



Recent trends of green human resource management: Text mining and network analysis

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Abstract

Issues of the environmental crisis are being addressed by researchers, government, and organizations alike. GHRM is one such field that is receiving lots of research focus since it is targeted at greening the firms and making them eco-friendly. This research reviews 317 articles from the Scopus database published on green human resource management (GHRM) from 2008 to 2021. The study applies text mining, latent semantic analysis (LSA), and network analysis to explore the trends in the research field in GHRM and establish the relationship between the quantitative and qualitative literature of GHRM. The study has been carried out using KNIME and VOSviewer tools. As a result, the research identifies five recent research trends in GHRM using K-mean clustering. Future researchers can work upon these identified trends to solve environmental issues, make the environment eco-friendly, and motivate firms to implement GHRM in their practices.

Keywords Green human resource management · KNIME · TF-IDF · Latent semantic analysis · VOSviewer · Text mining · Network analysis

Introduction

In the current era, the entire globe is faced with unprecedented environmental issues (Rajabpour et al. 2022). This era marks the epoch of globalization, digitalization, and technology, which have penetrated human lives to the extent that technology is required to perform even mundane routine tasks. In the past decade, environmental degradation and climate change have posed significant global threats such as natural disasters (droughts, hot waves, wildfires), resulting in a loss to the economy (Shafaei et al. 2020a). In addition, industrialization contributes to increasing global warming throughout the world. Human actions, automation,

and many other factors are responsible for global warming (UNEP 2020). In the year 2019, the Covid-19 virus shook the entire world, such that in the year 2020, it was declared a global pandemic. This virus has and is still degrading each country's economy. However, restrictions imposed by governments on human movement across different nations to contain the spread of the virus brought about slight environmental rejuvenation. According to UNEP (United Nations Environment Programme), the pandemic slowed down carbon dioxide emissions by 7% compared to previous years. Despite this, the world is still experiencing a 3% rise in temperature due to global warming (UNEP 2020). Various environmentalists, researchers, governments, and organizations have come forward to put various efforts into action. Agencies like UNCC (United nation climate change) have drafted some guidelines for environmental issues, which are represented on international platforms (UNCC 1997) (UNFCC 2007) (Agreement 2016).

This represents an important topic because ecological problems are about mindfulness and awareness. A critical asset that can be used to identify a solution for most of the issues mentioned above is the people. Work considering green human resource management has a rich background, and the management of human resources is central to any organization's strategy for fostering growth among its

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workers and entities (Vuong and Sid 2020). HRM serves as the organization's formal system for managing human resources and ensures that its vision and mission are achieved. Recruitment, hiring, onboarding, performance evaluations, on-the-the-job orientations, performance evaluations, training, retraining, performance evaluations, and employee discipline are all aspects of human resource management (Li et al. 2020). Until the mid-1990s, the HR department was not addressing strategic issues for practitioners and academics. Even in the twenty-first century, the human resources department was still an essential ally in expanding any business or organization. As a result of increased global competition, these organizations had to make policy and system changes. Since the dawn of globalization in the early nineteenth century, people everywhere have been concerned about the environmental consequences of this process.

Governments, businesses, and public and private sectors have committed to implementing green human resource management in response to environmental concerns (GHRM) (Rondinelli and Berry 2000; Victor 2011). In consideration of environmental issues, HRM has shifted its approach to green human resource management (GHRM) (Rondinelli and Berry 2000; Victor 2011). Various international bodies dealing with environmental issues have moved a firm's culture from HRM to GHRM (Wehrmeyer 2017). Wehrmeyer (2017) edited a book titled "Greening people: human resource and environmental management," where the first mention of "Green" in HRM occurred. The concept of GHRM gained existence in research works after the 1990s. A critical asset that can be used to identify a solution for all the issues discussed above is the people. Environmental problems are about mindfulness and awareness.

Human resource management began its journey a long time ago to improve the organization (Sharma et al. 2022). When Robert Owen and Charles Babbage came up with a simple idea during the Industrial Revolution in Europe in the eighteenth century, the human resources department was born. In the early 1900s, the HR department was referred to as the personal department. HR departments play an essential role throughout employee life, from recruitment to retention (Dulebohn et al. 1995). Personnel departments received official recognition in 1921 from the National Institute of Industrial Psychology (NIIP). Management of human resources is central to any organization's strategy for fostering growth among its workers and entities (Vuong and Sid 2020). Using HRM policies, any organization can boost its employees' productivity and commitment by influencing their motivation, ability, and availability for work-related responsibilities (Sharma et al. 2022). There is a long history of HRM's role in boosting every sector that contributes to the economy.

To ensure that the organization's vision and mission can be achieved, HRM serves as the organization's formal system for managing human resources. Recruitment, hiring, onboarding, performance evaluations, on-the-the-job orientations, performance evaluations, training, retraining, performance evaluations, and employee discipline are all aspects of human resource management (Li et al. 2020). A company's HR department determines how well its employees perform. When employees in any industry are selected, trained, inducted, monitored, rewarded, and promoted efficiently, this statement states that the company can produce goods that aid in realizing its vision. Human resource management (HRM) encourages employees to perform at their peak levels to get the most value from their time spent with the company. Until the mid-1990s, the HR department was not addressing strategic issues for practitioners and academics. Even in the twenty-first century, the human resources department is still an essential ally in expanding any business or organization. As a result of increased global competition, these organizations had to make policy and system changes. According to Ehrlich (1997), how well a company's HR system works and how well it treats its employees, the company's growth and value are evaluated. Human talent can be efficiently and effectively utilized through human resource management. Since the dawn of globalization in the early nineteenth century, people everywhere have been concerned about the environmental consequences of this process. Governments, businesses, and public and private sectors have committed to implementing green human resource management in response to environmental concerns (GHRM) (Rondinelli and Berry 2000; Victor 2011).

This section outlines the existing methods available in the literature for green human resource management. Firms all over the globe are also playing a significant role in the savior of the environment. These firms are adopting policies and practices to ensure sustainability. The human resource management (HRM) department is responsible for designing, implementing, and maintaining the sustainability culture (Collings et al. 2018). In addition, research shows that the HRM department is associated with recruiting people, making strategies, and providing facilities to employees for the organization's benefit (Heneman et al. 2000).

Renwick and others described GHRM as integrating Human Resource Management and Corporate Environment Management (Renwick et al. 2008). Green HRM is also considered to combine green policies and human resource policies (Jamal et al. 2021), as HRM encompasses the process of recruitment, performance, benefits, rewards, training, and development, and other employee-related tasks; for each process, green policies which incorporate the provision of sustainability and addressing environmental issues are provided by the government and international bodies (Jabbour et al. 2010; Daily and Huang 2001; Jackson et al. 2011; Sarkis

et al. 2010). Jackson et al. (2011) revised the definition of GHRM, stating that it is all about greening the HRM practices in context to its functional and competitive dimensions. Development, implementation, and maintaining the system to make employees and organizations green to achieve environmental goals contribute to ecological sustainability (Yong et al. 2020a). Numerous revolutionary initiatives have emerged by combining green with other fields, such as green marketing (Grant 2008), green finance (Bebbington 2001), green retailing (Lai et al. 2010), and green in the integration of HRM is evolving day by day.

Many literature reviews have been conducted in GHRM (Paulet et al. 2021; Pham et al. 2020; Shahriari et al. 2019). According to the author (Renwick et al. 2013), organizations' understanding of developing green abilities and giving employees opportunities to participate in environmental management organizational efforts delays how GHRM practices influence employee motivation to participate in environmental activities. EM improvement efforts may be hindered because organizations are not using the full range of GHRM practices. Jackson et al. (2011) discuss different functions of the HRM practices and stimulate the HRM field to expand its role in environmental sustainability. They describe the multiple opportunities for integrating strategic HRM and environment management. Jabbour and de Sousa Jabbour (2016) link GHRM and green supply management as an important subject area of HRM. This study proposed an integrated framework for GHRM and GSCM and a research agenda for this integration. Also, it highlighted the implications of GHRM-GSCM integration for scholars, managers, and practitioners in organizational sustainability and sustainable supply chains. Ren et al. (2018) provided the reason for introducing the concept of GHRM for effective environment management within the organizations. They provided GHRM theoretical foundations, empirical

development, measures, and factors that give rise to GHRM practices. The study advocated the need for understanding and quantifying and thus constructed a model that incorporates all factors influencing it. Yong et al. (2020b) provided a systematic literature review on GHRM to identify different focused areas, approaches, and scope. The author studied five focus areas to determine the performance outcome at the organizational level and individual levels.

Most of these previous works have used a subjective approach to conduct a literature review, which the researcher's bias may limit. Furthermore, several studies and surveys depict how to collect the database manually. No mathematical or machine learning techniques have been implemented to automatically interpret the corpus results and conclude the key findings. Manual reviews are subjective, limiting the raw number of studies and suffering from biasness in some cases due to the variable experience and skillset of reviewers (YONG 2020). The evidence from the last two decades strongly supports the significant drawbacks of manual review, which claims that it does not compare the inter and intra-document comparison of critical terms, methods, and findings. Therefore, research trends and future direction depend on the author's viewpoint, skillset, and experience.

To overcome these limitations, this study aims to conduct a systematic literature review (SLR) on the Scopus database of GHRM. The primary aim of the research work is to implement a semi-automated literature review that is less biased in interpreting the recent trend of the concerned field. The semi-automated and quantitative analysis of the collected dataset from Scopus has been performed using latent semantic analysis (LSA), which is part of natural language processing (NLP) (Hoblos 2020). The primary difference between the systematic manual review and semi-automatic review is shown in Fig. 1. To develop the semi-automatic analysis routine, the author uses the KNIME tool, which is

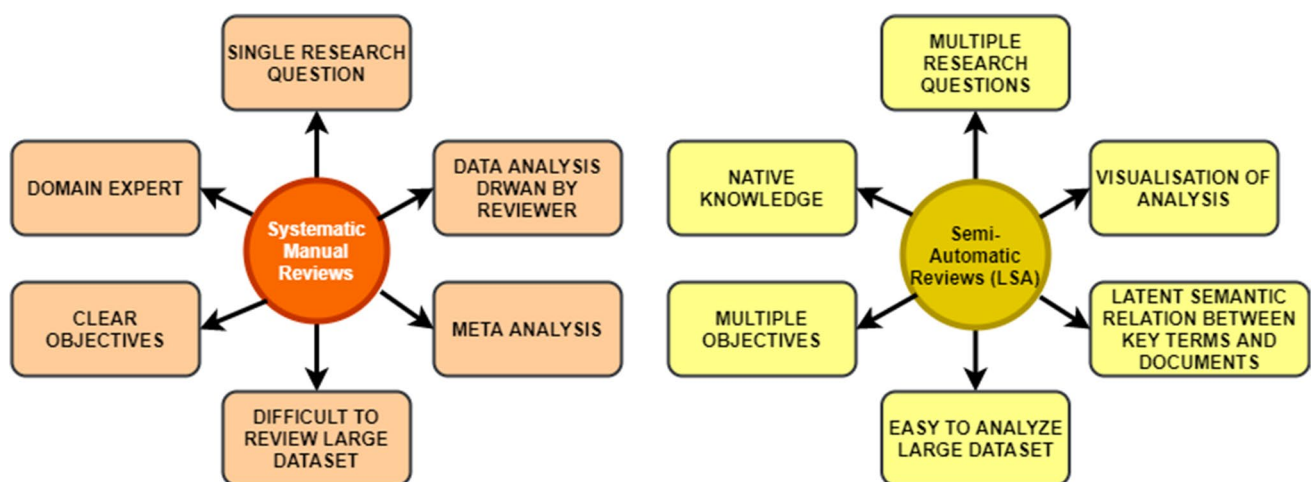


Fig. 1 Comparison of systematic manual vs semi-automatic review

available as open-source software for all researchers (Alam and Yao 2019). The analysis carried out in this work will help the research community to find the core areas and recent trends of GHRM. This technique has already found diverse applications in different domains to manifest the current directions and core areas of those domains (Fortuna et al. 2006; Kulkarni et al. 2014; Kundu et al. 2015; Rani et al. 2017; Yalcinkaya and Singh 2015). However, to the best of the researchers' knowledge, there is a lack of empirical research works that articulate recent trends in GHRM.

Thus, the uniqueness of this study is in the approach followed in carrying out the systematic literature review. Previous studies focussed on thematic analysis of literature providing knowledge about GHRM and their practices, models, and policies adopted by the organization. Instead, our focus is on extracting information from unstructured data using data mining techniques. As a result, it provides essential terms from the collected corpus with their relevant score for each term. Moreover, it gives the semantic similarity between the keywords, which helps in offering recent trends for future researchers. Hence, this study will help researchers find keywords, key topics, and evolving research areas in GHRM using natural language processing.

A systematic literature review follows a PRISMA guideline (2009) which examines the items which need to be reported while performing systematic reviews and meta-analyses. These items include reporting identification, screening, eligibility, and inclusion of relevant studies for performing the quantitative analysis (Aguilar-Hernandez et al. 2021; Det Udomsap and Hallinger 2020). A recent revision was made to these guidelines in the year 2020, which mandated the inclusion of checklists, explanation, elaboration, and flow diagrams while performing SLR (Page et al. 2021). Therefore, this study speaks off the revised PRISMA guidelines (2020) to collect and conduct an analysis of qualitative publications of GHRM.

Many strategies have been proposed in the literature to deal with the prediction of research trends in green human resource management practices; LSA (latent semantic analysis), one of the methods in NLP, helps in identifying and understanding the composed document through term frequency (TF) and inverse document frequency (IDF) scores (Aizawa 2003). It is considered one of the best methods to extract and infer meaningful relations of words stored as a bag of words (BOW) (Yalcinkaya and Singh 2015). LSA

is an objective method to analyze text data to answer the formulated research question by researchers (Evangelopoulos et al. 2012). A proven mathematical model provides the same results as a human brain interprets the words to draw semantics from them (Ding 2005).

The primary objective of this work is to uncover and predict recent trends and core areas of GHRM. Network analysis related to the research question is done using the VOSviewer tool, represented in the result section later in this article. It will be depicted based on answering the following broad research questions (RQ):

RQ1: Who are the leading researchers and top publishers in GHRM?

RQ2: What is the relationship between quantitative and qualitative literature of GHRM?

RQ3: What are the recent trends and future direction in GHRM?

The structure of the study is shown graphically in Fig. 2.

Methodology

The proposed methodology of this study has been graphically depicted in Fig. 3.

Selection of string

The first step in a systematic literature review is the formulation of string developed by following the guidelines (Kitchenham and Charters 2007). To develop the string, key terms have been taken from the topic selection, keywords from relevant articles, and AND, OR Boolean operations. Application of AND process on keywords in the search term enables the inclusion of only those articles in search results that contain all of the critical keywords. In contrast, the application of OR operation includes all articles incorporating one or more of the selected keywords. The primary keywords for this study are “Green” and “human resource management.” The final resultant search string after applying various combinations of keywords and using Boolean operations is “green human resource” OR “green human resource management” OR “ghrm” OR “green hrm.”



Fig. 2 Paper structure

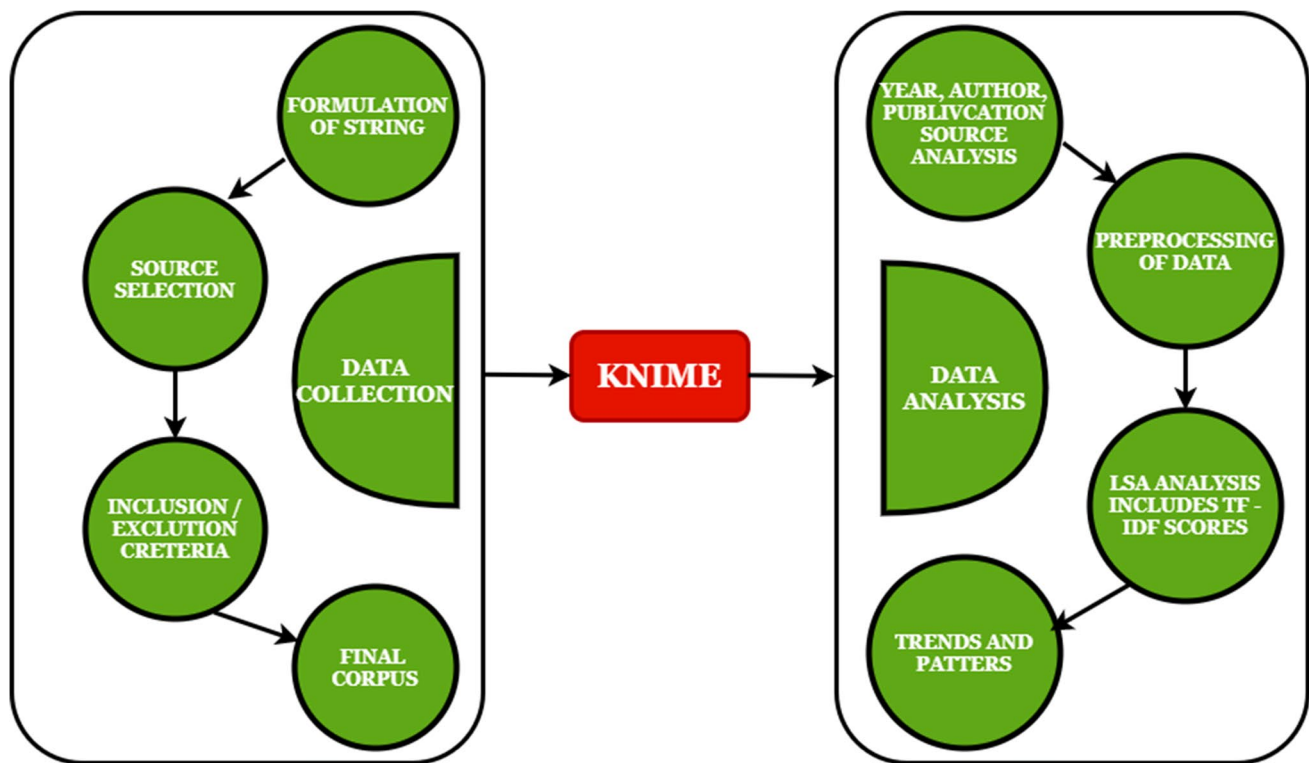


Fig. 3 Proposed methodology

Data source

Although there are various digital libraries to retrieve articles related to Green HRM, Scopus was considered for carrying out this research. Furthermore, prior comparative studies between Scopus, Web of Science, and other scholarly databases such as Singh et al. (2021); Zhu and Liu (2020); and Harzing and Alakangas (2016) indicate that Scopus has a broader coverage of articles proving that it is a comprehensive and reliable data source (Tseng et al. 2019) thereby justifying its suitability for this review. Therefore, the finalized search string was applied to the Scopus database. As a result, 318 results were fetched, out of which 317 studies were retained to perform analysis. A

sample of the obtained corpus has been depicted in Fig. 4 and contains the paper's title, authors, year, publication source, keywords, and abstract for effective LSA analysis.

Tool

Since the analysis is based on text mining, the KNIME tool has been used to conduct this study as it is an open-source tool with text processing features (Fillbrunn et al. 2017). The tool is easy to use and allows sharing of workflows among the authors (Dietz and Berthold 2016). Network analysis is performed using the VOSviewer tool (open-source software).

Authors	Title	Year	Source title	Abstract	Author Keywords
Sriram V.P., Suba M.	Impact of green human resource management (G-HRM) practices over	2017	Journal of Advanced Research in Dynamical and Control Systems	The green HRM is slightly differed from HRM, this small make over is covers the	E-HRM; Environment HRM; GHRM; Green
Fathy El Dessouky N., Alquaiti H.O.	Impact of Green Human Resource Management (GHRM) Practices on	2020	2020 2nd International Sustainability and Resilience Conference:	The aim of the paper is to study the impact of Green Human Resource	Environment Management; GCC
Khan M.H., Muktar S.N.	What's next for green human resource management: Insights and trends for	2021	International Journal of Sustainable Development and Planning	The theme of green human resource management (GHRM) has got immense	Environmental management; Green

Fig. 4 Corpus sample

KNIME workflows used in this study

The workflow developed in KNIME for conducting a meta-analysis is shown in Fig. 5.

To apply text mining, the text needs to be pre-processed in KNIME. The pre-processing steps include POS (Part of Speech) tagging, removing the numbers from the document, removing stop words (English only), and stemming the words in the paper (Tseng et al. 2019). POS tagging creates the token of words from the document, which further makes BOW (Bag of Words). BOW is a dictionary of words used to conduct the LSA. During the normalization process, all the documents are converted to lower or upper case using the case converter node in KNIME, making the paper ready within the corpus for text mining application. This case conversion is essential to neutralize any bias because of case sensitivity.

Furthermore, stop word filtering implies the removal of all those words in the text that do not draw any knowledge like punctuation marks or numbers or stop words in the language (is, am, are of) (Evangelopoulos et al. 2012). Finally, the stemming process is used to remove the data redundancy, which will improve the efficiency of the text mining process using LSA (Feldman and Sanger 2006). KNIME workflow used to conduct document pre-processing has been shown in Fig. 6.

A sample of all the steps executed for pre-processing the documents and their output at each step has been explained and depicted in Table 1.

- Document 1: Green human resource management deals with environmental sustainability and protecting the environment. This is under the green moment.
- Document 2: Various organizations adopt green practices in their daily work culture. Green policies and procedures have been involved in the system of organizations for better sustainability.

Result analysis

The following section presents the meta-analysis and network analysis results to answer the research questions laid at the beginning of the article.

Meta-analysis

Meta-analysis primarily focuses on descriptive statistics of the corpus of articles. Since the corpus contains data on year, author, countries, subject areas, and so on, different metadata can be generated by each article, year, subject area, author, etc.

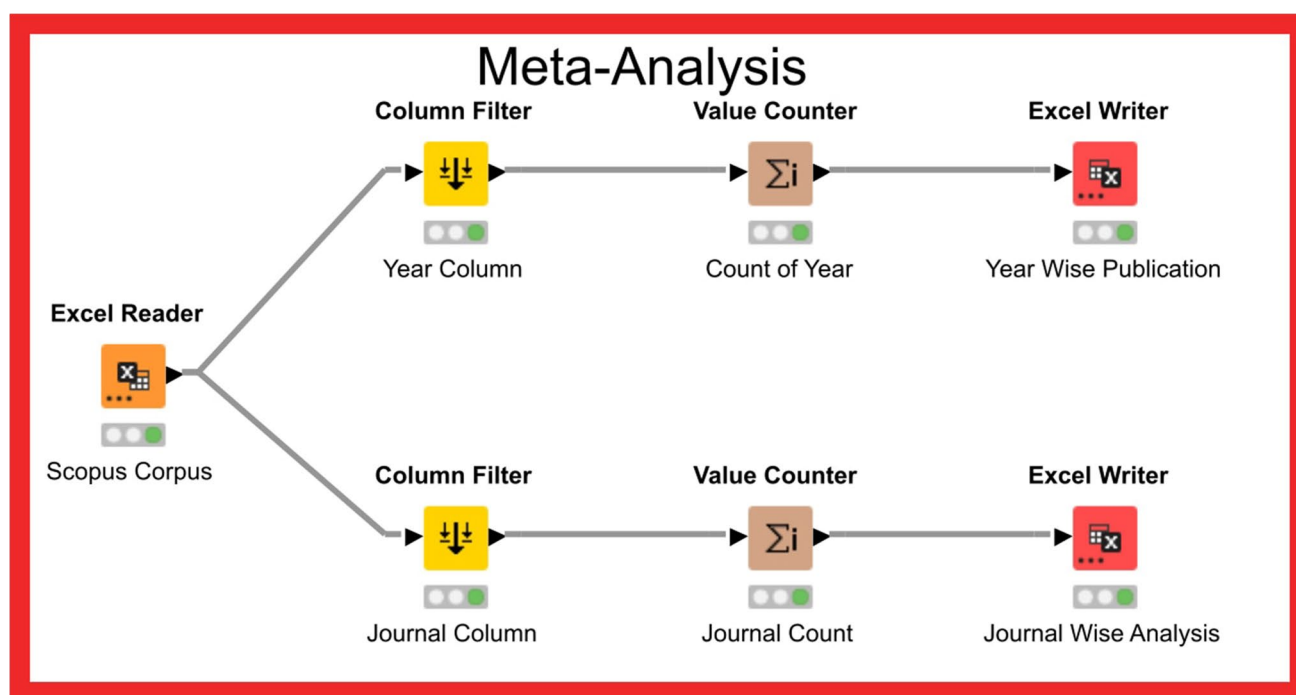


Fig. 5 Meta-analysis KNIME workflow

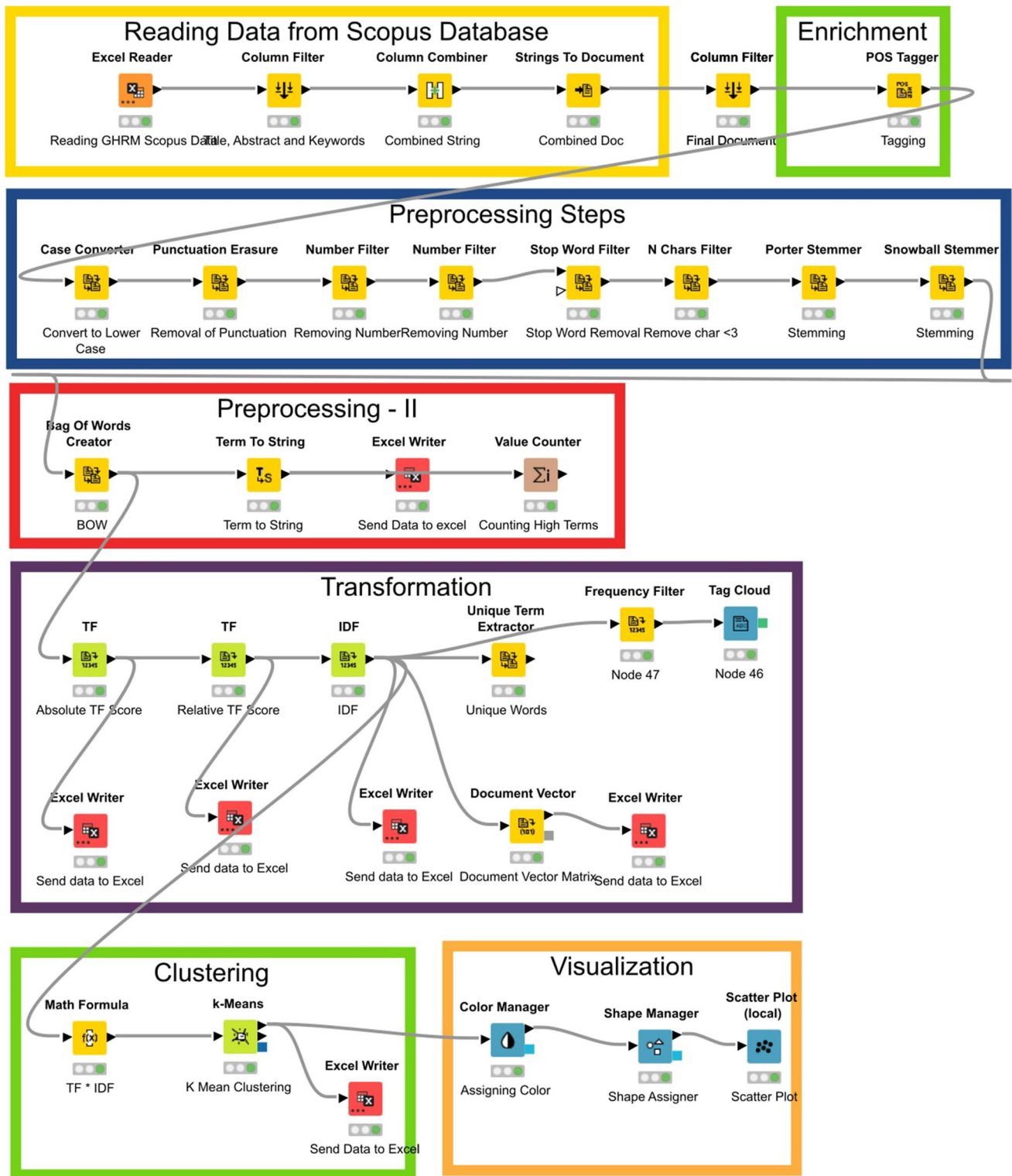


Fig. 6 KNIME workflow to conduct experiment

Table 1 Pre-processing steps

Pre-processing steps		
Steps	Document	Result
POS tagging	<ul style="list-style-type: none"> Document 1 Document 2 	["Green," "human," "resource," "management," "deals," "with," "environmental," "sustainability," "and," "protecting," "the," "environment," ".,," "This," "is," "under," "the," "green," "moment," "."] ["Various," "organization," "are," "adopting," "green," "practices," "in," "their," "daily," "work," "culture," ".,," "Green," "policies," "and," "practices," "have," "been," "involved," "in," "the," "system," "of," "organizations," "for," "better," "sustainability," "."]
Case converter	<ul style="list-style-type: none"> Document 1 Document 2 	["green," "human," "resource," "management," "deals," "with," "environmental," "sustainability," "and," "protecting," "the," "environment," ".,," "this," "is," "under," "the," "green," "moment," "."] ["various," "organization," "are," "adopting," "green," "practices," "in," "their," "daily," "work," "culture," ".,," "green," "policies," "and," "practices," "have," "been," "involved," "in," "the," "system," "of," "organizations," "for," "better," "sustainability," "."]
Removal of punctuation mark	<ul style="list-style-type: none"> Document 1 Document 2 	["green," "human," "resource," "management," "deals," "with," "environmental," "sustainability," "and," "protecting," "the," "environment," "this," "is," "under," "the," "green," "moment"] ["various," "organization," "are," "adopting," "green," "practices," "in," "their," "daily," "work," "culture," "green," "policies," "and," "practices," "have," "been," "involved," "in," "the," "system," "of," "organizations," "for," "better," "sustainability"]
Removal of numbers	<ul style="list-style-type: none"> Document 1 Document 2 	["green," "human," "resource," "management," "deals," "with," "environmental," "sustainability," "and," "protecting," "the," "environment," "this," "is," "under," "the," "green," "moment"] ["various," "organization," "are," "adopting," "green," "practices," "in," "their," "daily," "work," "culture," "green," "policies," "and," "practices," "have," "been," "involved," "in," "the," "system," "of," "organizations," "for," "better," "sustainability"]
Stop word removal	<ul style="list-style-type: none"> Document 1 Document 2 	["green," "human," "resource," "management," "deals," "environmental," "sustainability," "protecting," "environment," "under," "green," "moment"] ["various," "organization," "adopting," "green," "practices," "daily," "work," "culture," "green," "policies," "practices," "involved," "system," "organizations," "better," "sustainability"]
Stemming	<ul style="list-style-type: none"> Document 1 Document 2 	["green," "human," "resource," "manage," "deal," "environment," "sustainab," "protect," "environment," "under," "green," "moment"] ["various," "organiza," "adopt," "green," "practice," "daily," "work," "culture," "green," "police," "practi," "involv," "system," "organizat," "better," "sustainab"]

Table 2 Top 10 researchers

Author name	Document	Citation
Jabbour c.j.c	27	1706
Teixeira a. a	7	178
Yusliza m	7	177
Guerci m	7	381
Renwick	7	347
Yong	6	143
Ramayah	5	139
Paille	5	395
Pham	5	153
Raut	4	38

Top 10 leading authors

Table 2 shows the top 10 leading researchers in GHRM with their number of documents and citations found in the selected corpus.

This implies that the author Jabbour has the maximum number of publications on Green HRM and has been cited. All the remaining leading authors have a publication count of less than 10 in GHRM, while Jabbour's is 27.

Publications by year

Figure 7 shows that the emergence of articles in the field of GHRM began in the year 2008. The number of papers contributed per year has also risen steadily. The maximum number of publications in this field will be 102 in 2020. It implies that GHRM is a burning area of research in present times. The researchers are increasingly interested in incorporating green practices in HRM to achieve sustainability, manage environmental issues, etc.

Publications by journals

Figure 8 shows the top 10 journals by a count of publications. The highest number of publications is in the Journal of

Fig. 7 Year-wise publication analysis

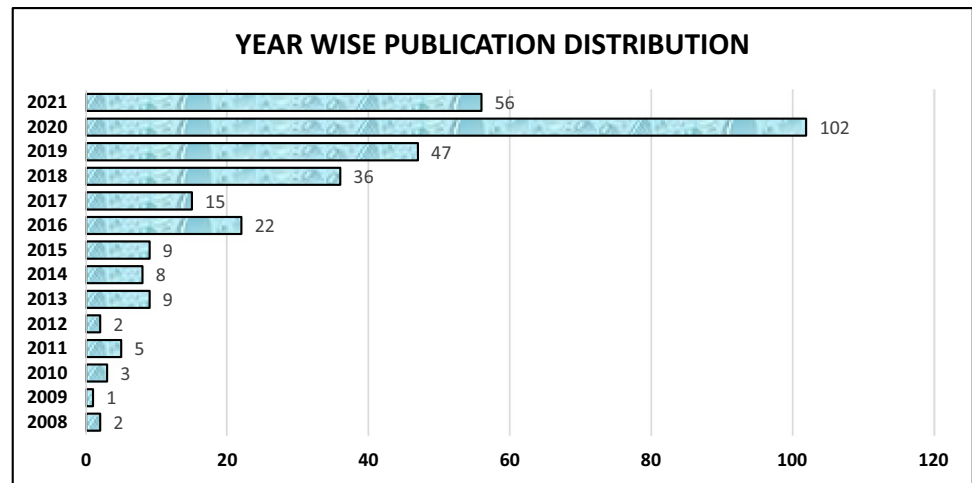
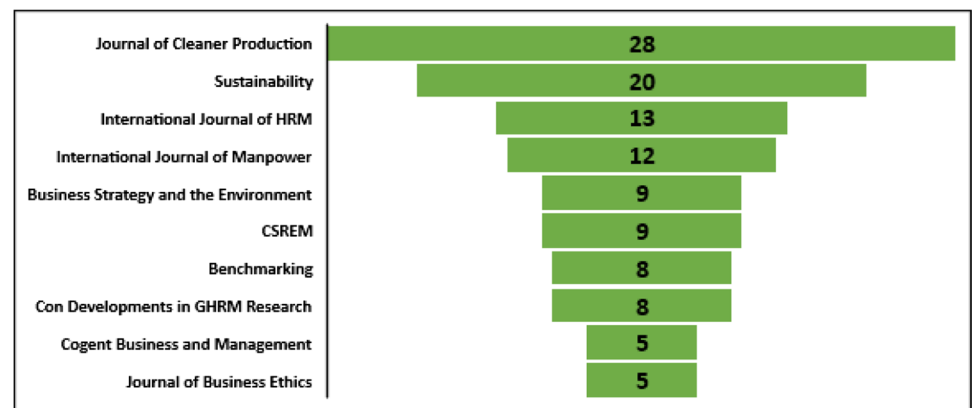


Fig. 8 Top 10 dominating journal in GHRM



Cleaner Production (28 articles), representing approximately 10% of the total papers used for analysis. This is followed by sustainability which also has a good publication count, followed by the International Journal of HRM and International Journal of Manpower.

Term frequency (TF)-inverse document frequency (IDF)

A document term matrix is developed from the corpus for ease of text analysis, which lists the absence/ presence or frequency of different terms in a particular document. Using this matrix, popular terms or recurring terms can be fetched. For this purpose, a metric called as term frequency-inverse document frequency (TF-IDF) score is generated. This study generated TF-IDF scores from the corpus to identify the highly weighed article compared to others and extract the terms with a high TF-IDF score. TF-IDF is a technique used under the umbrella of NLP for classification and text summarization (Jones 1972; Ramos 2003; Wu et al. 2008). This technique draws the importance of terms from the extracted terms from the selected corpus. TF-IDF generates

the weights against the words extracted from the corpus in BOW, which depends upon the term in a particular document (Yalcinkaya and Singh 2015).

TF refers to the term frequency and is used to calculate the frequency of a specific word in the document. It is estimated as the number of times the term appears in the document divided by the total times in the whole document (Artama et al. 2020; Kim et al. 2020). On the other hand, IDF is used to calculate inverse document frequency. The mathematical formula for TF-IDF is shown in the below equations.

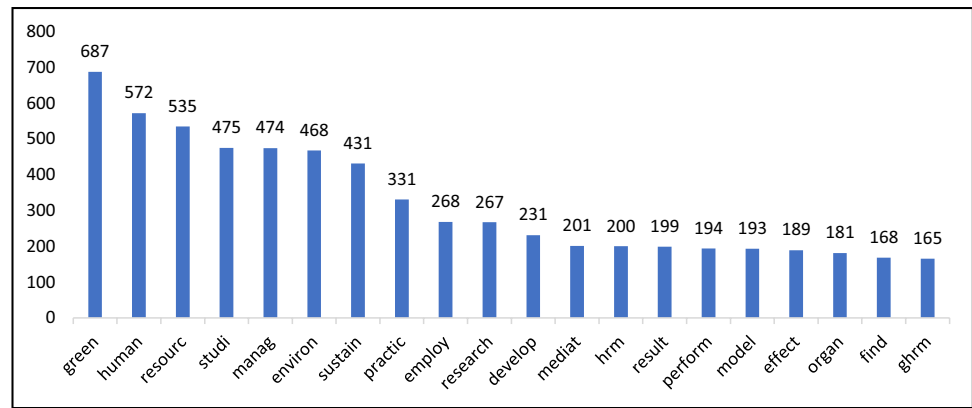
$$TF = \frac{\text{Number of times word appears in document}}{\text{Total number of terms in the document}} \quad (1)$$

$$IDF(i, j) = \log \left(\frac{\text{Total number of document}}{\text{Number of documents with term, i, inside it}} \right) \quad (2)$$

TF-IDF values for the corpus used in this study have been shown in Table 3, which have been computed automatically by KNIME workflow using Eqs. 1 and 2. In this study, the top 50 terms have been taken from the corpus encountered most frequently in BOW.

Table 3 Transformed TF-IDF values representation of 317 document

Term	Doc1	Doc2	Doc3	Doc4	Doc5	Doc6	Doc7		Doc317
green	0.0037	0.0088	0.0268	0.0063	0.0515	0.0513	0.0057	.....	0.0000
human	0.0073	0.0175	0.0045	0.0063	0.0000	0.0128	0.0057	.....	0.0000
resourc	0.0073	0.0175	0.0089	0.0126	0.0000	0.0128	0.0172	.....	0.0000
manag	0.0073	0.0044	0.0089	0.0189	0.0147	0.0128	0.0057	.....	0.0000
sustain	0.0073	0.0044	0.0089	0.0063	0.0000	0.0000	0.0000	.....	0.0000
literatur	0.0073	0.0088	0.0089	0.0063	0.0000	0.0128	0.0115	.....	0.0000
ghrm	0.0219	0.0000	0.0089	0.0189	0.0000	0.0513	0.0460	.....	0.0085
studi	0.0109	0.0044	0.0179	0.0031	0.0074	0.0000	0.0115	.....	0.0043
contribut	0.0073	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	.....	0.0000
environ	0.0073	0.0000	0.0089	0.0063	0.0294	0.1026	0.0057	.....	0.0000
practic	0.0146	0.0088	0.0089	0.0063	0.0294	0.0000	0.0057	.....	0.0000
hrm	0.0037	0.0263	0.0000	0.0000	0.0147	0.0000	0.0000	.....	0.0043
employ	0.0146	0.0000	0.0000	0.0063	0.0588	0.0000	0.0000	.....	0.0000
perform	0.0073	0.0000	0.0089	0.0126	0.0000	0.0897	0.0000	.....	0.0000
model	0.0073	0.0263	0.0000	0.0031	0.0000	0.0128	0.0029	.....	0.0000
develop	0.0073	0.0263	0.0000	0.0063	0.0000	0.0000	0.0057	.....	0.0000
manufactur	0.0037	0.0000	0.0000	0.0000	0.0000	0.0064	0.0000	.....	0.0000
organ	0.0073	0.0088	0.0000	0.0000	0.0294	0.0000	0.0057	.....	0.0000
support	0.0073	0.0088	0.0089	0.0000	0.0000	0.0064	0.0115	.....	0.0000
effect	0.0000	0.0088	0.0089	0.0000	0.0000	0.0000	0.0000	.....	0.0000
aim	0.0000	0.0088	0.0000	0.0000	0.0000	0.0000	0.0000	.....	0.0000
role	0.0000	0.0088	0.0000	0.0000	0.0000	0.0000	0.0000	.....	0.0085
purpo	0.0000	0.0088	0.0000	0.0063	0.0000	0.0000	0.0086	.....	0.0085
research	0.0000	0.0175	0.0000	0.0063	0.0000	0.0000	0.0000	.....	0.0000
analysi	0.0000	0.0088	0.0000	0.0126	0.0000	0.0128	0.0057	.....	0.0000
relationship	0.0000	0.0000	0.0089	0.0126	0.0000	0.0128	0.0000	.....	0.0000
train	0.0000	0.0000	0.0089	0.0063	0.0000	0.0000	0.0000	.....	0.0000
limit	0.0000	0.0000	0.0089	0.0031	0.0000	0.0000	0.0057	.....	0.0000
explor	0.0000	0.0000	0.0000	0.0063	0.0000	0.0000	0.0057	.....	0.0000
influenc	0.0000	0.0000	0.0000	0.0063	0.0000	0.0000	0.0000	.....	0.0000
find	0.0000	0.0000	0.0000	0.0063	0.0000	0.0000	0.0057	.....	0.0000
us	0.0000	0.0000	0.0000	0.0063	0.0000	0.0000	0.0000	.....	0.0085
paper	0.0000	0.0000	0.0000	0.0000	0.0147	0.0128	0.0057	.....	0.0000
firm	0.0000	0.0000	0.0000	0.0000	0.0000	0.0385	0.0000	.....	0.0000
impact	0.0000	0.0000	0.0000	0.0000	0.0000	0.0128	0.0057	.....	0.0000
mediat	0.0000	0.0000	0.0000	0.0000	0.0000	0.0064	0.0000	.....	0.0000
moder	0.0000	0.0000	0.0000	0.0000	0.0000	0.0128	0.0000	.....	0.0000
test	0.0000	0.0000	0.0000	0.0000	0.0000	0.0128	0.0000	.....	0.0000
result	0.0000	0.0000	0.0000	0.0000	0.0000	0.0128	0.0057	.....	0.0085
provid	0.0000	0.0000	0.0000	0.0000	0.0000	0.0064	0.0000	.....	0.0085
implic	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0115	.....	0.0000
industri	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0057	.....	0.0000
organiz	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0057	.....	0.0000
behavior	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	.....	0.0000
data	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	.....	0.0000
posit	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	.....	0.0000
examin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	.....	0.0000
theori	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	.....	0.0000
collect	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	.....	0.0000

Fig. 9 Top 20 frequent terms

The corpus contains 317 articles extracted from Scopus, and BOW had 3147 unique tokens to make a dictionary of words. Out of these 3147 tokens, the top 20 frequent words have been represented graphically in Fig. 9.

The matrix created is of 3147 terms \times 317 column and limitation to represent the data, top 50 terms \times 317 column has been described as there are high terms extracted from a corpus that is likely to be noisy or redundant, using clustering author identified prominent five latent topics from the corpus.

Terms represented in the matrix represent unique words from the corpus, and during the transformation step, weights are assigned against the terms according to their importance in the particular document. These TF-IDF scores obtained for the corpus can be used to perform the clustering of documents.

Recent trends identification using K-mean clustering

To derive insights from the articles extracted from the Scopus database on GHRM, the papers can be clustered, and

then topics can be assigned based on terms that load onto these clusters. As BOW extracts the K number of terms from the corpus, K-mean clustering is applied to this data to draw a topic solution. Selecting the perfect/appropriate number of topics is challenging, but Deerwester (Deerwester et al. 1990) suggests that five is an optimal number of topics for a 317 document corpus. The ideal five topics extracted using KNIME with their high loading terms have been represented in Table 4. These five topics or clusters can now be defined based on their TF-IDF scores. These topic labels are considered recent trends in GHRM on which further research in this field can be focused.

Labeling the clusters

The clusters extracted using K-mean clustering based on the TF-IDF score can be further refined based on their highest score. After analyzing the terms in each cluster, appropriate labels are assigned. They are then grouped according to their weight and are concluded as the recent trends for future research or areas of research needing more attention.

Table 4 Ideal topic label with high loading terms

Cluster value	Topic label	High loading terms
Cluster 1	Practices for Organization and Environment Sustainability	Green,sustainable,capital,fuzzy,barriers,,companies,leadership,organisational,practices,quality,r esources,employee,corporate,organizations,hrm
Cluster 2	Global Strategies for GHRM	Malaysia.,management.,analysis,information Sustainable,system,systematic,environmental Green,supply,transformational,automobile,banking,citizenship,brazil,bangladesh
Cluster 3	Behaviour Management and Performance Factors	Employee,social,training,green,sustainability,performance,behavior,management,environment,i nnovative,public,staff,human,social,reward
Cluster 4	Ethical and Health Benefits	Hospital,combustion,ecological,pandemic,performance,policy,green,ethic,practices,stakeholder s,diagnosis,quality,benefits,consumption
Cluster 5	Eco-Innovation Responsibilities	Management,behaviors,organizational,performance,training,development,eco-innovation,resour ce-based,citizenship,industry Sustainable,identification,responsible,structural Engagement,competences,products

Table 5 High loading article based on cluster

Cluster value	Label	High loading article	Score
Cluster 1	Practices for Organization and Environment Sustainability	(Rajiani et al. 2016)	0.4728
		(Masri and Jaaron 2017)	0.4670
		(Kerdpitak, n.d.)	0.4623
Cluster 2	Global Strategies for GHRM	Yong et al. (2020a)	0.3173
		(Elshaer et al. 2021)	0.3168
		(Jackson et al. 2011)	0.3154
		(Jabbour 2015)	0.3023
Cluster 3	Behaviour Management and Performance Factors	(Muisyo and Qin 2021)	0.2250
		(Xiang and Yang 2020)	0.2244
		(Malik et al. 2021)	0.2235
Cluster 4	Ethical and Health Benefits	(Saifudin et al. 2021)	1.2243
		(Balakrishnan et al. 2018)	1.0107
		(Paulet et al. 2021)	0.8844
Cluster 5	Eco-Innovation Responsibilities	Cabral and Dhar 2019)	0.1521
		Neto et al. (2014)	0.1520
		(Khan et al. 2021)	0.1516

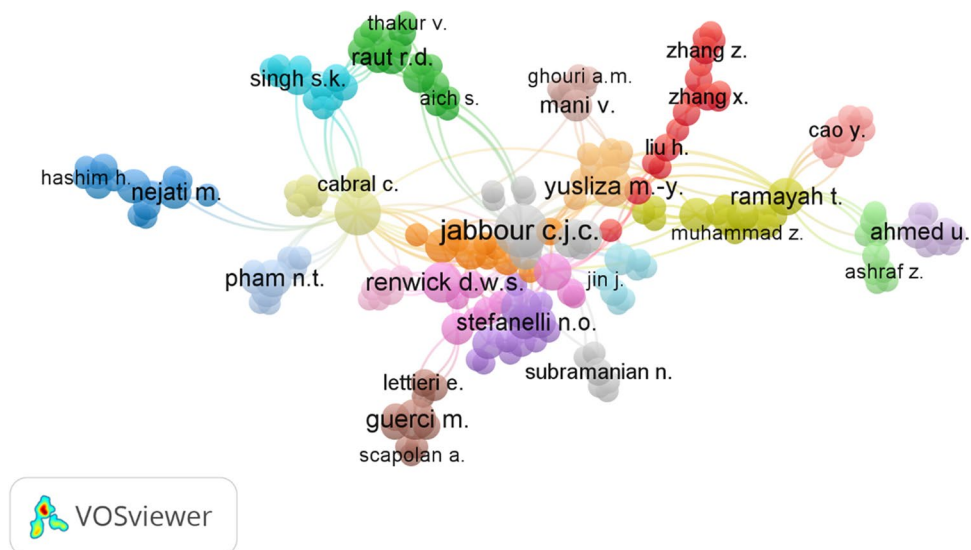
Similarly, clusters with high loading articles and corresponding scores can also be generated (Table 5).

Network analysis

The co-authorship analysis depicts the link between the authors and their co-authors. Such analysis is instrumental in identifying which authors are playing lead researchers and networking to spread the research. This can be highly useful in the strategic planning of research and development capacity-building programs (Morel et al. 2009). The co-authorship network for this work is shown in Fig. 10, generated using the VOSviewer tool. Each color code represents one network

of authors. Since Jabbour is at the center of the network and in bold, he is the main contributor with the most extensive networking. Similarly, node sizes also depict the density of the networks (Fig. 10).

Countries that are contributing to GHRM are shown in Fig. 12. Figure 11 shows the ten leading countries' document count and concludes that China has the leading publication in GHRM. The highest cited research is also published in this country in the area of GHRM (Dumont et al. 2017; Kim et al. 2019; Jabbour 2013; 2015; Jackson et al. 2011; Shafaei et al. 2020b; Renwick et al. 2013; Teixeira et al. 2016). Such cross-country networking can enable the development of better policies and learn from the best practices of other cultures. For example, authors from China and Canada

Fig. 10 Researcher network

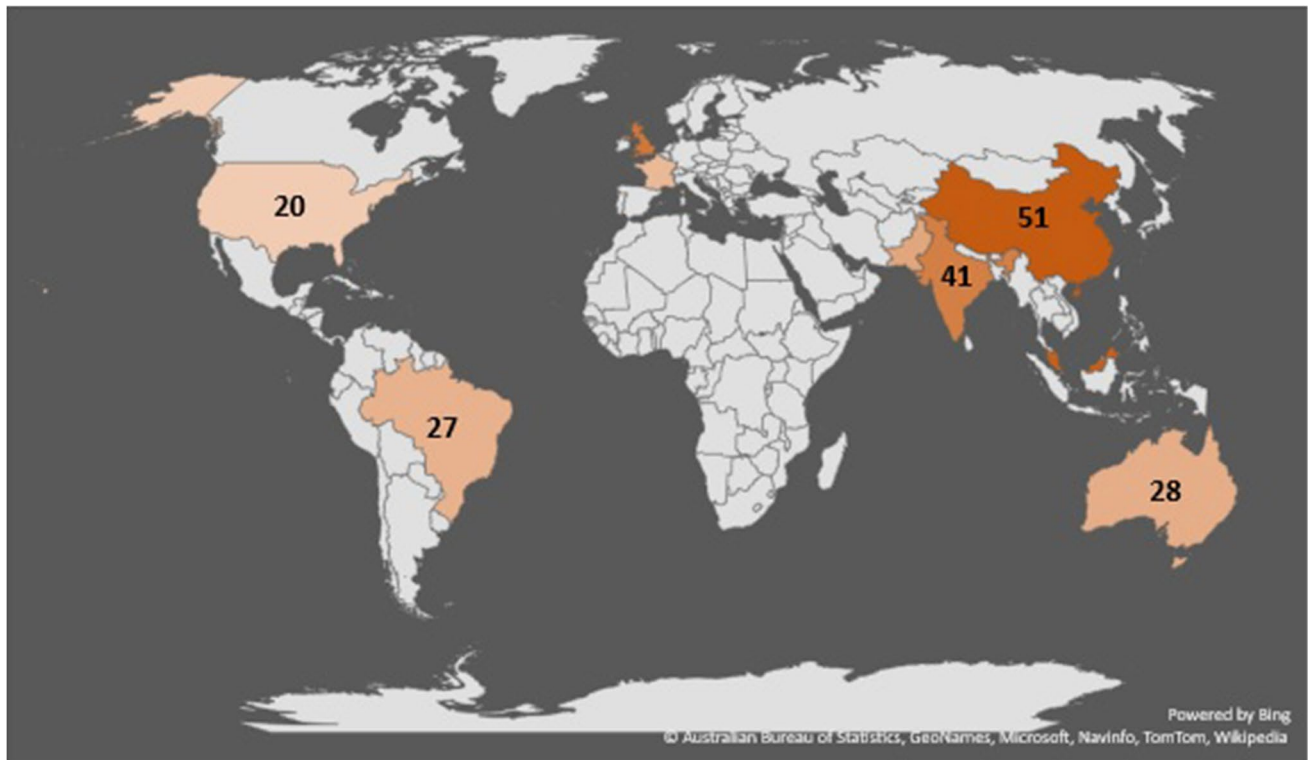


Fig. 11 Ten leading countries with article count

are networking to research in GHRM, and each country's researcher can leverage the best practices of others.

Network analysis can also be applied to keywords to unfold the directions in which research is heading for a particular topic. This can also provide a starting point of study for a few. The network analysis of keywords is shown in Fig. 13, and the word cloud generated for essential words in the corpus-based on their frequency is shown in Fig. 14.

Recent trends and future direction in the field of GHRM?

This work attempted to identify the existing trends in research in GHRM. Findings from keyword network analysis (Fig. 13) reveal that existing literature on Green HRM has contributed to specific theories. Ability Motivation Opportunity (AMO) Theory, Grounded theory, and Resource-Based View (RBV). Besides this, it is worth mentioning that works with keywords focusing on investigating GHRM in an employee context also find high occurrence. The highest frequency was cited for relating employee green behavior, employee ambidexterity, the study of generational differences, environmental commitment, green human capital, artificial intelligence, and

organizational barriers in the context of GHRM. The study also shows that India still has scope to produce works in this field, and the keywords mentioned above can be a good starting point. Additionally, keywords also depict the areas of application of GHRM researched in literature, viz. hospitals, hotels, faculty, and airlines.

From the topics and clusters extracted using K-mean clustering applied to TF-IDF scores, it is seen that in GHRM, more attention needs to be paid to environment and organization sustainability. The trends in GHRM adequately labelled have been shown in Fig. 15.

The first theme to identify recent trends in Green HRM research that emerged from the analysis is 'Practices for Organization and Environment Sustainability. Previous works have demonstrated that management practices can promote green behaviour among employees and thereby promote sustainability (Rubel et al. 2021). When a firm incorporates green practices in its policies and procedures, individual employees exhibit green behaviour, automatically enabling organizational sustainability. For example, looking for individuals with green values promotes the accomplishment of organizational green goals (Saifulina et al. 2020). Some practices followed by the organization to transform HRM to GHRM are Zia et al. (2020), Mehrajunnisa et al. (2021), and Suharti and Sugiarto (2020).

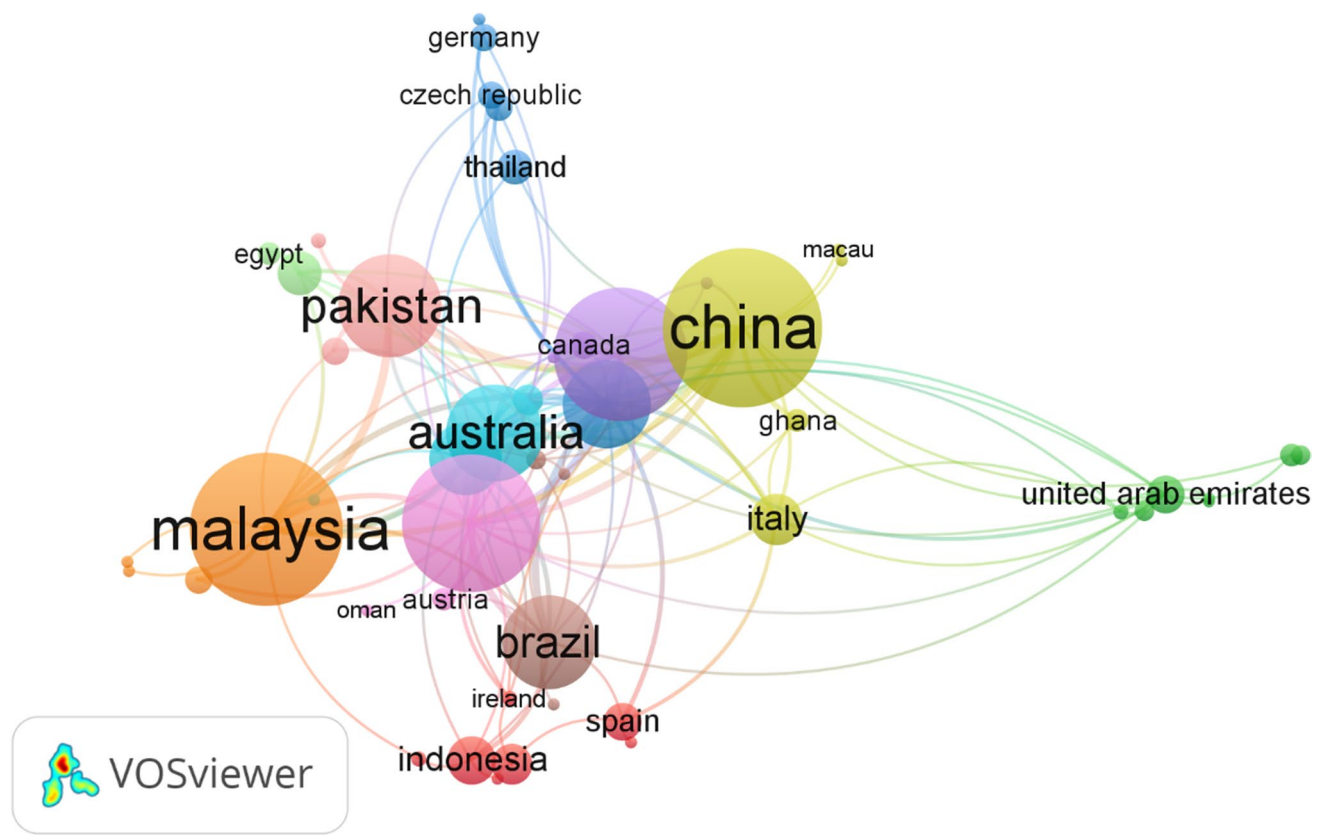


Fig. 12 Countries contributing to GHRM

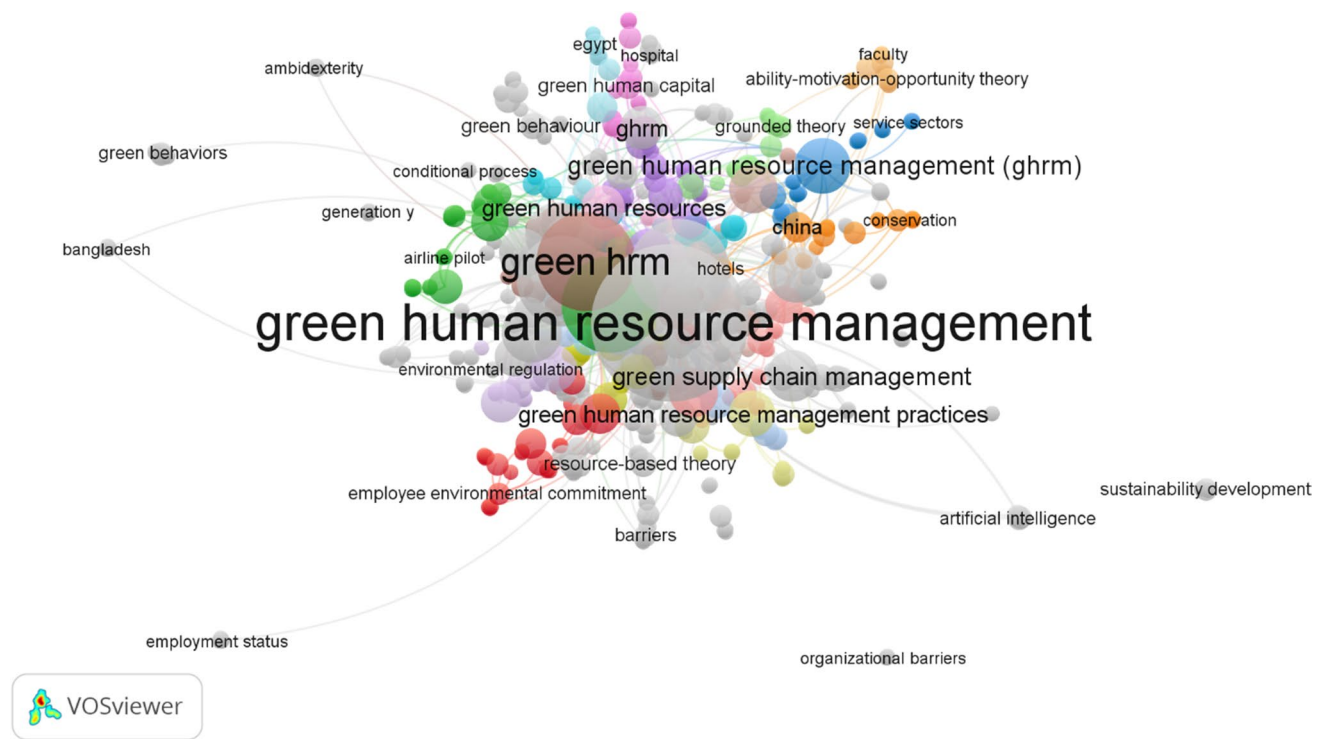


Fig. 13 Network analysis of keywords



Fig. 15 Recent trends

need to bring about process innovations in GHRM practices (Rajiani et al. 2016). Through the adoption and implementation of GHRM practices, firms influence employees' ability (through appropriate recruitment) and motivation (through green incentives), which fosters the environmental commitment among employees and aids in greening the firms and the environment. Masri and Jaaron (2017) also demonstrated that GHRM practices contribute to environmental performance, where green recruitment is the most likely and green training is the minor influential contributor (Masri and Jaaron 2017). It again emphasizes the AMO theory that when an organization recruits employees with green aptitude, it reflects environmental commitment. This way, firms can strategize HR practices to the green edge. In addition, ecological training contributes to operational performance (Kerdpitak), and environmental and human resources management practices significantly affect firm performance.

Studies have established a direct relationship between corporate social responsibility and firm performance, and indirectly through green behavior (Úbeda-García et al. 2021). It is said that when Green HRM practices are adopted in a firm, they promote environmental performance, leading to organizational optimization, which in turn enhances the financial, operational, and social performance of the firms (Zaid et al. 2018). Eco-innovation is innovations targeted at promoting environmental sustainability that is also encouraged when a firm adopts Green HRM practices. By adopting the eco-innovation culture, the firm's performance is also enhanced (Muisyo and Qin 2021), for example, by rewarding green innovations by employees (Suharti and Sugiarto

2020). HRM is the department that takes care of employees and motivates them to adopt green policies. Employee behavior plays a vital role in adopting green practices, and their behavior directly relates to their performance (Amjad et al. 2021). Therefore, organizations should include reward policies to motivate their employees to accept the green policies. From the day an employee is recruited until their exit from the organization, HRM handles all policies and practices to make their employee green. Employee ethics and their health also play an essential role in their performance, so health-related issues must be addressed and included in policies so that employees be healthy. A healthy person can attend the office daily, which makes high performance directly impacts organizational performance.

Global practices or strategies like green performance management enrich individual green competencies, thereby contributing to the environment-friendly culture at the workplace and accomplishing organizational green goals (Chakraborty et al. 2020). Globally, firms compete to gain an advantage, and Green HRM is a pivotal catalyst for promoting sustainability, the most sought-after factor in the current business environment (Ogbeibu et al. 2020). Green HRM also enhances non-green work outcomes such as enhanced economic performance, corporate image, and ethicality among employees (Suharti and Sugiarto 2020). Ethical behavior is also promoted through the increased perceived value of the meaningfulness of work (Al-Hawari et al. 2021). The relationship between green behaviour and the health outcomes of the employees is almost cyclic (French 2005). This is because exhibiting green behaviour helps keep the environment at the firm green, which improves both the physical and mental health of the employees. This, in turn, motivates the employees to exhibit pro-environmental behaviour to reap the health benefits.

Understanding such themes and recent trends can aid the researchers in identifying areas for future research. Besides this, researchers can explore how GHRM can contribute to global recognition and how it can be implemented to make the environment more sustainable. Human existence depends on environmental factors, so organizations must transform themselves into Green organizations to save our environment and save the earth.

Conclusion

Human resource management's primary goal is to recruit the right people at the right place and time. Human resource management continuously focuses on the performance, engagement, productivity, innovation, and sustainability of the organization and employees (Tayali and Sakyi 2020). The human resource department is concerned with advertising, recruitment, selection, training,

deployment, performance, rewards, etc. The process of advertising to recruit people is not that eco-friendly and less concerned about environmental sustainability. Due to climate change, our environment is degrading daily and forcing organizations and people to adopt green policies. All human resource processes are taken online, and less paper or green technologies are used to recruit people. Green human resources focus on environmental sustainability, but as this is the growing stage, future researchers concentrate on the areas that need more attention in terms of ecological sustainability. In this article, the author provided recent trends based on the extracted keywords using latent semantic analysis, which may need more attention. Areas that need more attention or that researchers can work on are Practices for Organization and Environment Sustainability, Global Strategies for GHRM, Behaviour Management, Performance Factors, Ethical and Health Benefits, and Eco-Innovation Responsibilities. Natural language processing (NLP) is an emerging area in this current era, and text mining is gaining more interest among researchers. In this study, the author implements the NLP on the Scopus database. In NLP, text mining and LSA are used to carry out this research.

Clusters are extracted using the K-mean clustering algorithm, which is further used to provide the recent trends for the GHRM. Identified areas need to be explored by future researchers for better implementation of green policies in their daily practices. This study tried to uncover the different aspects of the GHRM. Green practices are other for different people and organizations, but the Green Revolution is the area to save our environment by implementing various procedures, according to multiple researchers. Humans adapt to technology very fast, but it affects our environment too, which every individual is aware of. To provide awareness, different organizations introduce various campaigns from time to time. The campaign aims to motivate people to save our natural resources and personal resources to better the environment. This study provides information to researchers about the researchers providing various practices and policies to implement green policies in their practices through extensive research. The author identified various publishers that offer a platform to showcase their research globally. Countries that are leading in the field of GHRM are also represented graphically. This study provides all aspects of GHRM through the research areas identified. This study concludes every research area relates to GHRM and helps in environmental sustainability.

Through their research, progressive policies and practices may be provided to organizations to resolve environmental issues. In addition, literature in GHRM should be identified to provide awareness for the implementation of green practices. Text mining, LSA, and network analysis used in this study will help researchers see challenges in GHRM and

work toward implementing green practice to resolve environmental issues.

Author contribution Chetan Sharma collected the data from Scopus and preprocessed the data for further analysis of data using the KNIME tool. In addition, this author does network analysis using the VOSviewer tool. He also contributed as a writer of the paper. Dr. Sumit Sakhuja contributed the workflow to execute the analysis. First, this author analyzed the KNIME tool. Dr. Shivinder Nijjer contributed to writing the paper, and after completing the paper, all proofreading and errors were removed by this author.

Declarations

Ethics approval We adhere to all ethics as per journal policy.

Consent to participate Not applicable.

Consent for publication I consent to publish this article on behalf of all authors.

Competing interests The authors declare no competing interests.

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