM Normandie Business School	France	1	0.500	337	337	2016	1
Pietra Pieta	University of Minho	Portugal	1	0.500	10	10	2022	1
Adriano Teixeira	São Paulo State University	Brazil	2	0.400	271	136	2016	2

Note: The *h*-index was calculated based on the set of the author's most cited articles and the citation number that they have received in other publications considering the selected bibliographic dataset (Aria and Cuccurullo 2017).
Abbreviations: FPY, first publication year; NP, number of publications; NPF, number of publications (fractionalized); TC/NP, TOTAL citations per publication; TC, total citations.

in certified organizations under pressure to ensure sustainability throughout the production and delivery processes, from raw materials to the end consumer (Marrucci et al. 2023).

4.1.5 | Performance of Most Cited Publications

Tables 3 and 4 show the performance analyses of the 10 most cited publications in this sample. These articles were fundamental in shaping the concept of GHRM and ISO 14001. The results found in this analysis provide an overview of the most consolidated sources, highlighting important information about the impact of these publications on the academic community through the total number of citations. The summary of the major findings of these studies offers substantial insights into the academic contributions and influence of these sources in the scientific environment.

The research by Renwick et al. (2013) entitled "It reviews GHRM practices, describes gaps and suggests future research agendas. It focuses on the Capacity-Motivation-Opportunity of employees to strengthen environmental

TABLE 3 | The top 10 most cited publications about GHRM.

Title	Authors	Year	Journal	Major finding	TC	TC/Y	DOI
Green Human Resource Management: A Review and Research Agenda*	Douglas Renwick, Tom Redman and Stuart Maguire	2013	*International Journal of Management Reviews*	It reviews GHRM, describes gaps and suggests future research agendas. It focuses on the Capacity-Motivation-Opportunity theory of employees to strengthen environmental commitment	906	82	https://doi.org/10.1111/j.1468-2370.2011.00328.x
Green innovation and Environmental Performance: The Role of Green Transformational Leadership and Green Human resource Management	Sanjay Kumar Singh, Manlio Del Giudice, Roberto Chierici and Domenico Graziano	2020	*Technological Forecasting & Social Change*	It investigated the interaction between green transformational leadership, GHRM and green innovation in environmental performance, highlighting the importance of these practices in improving companies' environmental performance	705	176	https://doi.org/10.1016/j.techfore.2019.119762
Effects of Green HRM Practices on Employee Workplace Green Behavior: The Role of Psychological Green Climate and Employee Green Values	Jenny Dumont, Jie Shen and Xin Deng	2017	*Human Resource Management*	It investigates the relationship between GHRM and green behaviors at work, emphasizing the role of green psychological climate and individual green values, showing that GHRM influences green behaviors at work, mediated by green psychological climate and moderated by individual green values, promoting environmental sustainability	526	75	https://doi.org/10.1002/hrm.21792
The Effect of Green Human Resource Management on Hotel Employees' Eco-friendly Behavior and Environmental Performance	Yong Joong Kim, Woo Gon Kim, Hyung-Min Choi and Kullada Phetvaroon	2019	*International Journal of Hospitality Management*	Findings show that GHRM enhances employees' organizational commitment, their eco-friendly behavior, and hotels' environmental performance	468	94	https://doi.org/10.1016/j.ijhm.2018.04.007
Green Human Resource Management and Green Supply Chain Management: Linking Two Emerging Agendas	Charbel José Chiappetta Jabbour and Ana Beatriz Lopes de Sousa Jabbour	2016	*Journal of Cleaner Production*	It investigates the integration between GHRM and Green Supply Chain Management (GCSV), offering a synergistic framework and research agenda to promote sustainable supply chains, highlighting the importance of human and organizational factors in the implementation of environmental practices	427	53	https://doi.org/10.1016/j.jclepro.2015.01.052

(Continues)

TABLE 3 | (Continued)

Title	Authors	Year	Journal	Major finding	TC	TC/Y	DOI
Green Human Resource Management Practices: Scale Development and Validity	Guiyao Tang, Yang Chen, Yuan Jiang, Pascal Paillé and Jin Jia	2018	*Asia Pacific Journal of Human Resources*	It develops and validates a scale to measure GHRM practices by identifying five dimensions: green recruitment, green training, green performance management, green remuneration and green involvement, which are fundamental to improving companies' environmental performance	360	60	https://doi.org/10.1111/1744-7941.12147
The Impact of Green Human Resource Management AND Green Supply Chain Management Practices on Sustainable Performance: An Empirical Study	Ahmed A. Zaid, Ayham A.M. Jaaron and Abdul Talib Bom	2018	*Journal of Cleaner Production*	It investigates the relationship between GHRM and Green Supply Chain Management (GCSM) on sustainable performance, emphasizing the positive influence on environmental, social and economic performance	357	60	https://doi.org/10.1016/j.jclepro.2018.09.062
Promoting Employee's Proenvironmental Behavior Through Green Human Resource Management Practices	Bilal Bin Saeed, Bilal Afsar, Shakir Hafeez, Imran Khan, Muhammad Tahir and Muhammad Asim Afridi	2019	*Corporate Social Responsibility and Environmental Management*	It investigates how GHRM influence employees' pro-environmental behaviors, highlighting the role of pro-environmental psychological capital and environmental knowledge, revealing that GHRM promote positive environmental behaviors, mediated by psychological capital and moderated by environmental knowledge	337	67	https://doi.org/10.1002/csr.1694
Green Human Resource Management and the Enablers of Green Organisational Culture: Enhancing a Firm's Environmental Performance for Sustainable Development	Samuel Roscoe, Nachiappan Subramanian, Charbel J.C. Jabbour and Tao Chong	2019	*Business Strategy and the Environment*	It investigates how GHRM influences environmental performance through green organizational culture, using data from Chinese manufacturing companies, highlighting the importance of green organizational culture as a mediator between GHRM and environmental performance	325	65	https://doi.org/10.1002/bse.2277
Greening the Hospitality Industry: How Do Green Human Resource Management Practices Influence Organizational Citizenship Behavior in Hotels? A Mixed-Methods Study	Nhat Tan Pham, Zuzana Tučková and Charbel José Chiappetta Jabbour	2019	*Tourism Management*	It investigates how GHRM influence the pro-environmental behaviors of hotel employees, highlighting the role of green psychological climate and environmental training	320	64	https://doi.org/10.1016/j.tourman.2018.12.008

Abbreviations: DOI, digital object identifier; TC, total citations; TC/Y, total citations per year.

commitment" represents a milestone in the literature, as it explores GHRM as a consolidated concept, presenting knowledge gaps and suggesting future research agendas in this domain. Table 3 highlights this article as the most referenced, with a total of 906 citations to date. The article describes and addresses the Capability-Motivation-Opportunity theory of employees to improve environmental performance (Renwick et al. 2013), serving as a solid foundation that encouraged subsequent researchers, such as Pham, Tučková, and Chiappetta Jabbour (2019) and Singh et al. (2020), to apply this theoretical framework in their related studies. Regarding GHRM and its contribution to the future sustainable environment, the other articles in Table 3 exceed 4730 citations in total, revealing the impact of this area of study. The research highlights the multifaceted strength of GHRM in organizations. The studies examine aspects related to green

transformational leadership and green psychological climate (Dumont et al. 2017), the relationship between GHRM and green supply chain management (Zaid et al. 2018), organizational commitment, eco-friendly behavior, pro-environmental behavior, and environmental knowledge of employees (Kim et al. 2019; Bin Saeed et al. 2019) and the green organizational culture of organizations (Roscoe et al. 2019). There is also the scale developed by Tang et al. (2018) to validate the scale measuring GHRM, which is essential for assessing and driving the adoption of people management strategies aligned with environmental objectives. These studies are unanimous in recognizing that GHRM is a critical vector for promoting sustainable development, and consequently for helping to mitigate the effects of climate change.

Table 4 shows the Journal of Cleaner Production article, "Green Human Resource Management and Green Supply Chain Management: linking two emerging agendas" by Charbel José Chiappetta Jabbour and Ana Beatriz Lopes de Sousa Jabbour, which tops the ranking with a total of 337 citations. The study emphasizes the crucial role of human and structural factors in implementing effective environmental initiatives. In addition, it proposes a synergistic framework and an investigative agenda for the intersection between GHRM and green supply chain management, guiding companies in obtaining certifications (Chiappetta Jabbour and Jabbour 2016). The subsequent most cited article reiterates these findings, as it focuses on analyzing these practices in certified Brazilian companies (Teixeira et al. 2016). The articles in Table 4 on the intercession between GHRM and the ISO 14001 subtopic currently total 908 citations. The emerging topic covers subjects such as the dynamics of leader-member exchange and basic self-assessments (Gim et al. 2022), organizational citizenship behaviors (Freire and Pieta 2022), organizational citizenship behavior in relation to the environment (Pham et al. 2020), green training (Dias-Angelo et al. 2014), green recruitment and development (Freitas et al. 2020; Khan et al. 2020), green employee development (Ojo et al. 2022), and even how market pressure from green public procurement encourages environmental certification in companies (Ma et al. 2021). These studies indicate a move toward deeper integration of green practices and human resource management strategies, highlighting the role of regulations and standards such as ISO 14001 in promoting greener business practices.

4.1.6 | Distribution by Countries

Figures 5 and 6 illustrate the analysis of the performance and interaction of the different countries involved in publications related to the GHRM and the subtopic GHRM and ISO 14001. Understanding better the productivity and impact of these countries is crucial for a comprehensive bibliometric analysis (Donthu et al. 2020). The results of these analyses shed light on the contributions and influence of these countries in the field of research, reflecting the current scenario in response to concerns about climate change and sustainable development. Furthermore, identifying the most productive countries in a field of research helps to reflect the level of investment in research and the academic maturity of different regions, making it essential to understand the global dynamics of science in order to guide policies that strengthen scientific production, international collaborations, and the strengthening of academic institutions at a global level (Mas-Tur et al. 2018).

The countries situated in East, South, and Southeast Asia have been the most productive in the field of GHRM in this sample (Figure 5). Pakistan, a region with a high pollution index and suffering from systematic environmental degradation (Mehmood et al. 2023), stands out as the leader, with a total of 88 scientific publications (15.09%). In second place is China, the third largest country in the world by total area, with 81 publications (13.89%). Recognized as one of the largest emitters of greenhouse gasses, the country faces environmental concerns due to its significant dependence on coal for energy production and its rapid industrialization (Ge 2023; Ren et al. 2005). India, the most populous country in the world, ranks third in terms of productivity on this theme. With intensive agriculture and issues related to water management and biodiversity conservation, the region is constantly seeking alternatives to promote sustainable development (Mall et al. 2006; Sahoo et al. 2024). In fourth and fifth positions are Malaysia and Indonesia, with 53 (9.09%) and 35 (6%) publications, respectively. It is intriguing to note some commonalities between the countries leading the publications, namely the imminent need to create the necessary conditions to respond to the environmental issues resulting from their economic activities. The academic collaboration about GHRM between these countries seems to be restricted to nearby regions of the globe. Notably, India, Malaysia, and Pakistan present some of their contributions in a similar way to the United Arab Emirates (Figure 5). One of the reasons for this collaboration may be related to the unidirectional causality of Gross Domestic Product (GDP) to CO_2 emissions (Ansari et al. 2019; Lu 2017), and it is common sense among these countries involved that they intend to adopt ecological practices such as GHRM.

Within the scope of the GHRM and ISO 14001 subtopic, the results show greater geographical diversity in terms of the number of publications. Brazil is the country that has generated the largest number, with a total of 8 publications (42%) related to the topic (Figure 6). In this territory, an emerging industrial nation, legal pressures and constant changes in legislation contribute to companies creating the conditions for their processes to be managed sustainably (De Oliveira et al. 2010). In this sense, this may be the necessary input that justifies the amount of 42% of the publications in this sample. In this South American continent, the studies by Neves et al. (2017) were able to confirm that economic, environmental, and cultural factors, intrinsically linked to organizations, influence ISO 14001 certification. This is another congruent result that corroborates the production about GHRM and ISO 14001 in Brazil. The second most published country was Malaysia, with a total of three articles (16%), which focused on analyzing the behavior of the GHRM variable in the context of ISO 141 certified companies. These studies succeeded in their objectives, showing positive results in all the relationships investigated (Gim et al. 2022; Khan et al. 2020; Ojo et al. 2022). Although observed in lesser proportions, the results obtained are similar to those previously reported. The Czech Republic followed with two publications and the other countries with just one. The results of these analyses highlight the participation of potentially polluting countries, underlining the

TABLE 4 | The top 10 most cited publications about GHRM and ISO 14001.

Title	Authors	Year	Journal	Major finding	TC	TC/Y	DOI
Green Human Resource Management and Green Supply Chain Management: linking two emerging agendas	Charbel José Chiappetta Jabbour and Ana Beatriz Lopes de Sousa Jabbour	2016	*Journal of Cleaner Production*	It investigates the integration between GHRM and Green Supply Chain Management (GCSV), offering a synergistic framework and research agenda to promote sustainable supply chains, highlighting the importance of human and organizational factors in the implementation of environmental practices	337	42	https://doi.org/10.1016/j.jclepro.2015.01.052
Green Training and Green Supply Chain Management: Evidence From Brazilian Firms	Adriano Alves Teixeira, Charbel Jose Chiappetta Jabbour, Ana Beatriz Lopes de Sousa Jabbour, Hengky Latan and Jorge Henrique Caldeira de Oliveira	2016	*Journal of Cleaner Production*	This study shows that green training improves green supply chain management in certified Brazilian organizations, emphasizing the importance of training employees in sustainable practices for cooperation with customers and suppliers	226	28	https://doi.org/10.1016/j.jclepro.2015.12.061
The Role of Green Human Resource Management in Driving Hotel's Environmental Performance: Interaction and Mediation Analysis	Nhat Tan Pham, Tan Vo Thanh, Zuzana Tučková and Vo Thi Ngoc Thuy	2020	*International Journal of Hospitality Management*	It investigates the importance of GHRM in employee involvement, as well as organizational citizenship behavior toward the environment and to improve hotel environmental performance	157	39	https://doi.org/10.1016/j.ijhm.2019.102392
Does Green Public Procurement Encourage Firm's Environmental Certification Practice? The Mediation Role of Top Management Support	Yanlin Ma, Yuting Liu, Andrea Appolloni and Junqi Liu	2021	*Corporate Social Responsibility and Environmental Management*	It investigates how the pressure of the Green Public Procurement market encourages environmental certification of companies, with the support of top management playing a mediating role in this relationship through GHRM	60	20	https://doi.org/10.1002/csr.2101
Green Human Resource Management and Corporate Social Responsibility: Evidence From Brazilian firms	Wesley Ricardo de Souza Freitas, Jorge Henrique Caldeira-Oliveira, Adriano Alves Teixeira, Nelson Oliveira Stefanelli and Talita Borges Teixeira	2020	*Benchmarking: An International Journal*	It investigates the relationship between GHRM and Corporate Social Responsibility (CSR) in certified Brazilian companies, showing that GHRM positively influence CSR practices, with performance evaluation, teamwork and recruitment and selection being the most significant practices for better CSR performance	45	11	https://doi.org/10.1108/BIJ-12-2019-0543
Linking Green HRM Practices to Environmental Performance Through Pro-Environment Behavior in the Information Technology Sector	Adedapo Oluwaseyi Ojo, Christine Nya-Ling Tan and Mazni Alias	2022	*Social Responsibility Journal*	This study shows how GHRM influence the pro-environmental behavior of information technology (IT) employees and the environmental performance of these employees, highlighting the mediating role of IT pro-environmental behavior on the environmental performance of information technology employees	38	19	https://doi.org/10.1108/SRJ-12-2019-0403

(Continues)

TABLE 4 | (Continued)

Title	Authors	Year	Journal	Major finding	TC	TC/Y	DOI
Do Green Human Resource Management Practices Contribute to Sustainable Performance in Manufacturing Industry?	Noor Ullah Khan, Mansoor Nazir Bhatti, Asfia Obaid, Abdul Sami and Abrar Ullah	2020	*International Journal of Environment and Sustainable Development*	This study confirms that GHRM are positively related to sustainable performance in manufacturing companies, with an emphasis on green recruitment, green training and green development	14	3	https://doi.org/10.1504/IJESD.2020.110647
Greening the Work force in Brazilian Hotels: The Role of Environmental Training	Fernanda Dias-Angelo, Charbel J.C. Jabbour and José Armando Calderaro	2014	*Work*	It investigates how adherence to GHRM in certified Brazilian hotels helps environmental management practices, emphasizing the critical importance of environmental training to improve environmental management	11	1	https://doi.org/10.3233/WOR-141873
Green Human Resource Management, Leader–Member Exchange, Core Self-Evaluations and Work Engagement: the Mediating Role of Human Resource Management Performance Attributions	Gabriel C.W. Gim, Say Keat Ooi, Siau Teng Teoh, Hui Ling Lim and Jasmine A.L. Yeap	2022	*International Journal of Manpower*	It investigates how GHRM, leader-member exchange (LMX) and basic self-evaluations (CSE) relate to work engagement, along with the performance attributions of human resource management as a mediator	10	5	https://doi.org/10.1108/IJM-05-2020-0255
The Impact of Green Human Resource Management on Organizational Citizenship Behaviors: The Mediating Role of Organizational Identification and Job Satisfaction	Carla Freire and Pietra Pieta	2022	*Sustainability*	It investigates how GHRM drive organizational citizenship behaviors in ISO 14001-certified companies, with job satisfaction and organizational identification as mediators	10	5	https://doi.org/10.3390/su14137557

Abbreviations: DOI, digital object identifier; TC, total citations; TC/Y, total citations per year.

growing interest of political decision-makers in achieving better results in response to climate change.

4.2 | Scientific Mapping

4.2.1 | Co-Authorship Network Analysis

The analysis of a co-authorship network helps visualize research collaborations in a given field, as well as identify distinct research areas at geographical levels (Perianes-Rodriguez et al. 2016). In the co-authorship network graph, each author is represented by a circle, while publications co-authored by two authors are indicated by connecting lines. The thickness of these lines increases as the number of co-authored publications grows. To ensure clarity of interpretation, only authors with five or more related publications were included in the analysis.

The results presented in Figure 7 provide a detailed analysis of the co-authorship network in the context of the GHRM. The arrangement of the clusters reveals both closely connected networks of contributions and isolated ones. The author Richa Chaudhary, the leader in the number of publications about GHRM (Table 2), conducts research more independently, standing out for the relevance of his individual contributions. A similar behavior occurs with Trong Luu, who does not have strong links with the other authors related to this topic, but is active in publications about GHRM. This phenomenon of isolation, visible in Figure 7, may stem from geographical barriers that limit cooperation between researchers (Schorr et al. 2021), suggesting that new government incentive measures, for example, could help improve this cooperation. Charbel Jabbour emerges at the center of a densely connected network (Figure 7), highlighting his strong influence and role as the main facilitator among researchers, as well as demonstrating his expertise on the theme. Mohd Yusliza occupies a strategic position in this analysis, as a result of his efficient connectivity with other researchers. With a high number of publications (15), this author stands out for the ability to disseminate ideas quickly in the network. On the other hand, Qasim Nisar is in a more restricted collaboration position, limited to just two co-authors, although his work has a significant impact in terms of citations, and he has a growing network. These patterns of collaboration between authors highlight the complexity of co-authorship in GHRM research. These results can help new researchers to recognize this mapping and draw up research strategies similar to these authors to achieve new results in other contexts.

The results presented in Figure 8 provide a detailed analysis of the co-authorship network in the context of the GHRM and ISO 14001 subtopic. The criteria for the co-authorship network

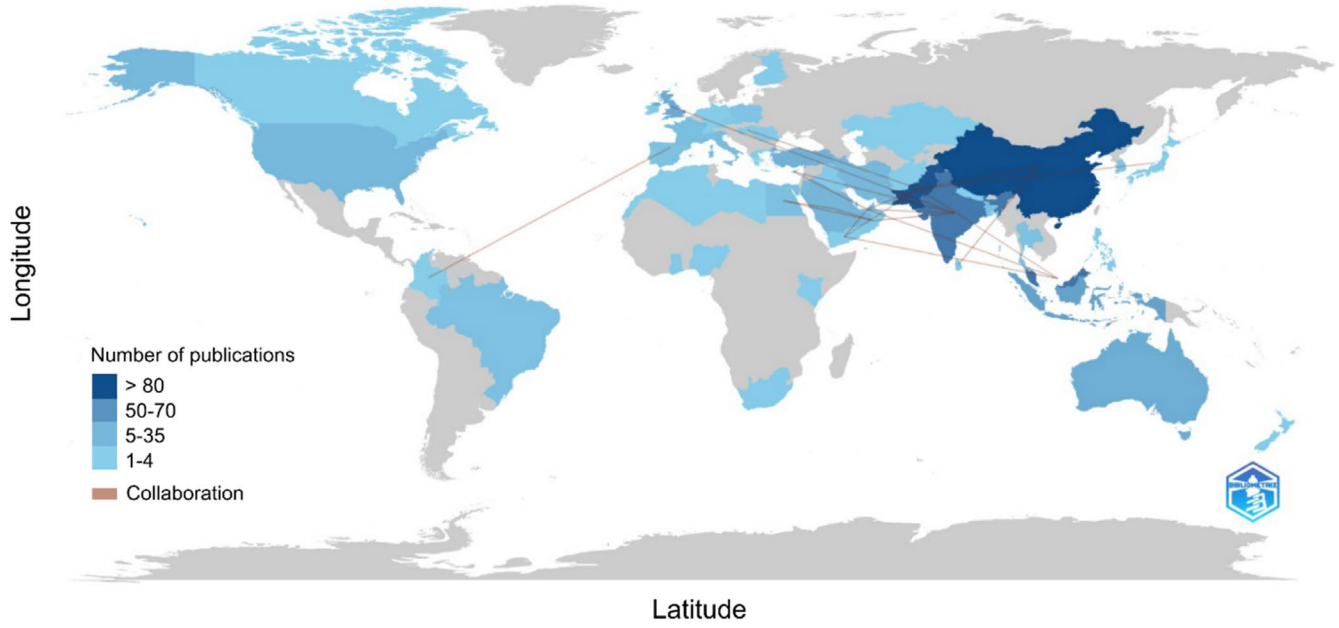

FIGURE 5 | Worldwide distribution of scientific output and partnerships in GHRM. Countries are shaded in varying shades of blue to indicate the volume of research publications. Collaborative efforts are depicted by red lines connecting countries, with a minimum of one co-authored paper; the thickness of these lines is indicative of the extent of collaboration.

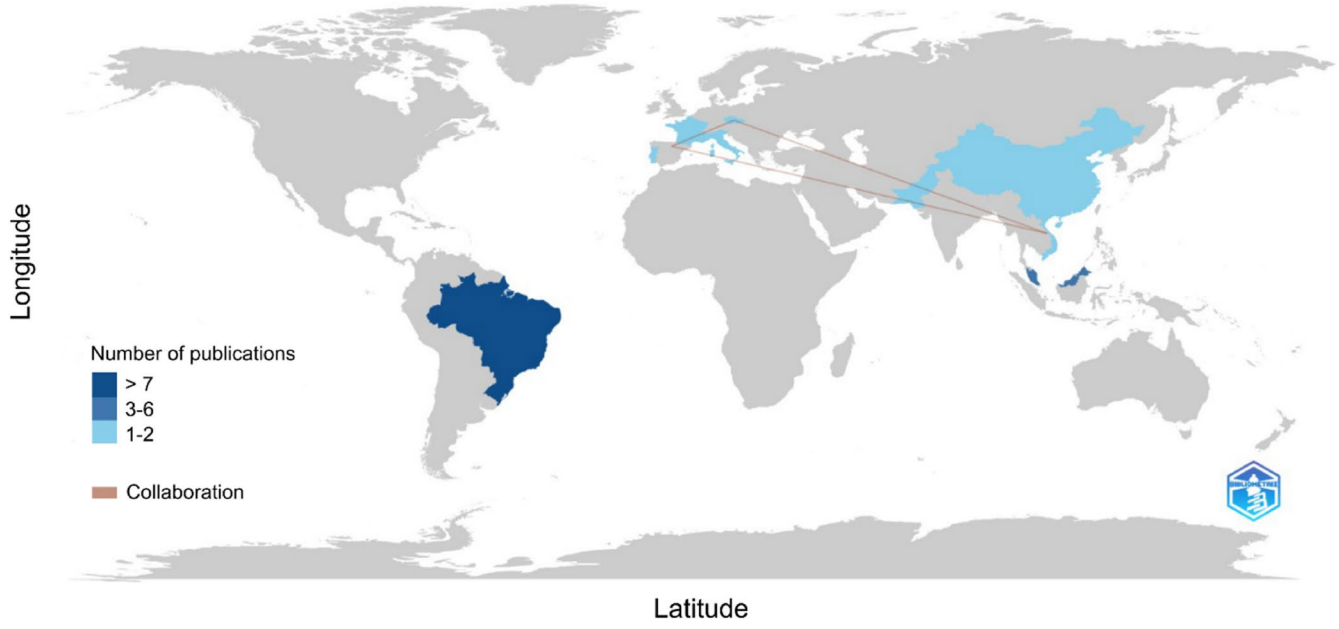

FIGURE 6 | Worldwide distribution of scientific output and partnerships related to GHRM and ISO 14001 subtopic. Countries are shaded in varying shades of blue to indicate the volume of research publications. Collaborative efforts are depicted by red lines connecting countries, with a minimum of one co-authored paper; the thickness of these lines is indicative of the extent of collaboration.

map were adjusted due to the volume of articles in the sample. It was established that authors with at least one publication, and each publication with at least one citation, would be included in the analysis. Charbel Jabbour, Ana Jabbour, and Adriano Teixeira are included in a close network of collaborations in the field of the GHRM and ISO 14001 subtopic (Figure 8). This collaboration can cover a multitude of research interests, for example, industry requirements, practical challenges, technological advances, global and economic changes, social and environmental concerns, as well as emphasizing the importance of interdisciplinarity, academic and industrial collaborations, and the role of funding and institutional support (Barbosa et al. 2017). The results demonstrated that several clusters researched both themes and made more limited connections with each other. Despite being in isolated clusters in the co-authorship analysis, they stand out for their specific contributions, such as Carla Freire and Pietra Pieta. The extent of this co-authorship network has demonstrated an embryonic stage of the subject as GHRM and ISO 14001 come together. Strengthening these cooperations may require elements both internal and external to

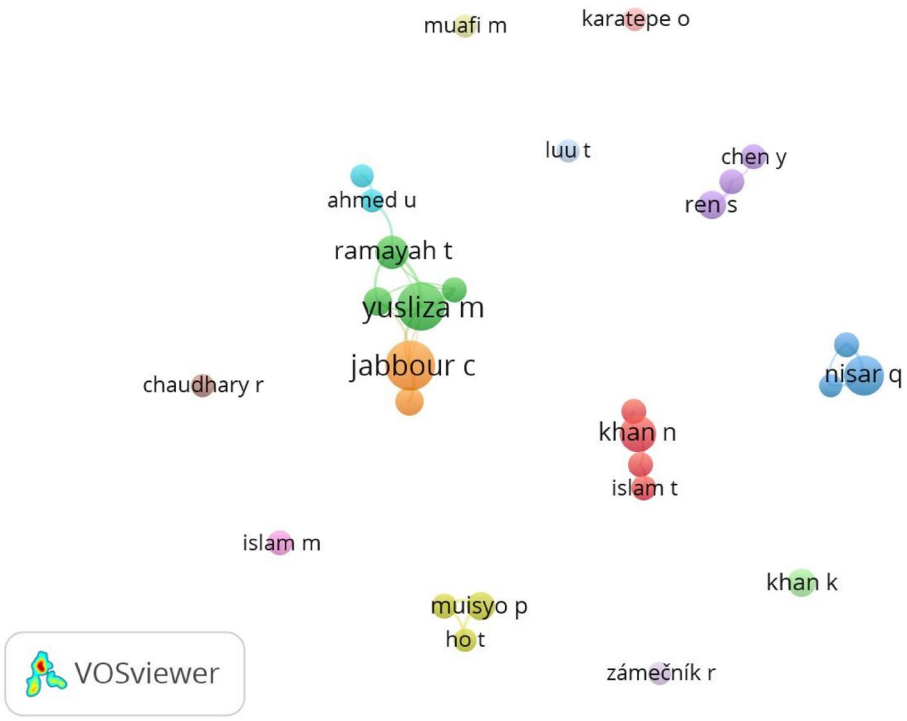

FIGURE 7 | Co-authorship network map illustrating the relationships between researchers about GHRM. The figure represents the relationships between authors, with the links weighted according to total strength.

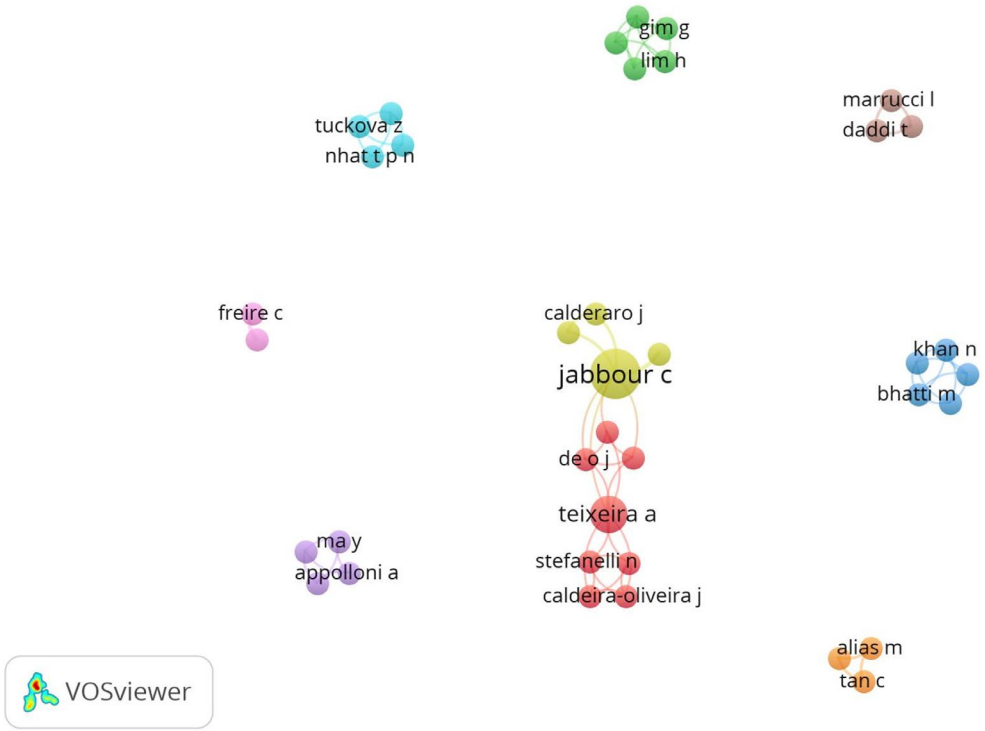

FIGURE 8 | Co-authorship network map illustrating the relationships between researchers about the GHRM and ISO 14001 subtopic. The figure represents the relationships between authors, with the links weighted according to total strength.

the academic community, such as technological advances that simplify communication, government policies that encourage international cooperation, and the political valorization of international scientific collaboration (Luukkonen et al. 1990). A better understanding of cultural differences or institutional limitations could further promote intellectual exchange.

4.2.2 | Term Co-Occurrence Analysis

Within the field of bibliometric research, term co-occurrence analysis is a powerful method for identifying patterns and connections between terms extracted from the titles and abstracts of scientific papers. This approach makes it possible to

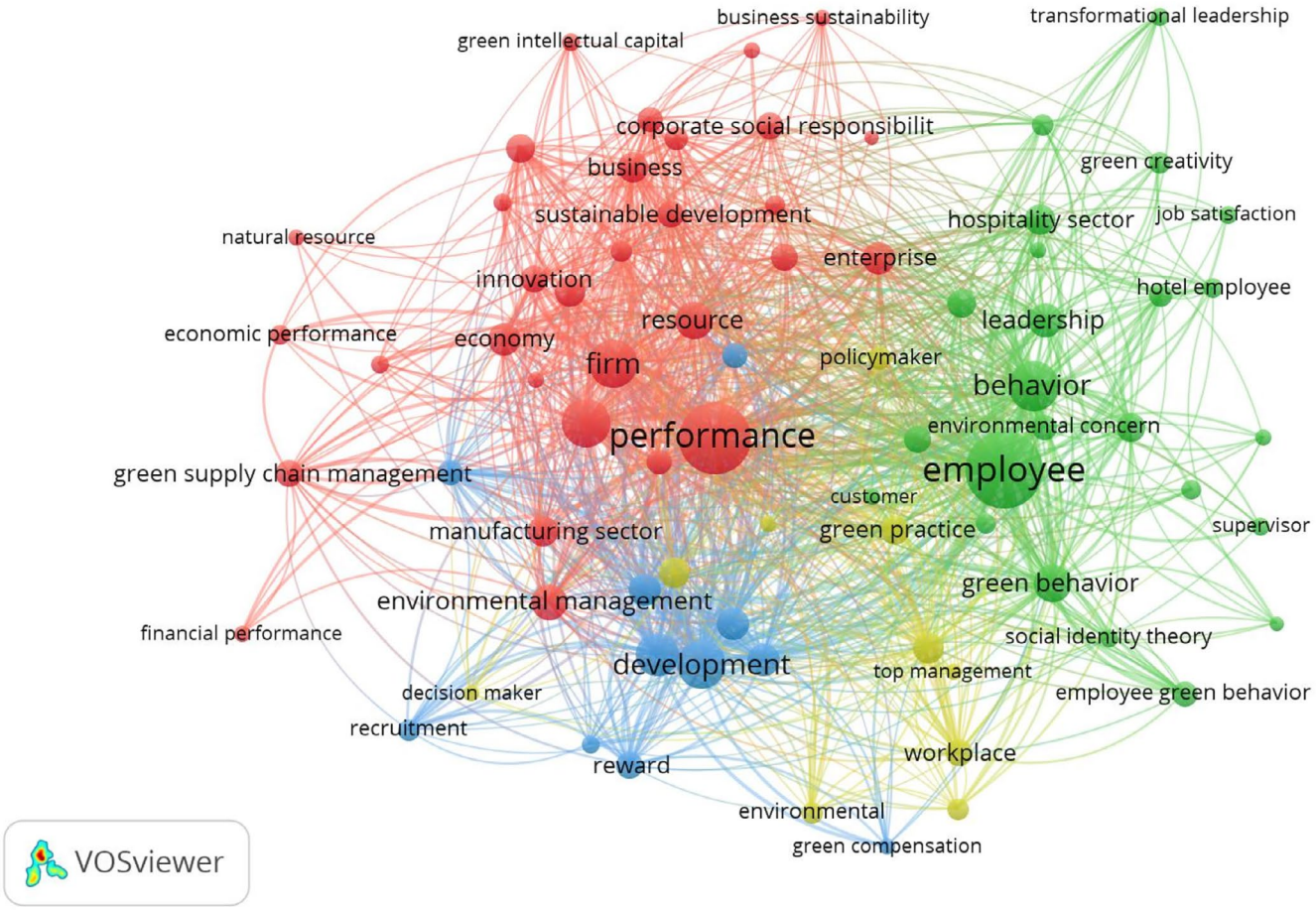

FIGURE 9 | Terms co-occurrence network map about GHRM, where the size of each circle represents the weight of the term, which is based on the frequency with which it appears, and the color indicates the link between the terms.

identify the terms present in the documents analyzed and map their interconnections, contributing to a better understanding of the topic being addressed (Bukar et al. 2023; Van Eck and Waltman 2023). Terms present in a text reveal its content, so by analyzing the frequency with which terms appear together in various texts, it is possible to detect the most addressed topics and the most relevant issues for the research area in which it was studied (Donthu et al. 2021).

In this context, the results of the GHRM can be seen in Figure 9, where the terms were identified using the binary counting method in VOSviewer, establishing a minimum threshold of 10 occurrences for each term (Van Eck and Waltman 2023). Terms with similar colors are organized into groups. The color represents the relationship between the terms, while the size of each circle corresponds to the weight of the term, which is determined by the frequency of its occurrence. The strength of the association between two terms is determined by the number of publications in which they occur together (Van Eck and Waltman 2023). Of the 8469 terms identified, 129 met the criteria for creating the map of terms most frequently associated with GHRM research.

Figure 9 presents the terms analyzed divided into three large distinct groups that examine the actual content of publications about the GHRM. The first cluster, visually identified by the color red, covers terms such as "performance", "manufacturing sector" and "economy." This selection of terms evidences the depth with which the literature addresses the topic, with a particular focus on organizational performance. This suggests that the scientific material currently being published is primarily aimed at achieving organizational performance through GHRM (Longoni et al. 2018; Muisyo and Qin 2021; Zaid et al. 2018; Zhao et al. 2023). It is possible to note the prominence of the term "sustainable development", which reinforces the need to include GHRM as a key element to help achieve this specific goal (Abbas and Dogan 2022), consequently mitigating the effects of climate change on the planet (Albugami et al. 2024).

The second cluster, denoted in green, encompasses the terms that appeared most frequently in the analyses, including "employee", "behavior" and "leadership." These terms focus more directly on aspects of human resources. Despite being an emerging topic, many researchers have focused on how GHRM can affect employees' behaviors in the workplace. However, this analysis reinforces that studies are being carried out that range from understanding how much it can promote psychological safety (Moin et al. 2021) to how much it can contribute to increasing workers' creativity (Abualigah et al. 2022), especially with the influence of different types of leadership, such as servant leadership (Darvishmotevali and Altinay 2022). Current literature has investigated and presented strong scientific evidence on the importance of leadership interacting with GHRM (Liu et al. 2025; Usman et al. 2025).

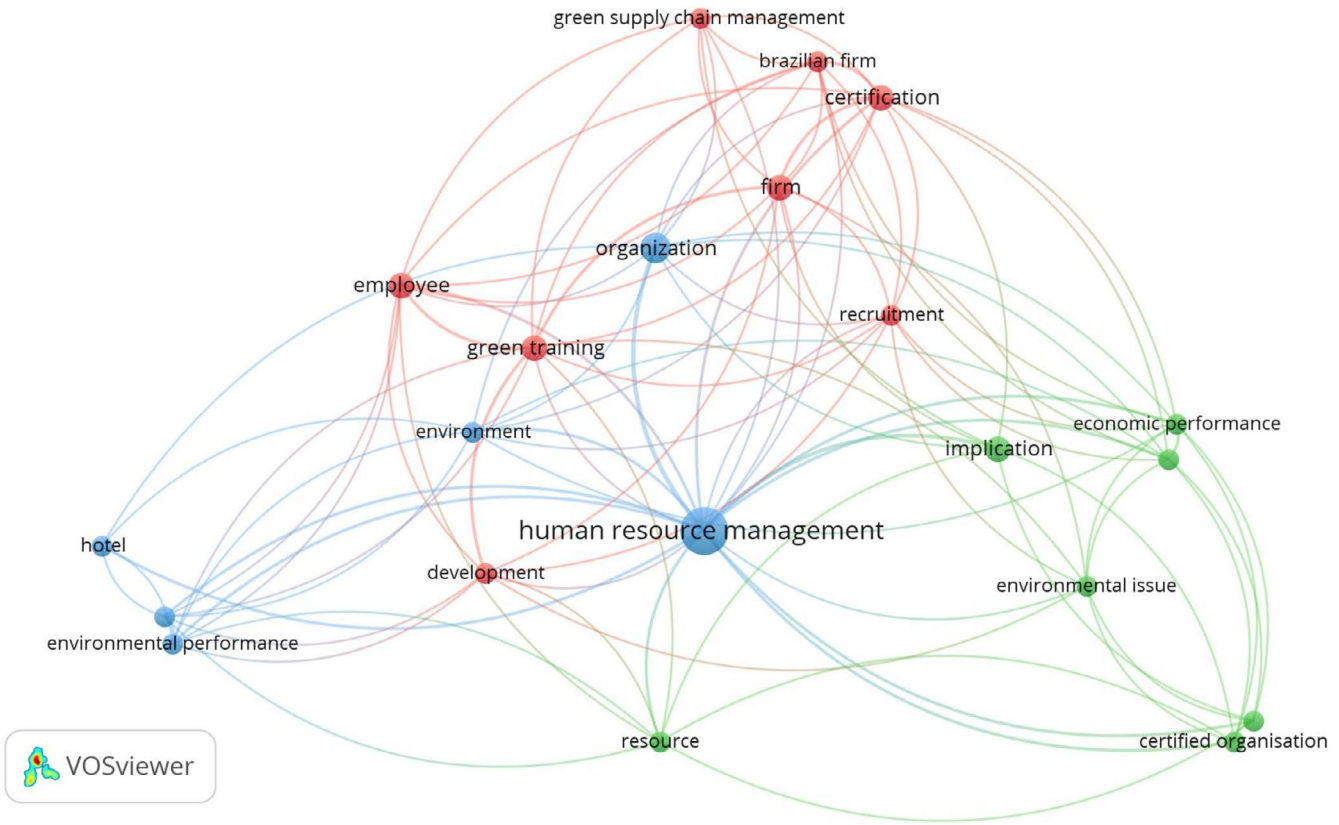

FIGURE 10 | Terms co-occurrence network map about GHRM and ISO 14001, where the size of each circle represents the weight of the term, which is based on the frequency with which it appears, and the color indicates the link between the terms.

The third cluster, illustrated by the color blue, brings together terms such as "development", "training" and "reward", pointing to the most recognized and implemented dimensions of GHRM. This highlights the importance of these elements in the context of green human resource management, as well as revealing how much each of these dimensions has been studied together (Shah 2019), or even analyzed separately (Chiappetta Jabbour and Jabbour 2016). Additionally, the strong connection with development time shows how much these strategies foster improvement at both the individual and organizational levels.

Figure 10 shows the results obtained through the term co-occurrence analysis centered around the GHRM and ISO 14001 subtopic, using the same binary counting methodology with an inclusion criterion of at least two mentions per term. In this analysis, 377 terms were initially identified, but only 42 met the inclusion criteria. The results shown in Figure 10 reflect three solid clusters and the initial state of research about the subject of GHRM and ISO 14001. The first cluster, highlighted in blue, features the terms "human resource management", "environmental performance" and "organization", suggesting that organizations that adopt GHRM and ISO 14001 not only have better environmental performance but also demonstrate greater commitment to people management by promoting positive environmental behaviors (Khan et al. 2020; Gim et al. 2022).

The second red cluster emphasizes terms including "green supply chain management", "Brazilian company" and "certification", indicating a tendency for this subtopic to focus on Brazilian business contexts. The Brazilian context of ISO 14001 certification appears to be promising for the study of green supply chain management, essentially because it provides innovative insights into the behavior of companies that adopt green practices (Jabbour 2015b). Considering that the results of the ISO 14001 subtopic were explored predominantly in Brazilian companies, the literature provides a margin for studies carried out in other countries to present different results (Chiappetta Jabbour and Jabbour 2016). This is an important way forward, considering that the current literature still lacks an assessment of developed countries on this subject.

The third cluster, identified by the color green, highlights the links between the terms "economic performance", "environmental issue" and "certified company." These findings corroborate the view that companies must maintain a focus on environmental issues in order to achieve economic performance and the sustainability challenges faced by organizations, especially those with ISO 14001 (Ojo et al. 2022; Fiorini et al. 2022). Furthermore, the growing interest in this topic is evident, particularly with regard to economic performance, which can stem from pressure from stakeholders—including consumers, investors, and governments—playing a crucial role in the adoption of greener practices (Marrucci et al. 2023). The analysis reflected in Figure 10 helps to clarify the understanding of the dynamics of this interaction and can offer ways to respond to the growing demands of the market in terms of sustainable practices, as well as helping to mitigate the risks caused by climate change.

Although it was noted that the terms of both analyses guarantee the consistency of the results found, it is important to point out

that topics related to the impact of the image or prestige of an organization that adopts green strategies on its attractiveness to potential candidates (Guillot-Soulez et al. 2022) did not appear in the analyses. In addition, the integration between GHRM, ISO 14001, and other strategies aimed at attracting, engaging, and retaining talent has not been highlighted in the current literature (Yasin et al. 2023). This opens the door to further research to explore the extent to which companies can become more attractive by adopting sustainable strategies.

4.2.3 | Thematic Analysis

Within the ambit of bibliometrics and evaluation of scientific progress, a thematic map was created to outline the current panorama and anticipate the possible future directions of research in the investigated domain (Cobo et al. 2018). Terms used were generated automatically by the WOS and Scopus database algorithms; this analysis reflected broader contextual connections derived from the literature, complementing the more focused scope of titles and abstracts materialized through a Cartesian plane, composed of motor, niche, peripheral, and basic themes (Aria and Cuccurullo 2017; Aria et al. 2022). These themes are characterized by two parameters: centrality and density, which help to define the role of each theme in the context under investigation. Centrality refers to the degree to which a theme interacts with other external themes, that is, themes with high centrality play a crucial role in linking different areas of study. Density, in contrast, refers to internal cohesion, that is, the degree of conceptual development and the strength of the connections between the terms that make up the topic under investigation. A high density indicates that the topic is well consolidated (Cobo and Herrera 2011). Thus, these results provide a basis for integrating innovative approaches that strengthen internal and external connections and turn emerging and basic themes into driving themes.

Figure 11 shows the results found from the thematic analysis about GHRM. The motor themes, located in the top right quadrant, group together the key elements that are not only advanced in their development but are also crucial to the formation and evolution of a field of research. The themes represented by the terms "performance", "company" and "sustainability" stand out as central concepts, highlighting their importance and relevance. These results underline the consistency with previous research that positions GHRM as an influential factor capable of promoting significant improvements in both the performance and sustainability of companies (e.g., Joshi et al. 2023; Montalvo-Falcón et al. 2023; Niazi et al. 2023). This reaffirms the relevance of GHRM as a strategic element for the development and effective integration of sustainable practices in organizations. Its effectiveness has been reinforced by literature reviews that highlight how GHRM can be a strong element in helping companies to improve their performance and sustainability (Xie and Lau 2023).

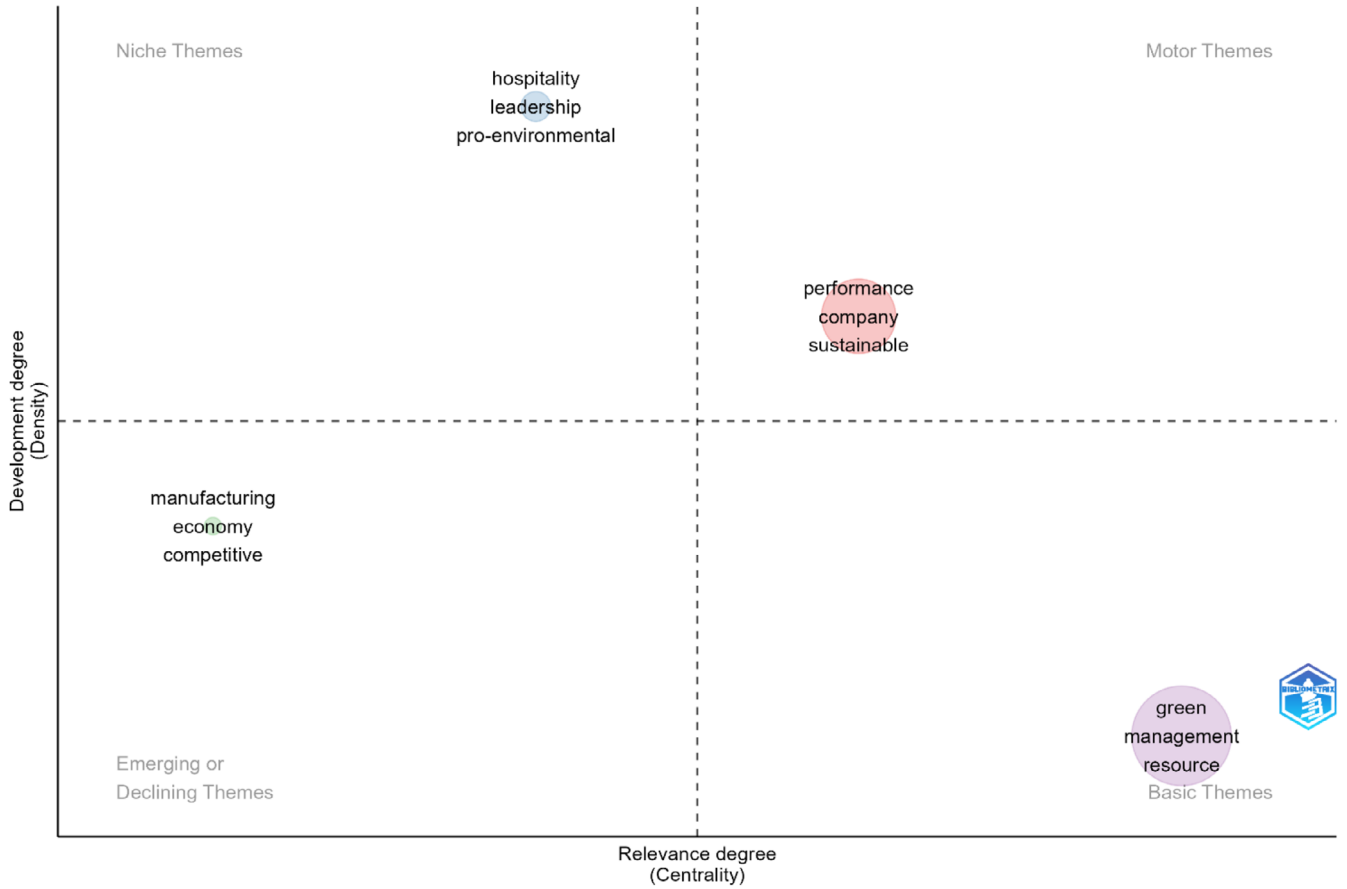

FIGURE 11 | Thematic map about GHRM. The quadrants of the Cartesian plane divide the themes into four categories: Niche (top left), driving force (top right), emerging or declining (bottom left), and basic themes (bottom right).

Niche themes, located in the upper left quadrant, are characterized by having robust internal connections while exhibiting limited external links, which makes them highly specialized and peripheral in nature. This specificity is supported and evidenced by the results of this study, which demonstrate how themes such as "hospitality", "leadership" and "pro-environmental" are deeply intertwined with the GHRM. Previous research has highlighted the relevance of hospitality as a favorable field for exploring the impacts of this variable on the hotel sector, as indicated by Pham, Tučková, and Chiappetta Jabbour (2019); Pham, Tučková, and Phan (2019) and Ribeiro et al. (2022). Equally, studies such as those by Islam et al. (2021), Darvishmotevali and Altinay (2022), and Tuan (2022) highlight the importance of leadership as a determining element. This focus on such specialized areas underlines the unique nature and importance of these niche topics within GHRM research, pointing to their essential, albeit concentrated, contribution to the advancement of knowledge in this field. The specificity of the hospitality context has been the subject of more in-depth research that has suggested new approaches, such as comparative studies between developed and emerging economies or even sectors other than hospitality and tourism (Choudhary and Datta 2023). These results may provide clues for new theoretical contributions to the development of people management strategies guided by sustainable practices, particularly in economic sectors such as energy (Stjepcevic and Siksnelyte 2017), automotive (Kumar et al. 2019), and agriculture (Le et al. 2024).

The peripheral and emerging themes, located in the lower left quadrant, show low density and centrality, representing emerging or dying research topics. The results revealed themes reflected by the terms "manufacturing", "economy" and "competitive" indicating an ambiguous interpretation. GHRM has been widely researched in the context of manufacturing (Muisyo et al. 2022; Zaid et al. 2018), a very important sector for the economy. On the other hand, competitiveness seems to be an emerging theme, especially as it depends on GHRM (Mustafa et al. 2023). This dynamic suggests an evolution in research patterns, where competitiveness, anchored in the principles of HRM, is configured as a new element that transcends performance or leadership. The results suggest that more research should be carried out, especially in the context of certified companies, so that organizations have the ability to outperform the competition by finding GHRM in their routine (Karakasnaki and Gerou 2024). Additionally, it is necessary to create conditions for organizations to face the challenges and translate stakeholder pressures into effective environmental practices, especially to achieve greater competitiveness (Vázquez-Brust et al. 2023).

The basic themes, located in the lower right quadrant, are crucial themes. Although important, these themes tend to be broad and fundamental, just like the transversal and general themes. The results clearly show "green", "management" and "resource", clarifying the basic and indispensable elements of the theme in question. Considering the openness that this quadrant provides, it makes it possible to imagine the integration of new resources such as green marketing in conjunction with GHRM, to help achieve the environmental performance of companies and consequently contribute to sustainable development (Wang and Juo 2023). This thematic map is an indispensable resource that provides researchers, academics, and other stakeholders with a rich and structured database capable of guiding strategic decisions and promoting new research.

Figure 12 shows the results for the GHRM and ISO 14001 subtopic. In this analysis, the motor theme was represented by the terms "green", "management" and "resource" as prominent elements in the quadrant. In contrast to previous results, the presence of these elements in this quadrant highlights their relevance in the field of GHRM, particularly in companies with ISO 14001 (Chiappetta Jabbour and Jabbour 2016). This suggests the fundamental role that these two concepts play in solidly structuring and advancing research in the area. On the other hand, the themes "economy", "pressure" and "managers" were grouped together in the same quadrant, standing out as relevant motor themes. These results corroborate the relationship observed between the institutional pressures exerted by managers to improve organizational performance, stakeholder demand for greater competitiveness, and the role of management in encouraging the adoption of GHRM as a key element in responding to these sustainability demands (Marrucci et al. 2023). These results help clarify a topic that is still underexplored but suggest new opportunities for research, such as exploring how internationalization and the implementation of new standards can work as a positive pressure, encouraging organizations to adopt greener policies (Ayuso et al. 2016).

Niche themes have the characteristics of high specialization and strong internal links, but weak external links. In this analysis, the themes "greening", "implementation" and "internal" appeared in the top left quadrant. These concepts indicate a particular emphasis on specific aspects of implementing sustainability practices in organizations, reflecting a tendency toward topics highly focused on ISO 14001. These results are supported by the conclusions obtained by Khan et al. (2020), who confirmed a direct and significant positive relationship between GHRM and the sustainable performance of certified companies. In light of this, a new direction of research could attempt to broaden the internal links and compare the results of the effects of GHRM on certified and non-certified companies. Additionally, it is important to promote research to understand whether regulations are drivers of environmental awareness and whether encouraging training in environmental management can facilitate the implementation of ISO 14001 (Waxin et al. 2019).

The peripheral themes, present in the lower left quadrant, identify themes with characteristics that are under limited and/or insignificant development. The prominent themes "manufacturing" and "strategy" showed a possible trend of decline or exhaustion in these areas, especially in the context of manufacturing companies that are the targets of ongoing sustainability studies (e.g., Chiarini and Bag 2024; Gelagay and Werke 2024; Nosrati et al. 2024). Looking at it from another angle, this could be an opportunity to conduct research in areas related to strategies aimed at broadening knowledge about the impact of GHRM on ISO 14001 companies (Khan et al. 2020). Furthermore, future lines of research can explore how both topics behave in

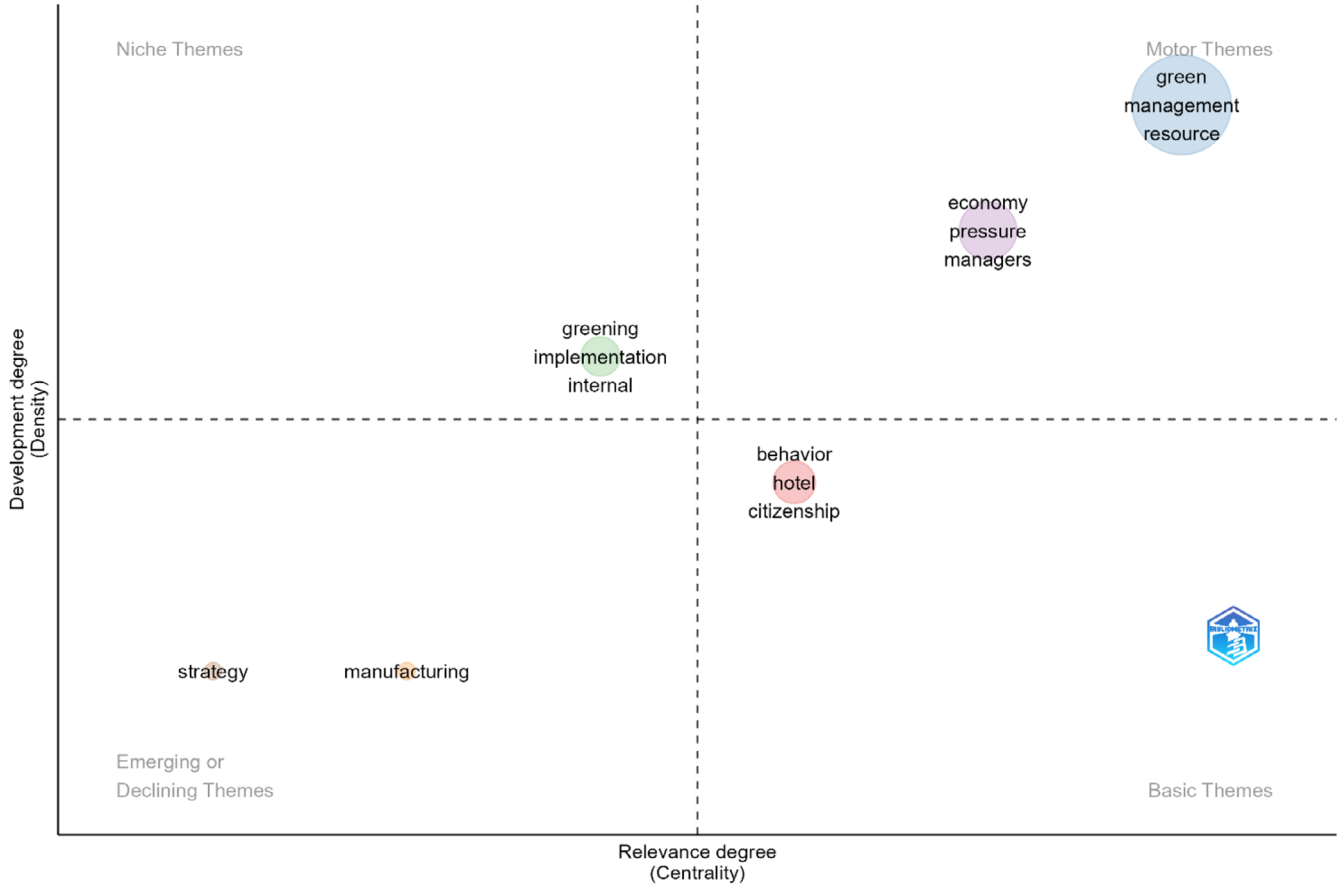

FIGURE 12 | Thematic map about GHRM and ISO 14001. The quadrants of the Cartesian plane divide the themes into four categories: Niche (top left), driving force (top right), emerging or declining (bottom left), and basic themes (bottom right).

other economic sectors, which can favor the creation of innovative management strategies that allow the benefits of GHRM to be extended even further. Thus, expanding knowledge about the dynamics of environmentally damaging sectors such as the fashion industry could be a new opportunity to enrich the literature (Da Giau et al. 2020).

The terms that emerge in the basic theme, identified in the lower right quadrant, are crucial and occupy an important place in knowledge. Despite this, these themes generally cover broad areas, resembling transversal and general themes. In this analysis, the themes "behavior", "hotel" and "citizenship" emerged in the results, standing out as fundamental elements for GHRM and ISO 14001. In the case of "hotel", this is understood to be the specific context used to carry out research of this nature. These findings highlight how organizational citizenship behaviors, particularly their individual impacts, can drive substantial advances in research about GHRM, especially in companies with ISO 14001 (Freire and Pieta 2022). Considering this, it is recommended that comparative studies be carried out in different economic sectors to clarify where GHRM proves to be most effective. In this way, it would be possible to identify specific contexts in which these practices have a greater effect and are more effective. Additionally, it is suggestive to evaluate how cultural, economic, and regulatory factors influence the implementation of GHRM in different sectors, regions, or countries (Al-Swidi et al. 2021; Pham, Tučková, and Chiappetta Jabbour 2019; Pham, Tučková, and Phan 2019).

5 | Conclusions

Based on the literature review and bibliometric analysis, including performance and scientific mapping, this study sheds light on how organizations are responding to environmental challenges through GHRM, particularly those with ISO 14001. Additionally, it was important to clarify the effects of these joint efforts in promoting sustainable development, since these concepts are multifaceted and still need further investigation. These findings contribute to expanding knowledge about GHRM, ISO 14001, publication performance, scientific mapping, and their role in promoting sustainable development.

5.1 | Theoretical and Practical Implications

The results of this study may fill a notable gap in the literature about GHRM and ISO 14001, contributing substantially to knowledge. While several studies have explored the impact of GHRM on companies with ISO 14001 certification (Teixeira et al. 2016; Khan et al. 2020; Freire and Pieta 2022; Gim et al. 2022; Marrucci et al. 2023; Ojo et al. 2022), this study's methodology revealed a lack of deeper content analyses that simultaneously address the intersection of these two themes. The lack of joint research may limit the understanding of how these domains interact with each other, but this absence may broaden the opportunity to frame studies that guide future research. Therefore, some theoretical and practical contributions emerge from this study.

5.1.1 | Theoretical Implications

The results of the performance analysis contribute to advancing theoretical understanding by clarifying that the current state of knowledge about GHRM and ISO 14001 has seen remarkable progress in terms of publications and citations (Cerver-Romero et al. 2020). Moreover, the results also present relevant authors and publications, such as Richa Chaudhary and Charbel Jabbour and their publications. These findings offer solid foundations in knowledge through the influence of these authors in these fields (Albort-Morant and Ribeiro-Soriano 2016). The analysis shows that the countries located in East, South, and Southeast Asia have been the most productive in the field of GHRM, while Brazil has produced the largest number of publications related to the ISO 14001 subtopic, suggesting new opportunities for research in other regions.

The results of the scientific mapping identified the level of collaboration between the relevant authors by the co-authorship network analysis. An important contribution consists of revealing the patterns of collaboration between the most prolific authors and the main barriers that cause individual work, and suggests that decision makers create conditions to strengthen scientific collaborations. The technical mapping of the terms found in the term co-occurrence analysis shed light on the current organization of the most prominent terms in this field of study (Van Eck and Waltman 2010). Thus, the most prominent terms revealed that human behavior, organizational performance, and sustainable development have strong links with GHRM and ISO 14001. The scientific mapping outlined the main axes of research on the themes and contributed by providing future avenues to be investigated, such as other economic sectors or greater integration between GHRM and ISO 14001, to achieve sustainable development.

5.1.2 | Practical Implications

Regarding practical implications, the contribution of this research provides a support to guide future efforts and guide managers to promote the well-being of employees, improve the performance of organizations, optimize resources and, consequently, contribute to sustainable development and climate change mitigation. The literature highlights the fundamental role of GHRM in aligning traditional human resources practices with the environmental objectives of organizations (Jabbour et al. 2008), thus fostering green behaviors among employees and enhancing both the environmental performance of organizations and their global competitiveness. These results are in line with the case study that revealed the importance of GHRM in environmental engagement and integration between human resources functions and sustainability (Haddock-Millar et al. 2016). Limited attention to people management can pose a risk to the sustainable growth of companies, corroborating that SMEs entrepreneurs must focus on efficient financial management for the longevity of their businesses (Belas et al. 2024). There are indications that investing in a qualified workforce and effective people management practices can strengthen adaptability and international competitiveness (Kuděj et al. 2023).

In organizational practice, it is essential for managers to establish environmental criteria during recruitment and selection to attract talent aligned with the organization's environmental vision. This approach promotes a workforce that is more motivated and engaged in sustainable initiatives (Renwick et al. 2008). To attract new talent, future studies could explore green marketing concepts to enhance organizational appeal. Corporate social responsibility has recently proven effective in attracting and retaining talent. Many individuals prefer working for ethical and environmentally responsible companies, even if it means accepting lower salaries (Barbara et al. 2019). Future research could go beyond the goal of improving performance in companies by focusing on green marketing strategies to increase organizational appeal.

ISO 14001 is crucial for helping managers formalize environmental management systems and for achieving the sustainable development goals set out in the United Nations 2030 Agenda (Fonseca and Carvalho 2019). This certification serves as a strategic ally for managers by integrating environmental issues into business strategies. It promotes operational efficiency, establishes regulatory compliance guidelines, engages employees, monitors results, and drives responsible practices that provide a competitive advantage (Maletič et al. 2015). A recent case study revealed that ISO 14001 helped reduce the costs of financing loans to companies in the metallurgy industry, as their reputation with lenders was taken into account (Wu et al. 2020). Furthermore, a well-implemented environmental management system can strengthen a company's environmental reputation and facilitate internal management, despite challenges such as high costs and bureaucracy. In practice, this system can guide managers to direct their strategies toward optimizing the use of resources and minimizing waste, promoting sustainable practices such as saving energy, water, and materials, as well as encouraging the adoption of other green initiatives in organizations (Camilleri 2022).

The results of this study contribute to the dissemination of best practices, suggesting theoretical frameworks and offering empirical evidence that provide organizations with valuable knowledge, strategies, and pathways for responding to current environmental challenges. Additionally, these results are essential for managers seeking to improve their people management strategies and their environmental management systems. For academics, it identifies future directions for bridging knowledge gaps and exploring emerging trends, furthering the understanding of GHRM and ISO 14001. Although the structured representation of GHRM and ISO 14001 has clarified the interconnection between these themes and broadened the debate on the topics investigated, there is clearly a need to explore new themes and research directions.

5.2 | Limitations and Future Research

5.2.1 | Limitations

Although the theoretical and practical contributions of this study significantly reinforce existing knowledge, it is essential to recognize its limitations. Despite the application of a rigorous methodological approach and the use of consolidated bibliometric techniques, some limitations must be acknowledged. Firstly, the selection of databases (WOS and Scopus), although widely

TABLE 5 | Description of future research directions and needs in GHRM and ISO 14001.

Description of future research directions	Research needs	TC	DOI
GHRM			
Investigate SMEs from other economic sectors. Apply employee surveys and use employees' environmental beliefs and values as moderators of the influence of GHRM on Green innovation (GI). Investigate internal and external factors for adopting environmental strategies	Consider investigations in SMEs from various economic sectors, using employee surveys to examine workers' environmental beliefs and values as moderators of the influence of GHRM on green innovation, while exploring internal and external factors that influence the adoption of environmental strategies	705	https://doi.org/10.1016/j.techfore.2019.119762
Investigate the relationship between Green Intellectual Capital, GHRM, GI, environmental strategies and performance in countries other than Malaysia. To examine the variation of GI, with a focus on radical transformation or adding new products/processes. Analyze the effectiveness of companies' environmental strategies	There is a need for comparative studies in different countries to measure these variables in a different context and to apply new surveys that explore variation in GI	237	https://doi.org/10.1016/j.techfore.2020.120481
Investigate the role of stakeholder pressure to safeguard the environment in healthcare organizations in other developing countries. Analyze whether this will bring about improvements for healthcare organizations and whether new pro-environmental strategies emerge	Research could be conducted in developing countries on how stakeholder pressure can affect the environment and if this promotes new environmental strategies	237	https://doi.org/10.1016/j.jclepro.2019.118595
Investigate how GHRM affects the different dimensions of sustainability. Use longitudinal data to establish causal relationships between HRM practices and sustainability and other constructs	It may be interesting to use longitudinal data to apply environmental performance as a final objective considering constructs such as environmental knowledge and awareness, environmental concern, pro-environmental behavior, HR functions and competencies, stakeholder pressure, top management commitment, relative advantage and green intellectual capital	234	https://doi.org/10.1002/bse.2359
Investigate with longitudinal data, collected in another university context with mixed methods, to analyze changes in employees' environmental citizenship behavior, environmental performance and environmental results and include non-teaching staff. Apply mediating variables such as organizational culture, management support and employee attitude	Research could be carried out in the university context in developed and developing countries, with longitudinal data that could compare the results. Use variables such as organizational culture and employee attitudes	193	https://doi.org/10.1016/j.jclepro.2020.120401
ISO 14001			
Investigate all the dimensions of the GHRM, together and separately, including them in models that verify whether these dimensions or the construct affect corporate green performance. Apply surveys to non-managerial employees in developed countries in industries different from hotels	There could be studies to standardize the GHRM variable and apply surveys to employees in industries with environmental management systems in developed countries, to verify whether these practices influence green corporate performance	157	https://doi.org/10.1016/j.ijhm.2019.102392

(Continues)

TABLE 5 | (Continued)

Description of future research directions	Research needs	TC	DOI
Analyze the environmental values and emotional commitment of individual employees. Investigate how central and local government can formulate more green public procurement as an environmental policy tool for the adoption of environmental certification practices. To verify the relationship between market pressures (government, individual consumers, companies and foreign consumers) and their impact on this certification	Develop surveys to check employees' feelings. Apply surveys to public authorities on their intentions to carry out green public procurement. Identify market stakeholders' perceptions of certified companies	60	https://doi.org/10.1002/csr.2101
Investigate the interaction between GHRM and corporate social responsibility in different economic sectors and in other emerging countries, with a larger sample, considering whether CSR may depend on legal and regulatory factors in addition to certification	Further studies could be carried out considering other dimensions of GHRM in emerging countries where new regulatory standards have been implemented	45	https://doi.org/10.1108/BIJ-12-2019-0543
Investigate other developing and emerging economies, and industries such as manufacturing and aviation, collecting multiple sources of longitudinal data. Analyze the relationship between GHRM and company environmental performance, mediated by pro-environmental behaviors, in addition to exploring cognitive factors.	Studies could be carried out in certified civil commercial aviation companies, using longitudinal data, to analyze the casual relationship between GHRM and cognitive variables.	38	https://doi.org/10.1108/SRJ-12-2019-0403
Investigate ISO 14001 certified companies in various sectors of the economy in developed countries, also considering other dimensions of GHRM and sustainable performance	Select certified companies from developed countries such as (e.g., the USA, the UK, Japan, Germany, Sweden, Australia, etc.) and conduct studies with other HRM dimensions to see if they affect sustainable performance	14	https://doi.org/10.1504/IJESD.2020.110647

Abbreviations: DOI, digital object identifier; TC, total citations.

recognized in the academic community, excluded other relevant sources such as Google Scholar, PsycINFO, and IEEE Xplore, which may include important studies. Secondly, the search strategy used for the search strings represents another limitation. Some studies may have been inadvertently omitted if they did not include words related to GHRM, such as green training or green recruitment. Thirdly, although the literature review strengthened the study, the research strategy for the joint analysis of the two themes had limitations. The research strategy followed a sequential approach, starting with GHRM individually before including the subtopic GHRM and ISO 14001. Fourthly, the time period selected is another limitation since publications prior to the period analyzed were excluded. Fifthly, restricting the analysis to publications in English may have excluded relevant studies in other languages, limiting the representativeness of the results. Finally, although the analytical techniques used are robust, they may not fully capture the complexity and diversity of the domain. Despite these efforts, these results should be interpreted with caution. Future research should address these limitations to deepen the understanding of GHRM and ISO 14001.

Despite these limitations, this study addresses several critical research questions. Following the guidelines of Donthu et al. (2021), the objectives and scope of the study were clearly defined, justifying the use of the chosen analytical approach. The techniques were selected based on their ability to respond to these objectives and the context of the study. All search terms were carefully designed to align with the study's scope. The selection of databases was appropriate for the study, and rigorous procedures were adopted to ensure that the data were free of errors, such as duplicates and incorrect entries. The final data set was sufficient for the chosen bibliometric analysis techniques, allowing for thorough and precise analysis. A clear and understandable analytical approach was employed, facilitating the interpretation of the results. The particularities and implications were methodologically documented. Thus, this study offers a reliable foundation for future research, contributing significantly to the advancement of the research field.

5.2.2 | Future Research

These results suggest the need for future research with a more in-depth exploration of this interrelationship to provide insights into more effective integration of environmental practices and standards into organizational operations, with potential benefits for sustainable development and climate change mitigation. Future research could adopt a more analytical approach to GHRM and ISO 14001 to better understand how the internationalization of companies, or the implementation of non-audited ecological standards, for example, Lean Management, Lean Six Sigma, or ISO 9001, could contribute to environmental sustainability (Laureani and Antony 2011). Further investigation is encouraged to examine how the applicability of GHRM in certified and non-certified companies could yield different outcomes.

New research opportunities arise to explore or develop different management strategies in economic contexts that remain underexplored in the relationship between GHRM and ISO 14001. Some of these contexts could be the fashion industry, the transport sector, the energy sector, or even waste management. Moreover, research into how green marketing strategies can attract new talent or raise the organization's position in the market, as well as help the environment, is a relevant area of study (Chen 2010; Wang and Juo 2023). Adopting these sustainable practices not only contributes to operational efficiency but also has a positive influence on attracting customers and is a promising field of study (Alreahi et al. 2023). These findings highlight how integrating sustainable practices and standards serves as a key driver of sustainable development, promoting continuous improvements in the environmental, social, and economic performance of organizations. Additionally, it contributes to the mitigation of climate change.

Finally, this study proposes a new agenda for future research in this field. Table 5 provides a synthesis of future research directions identified in the relevant articles in the sample. It also highlights research needs that could fill identified gaps, making a significant contribution to the practice of organizational science and addressing deficiencies in the current literature. Potential research fields span both domains, particularly in people management and certified companies. This study emphasizes the need to consolidate GHRM as a variable that encompasses all its dimensions, including external elements often overlooked in the literature. These results could significantly advance knowledge in the areas explored in this study, complementing the analyses presented.

Author Contributions

Eduardo Ortega: conceptualization, methodology, investigation, data curation, software, validation, formal analysis, visualization, writing – original draft, writing – review and editing. **Arnaldo Coelho:** supervision. **Neuza Ribeiro:** supervision. All authors have read and agreed to the published version of the manuscript.

Acknowledgments

During the preparation of this work, the authors used ChatGPT in order to rephrase a couple of sentences to improve their readability. After using this tool/service, the authors reviewed and edited the content as needed and took full responsibility for the content of the publication. Wiley and FCT/b-on have an agreement to cover the cost of your open access publishing. Please note: FCT/b-on strongly encourages you to apply a CC BY license to your article as this will amplify the article visibility and knowledge advancement, while retaining full credit of your authorship.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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