Zhang, J.; Zhang, Z.; Ballesteros-Pérez, P.; Skitmore, M.; Yang, G.; Philbin, SP.; Lu, Q. (2023). Factors influencing environmental performance: a bibliometric review and future research agenda. International Journal of Urban Sciences. 27(4):543-569. https://doi.org/10.1080/12265934.2021.1899845

Factors influencing Environmental Performance: A bibliometric review and future research agenda

Jingxiao Zhang[1*]; Zhiyue Zhang[2] ; Pablo Ballesteros-Péreze[3]; Martin Skitmore[4]; Guoliang Yang[5]; Simon P. Philbin[6]; Qingchang Lu[7];

1=Professor, School of Economics and Management, Chang'an University, Shanxi Xian, P.R .China, 710061, zhangjingxiao964@126.com

2=Lecturer, School of Economics and Management, Chang'an University, Shanxi Xian, P.R. China, 710061, zhangzhiyue1206@126.com

3= Dpto. de Proyectos de Ingeniería, Universitat Politècnica de València Camino de Vera s/n, Valencia, Spain;, pabbalpe@dpi.upv.es

4=Professor, School of Civil Engineering and Built Environment, Queensland University of Technology (QUT), Brisbane, Australia. Email: rm.skitmore@qut.edu.au

5=Researcher, Institutes of Science and Development, Chinese Academy of Sciences, Beijing, China, glyang@casipm.ac.cn

6=Professor, Nathu Puri Institute for Engineering and Enterprise, London South Bank University, London, United Kingdom, philbins@lsbu.ac.uk

7=Professor, School of Electronic and Control Engineering, Chang'an University, Shaanxi Xian, P.R. China, 710064, qclu@chd.edu.cn

* = zhangjingxiao964@126.com; Tel: +86-159-2973-9877

Abstract： Environmental performance allows measuring the existing gap between countries regarding their environmental policy objectives. Improving environmental performance also allows countries to achieve their sustainable development goals. However, a systematic identification of factors influencing environmental performance constitutes a premise to improve it and such a review of factors has not been conducted in previous research. This paper develops a quantitative literature review of the factors influencing environmental performance in which a total of 84 journal papers were identified by keyword retrieval between 2004 and 2019. Literature metrological and literature content analyses are performed and two major research outcomes are obtained: first, a list of environmental performance influencing factors and a classification of the five main research streams related to environmental performance: enterprise, government, economy, technology and society. Second, building on the previous

classification, a research agenda is proposed which points out current shortcomings and potential research directions for environmental performance research. The results of this piece of research provides a theoretical reference for improving environmental performance. It can also help countries target better environmental management practices when seeking global sustainable development.

Highlights

- 84 journal papers are analysed with metrological and content analysis.
- Grounded theory produces a list of factors affecting environmental performance.
- Environmental performance factors are classified in five relevant categories.
- These categories are: enterprise, government, economy, society and technology.
- A research agenda is proposed for meeting the 2030 Sustainable development goals.

Keywords: Environmental performance; literature review; bibliometric survey; grounded theory; categorization; research agenda.

Word Count:5423

List of abbreviations:EP= Environmental Performance

1. Introduction

The consequences of economic development (e.g. climate change, deforestation, loss of biodiversity, depletion of water resources) create pollution and environmental problems that threaten sustainable development (Asumadu Sarkodie, Owusu, & Leirvik, 2020; Givens, Huang, & Jorgenson, 2019). According to the World Health Organization (World Health, 2019), one quarter of the world's deaths and diseases are caused by known and avoidable environmental risk factors. The need to face these large-scale and urgent environmental problems has reached a global consensus. Governments of all countries are taking responsibility for international environmental problems and must adopt measures to tackle them. At present, governments around the world are starting

to include what they deem marginal and secondary environmental issues into their political agendas. The inclusion of environmental performance indicators has become one of the most popular metrics to measure progress towards the achievement of sustainable development goals (SDGS) (Guijarro, 2019; Mokhayeri, 2017; Punyatoya, 2014)

Countries have incorporated environmental performance indicators into a series of pollution control and natural resource policies. An annual report ranks 180 countries based on 24 performance indicators in 10 categories spanning from environmental health to ecosystem vitality. However, in order to maximize the return on (government) investment, environmental performance should also be analyzed by specific issues, policy categories and countries, but these factors must also be clearly understood by everyone (Wendling, 2018).

The International Organization for Standardization defines environmental performance as "measurable results of an organization's management of its environmental aspects"(Ostad-Ahmad-Ghorabi & Attari, 2013). Hence, environmental performance can be a company’s measurement of its environmental impact, resource consumption and financial factors, as well as the result of strategic activities involving its natural environmental mitigation and preventive measures (Dragomir, 2018; Walls, Phan, & Berrone, 2011). Environmental performance is an integrated system concept that also includes financial and management performance and its impact on the social economy. It can not only reflect the actual level of coordinated development of economic and environmental systems, but also needs to reflect the government's ability to meet a series of pollution control and natural resource management challenges (F. M. Deng, Y. A. Jin, M. Ye, & S. Y. Zheng, 2019; Wendling, 2018). Therefore, this paper studies the interrelated environmental performance influence between companies, industries and governments. This will be helpful to systematically analyze the influencing factors of environmental performance at different levels.

On the other hand, national education levels have been documented to play a fundamental role in environmental performance. The political system and population density are also relevant factors (Fiorino, 2011; Gallego-Alvarez, Garcia-Rubio, &

Martinez-Ferrero, 2018; Gallegoalvarez, Vicentegalindo, Galindovillardon, & Rodriguezrosa, 2014). Other factors that influence environmental performance include per capita GDP, industrial structure and level of economic development (Guo, Zhu, Wu, & Yan, 2017; Kumar, Giridhar, & Sadarangani, 2019; Song, Zhang, Fang, & Zhang, 2016). There is also evidence that regulatory pressure by the government to strengthen environmental supervision and law enforcement can improve companies' environmental performance. In addition, the government's increased investment in environmental protection is expected to improve environmental performance (F. M. Deng et al., 2019; J. H. Sun, Hu, Yan, Liu, & Shi, 2012; R. X. Wang, Wijen, & Heugens, 2018).

Additionally, companies' social responsibility, strategy and innovation practices condition their environmental performance (Dilla, Janvrin, Perkins, & Raschke, 2019; Jin, Du, Long, & Boamah, 2019; Long, Chen, Du, Oh, & Han, 2017; Song, Song, An, & Yu, 2013). There is also evidence that public participation and public awareness of environmental protection can also have a positive impact on environmental performance (F. M. Deng et al., 2019; Song et al., 2013; Wu, Xu, & Zhang, 2018).

It is clear then that the number of factors influencing environmental performance keeps growing, but in view of their differences and heterogeneity, it is necessary to explore them systematically. This systematic identification will help understand better how these multiple factors interact with each other and eventually improve environmental performance.

Hence, the purpose of this study is to identify combinations of environmental performance influencing factors and how they can be incorporated in research agendas. In doing so, the paper uses a bibliometric metanalysis and describes the current status of environmental performance impact studies. Additionally, the paper provides solid documentary evidence that can help establish future research agendas.

The rest of this article is organized as follows. The next section describes how systematic literature review was conducted and the collected data from environmental performance-related (EP-related) documents. The third section provides some descriptive statistics of the literature review (e.g. journals that have published relevant

studies, article citations, and a keyword analysis of papers). The fourth section uses grounded theory to carry out a content analysis and classify the influencing factors into major research streams. A discussion of the previous classification is then provided and some approaches to improve environmental performance under a future research agenda. The last section includes the conclusions and idntifies some research limitations.

2. Methodology

2.1 Research Framework

A systematic literature review is a means of identifying, evaluating and interpreting existing research relevant to a particular research question, topic area, or problem of interest (Kitchenham, 2004). Bibliometrics is one of the most common methods used to perform systematic literature reviews as it is cheap, objective, and informative. With the aid of bibliometric statistical tools (e.g., HistCite, VOSviewer, and Citespace), data analysis methods allow metrological analyses, co-occurrence analyses, and cluster analyses as well as varied visual data representations (Linnenluecke, Marrone, & Singh, 2019; Mingers & Leydesdorff, 2015).

This paper performs a bibliometric analysis but also collects literature based on grounded theory to carry out qualitative analysis of the influencing factors of EP. Grounded theory refers to the method of constructing the theory from the bottom-up by summarizing and analyzing the basis of systematic data collection (Glaser, Strauss, & Strutzel, 1968). The combination of these methods reduces subjectivity while improving the representativeness of the research results. The research framework is summarized in Fig. 1.

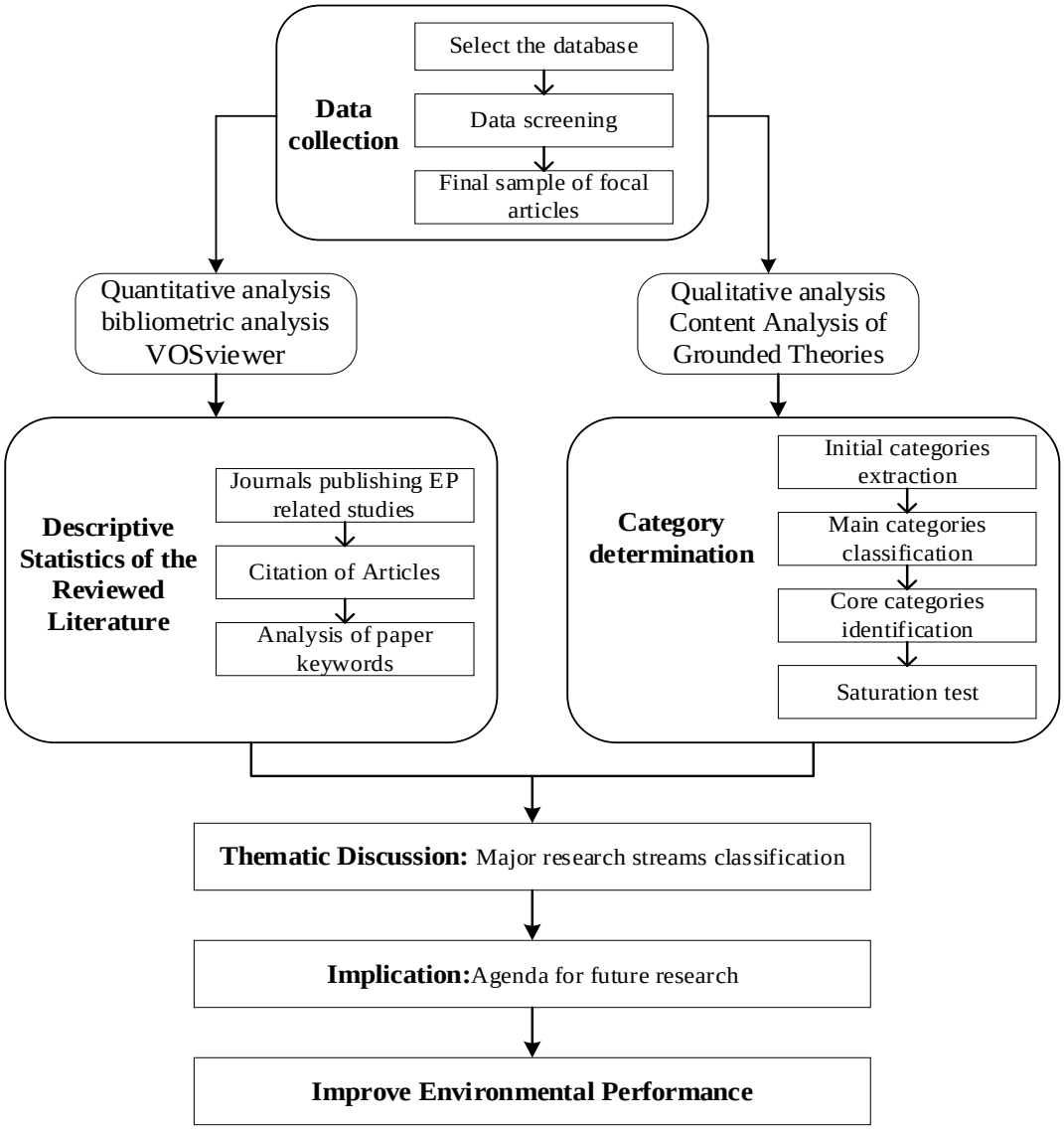

Fig.1. Research Framework

2.2 Data collection

The data in this study are peer-reviewed literature from the Web Of Science, Science Direct, Scopus, Emerald and other databases from 2004 to 2019. In order to obtain relevant documents, we resorted to a multiple keywords combination of "sustainable development", "environment", "performance", "management", "governance", "quality", "effect", "protection", “efficiency”. A total of 702 papers were obtained from the preliminary search. After reading the titles and abstract, papers not related to this research were excluded. Eventually, 84 papers were retained for further analysis. Data collection process as shown in Appendix A.

3. Descriptive Statistics of the Literature review

3.1 Journals publishing EP-related studies

3.1.1 Distribution of published papers

First, we observed the annual publication rate and annual citations of the 84 articles as shown in Fig.2. It can be seen on the leftmost graph that, although the retrieval time spanned from 2004 to 2019, the earliest document was not published until 2010. This indicates that serious studies of environmental performance started in 2010, and have been increasing since. It can also be seen that environmental performance is still a popular topic in academic research.

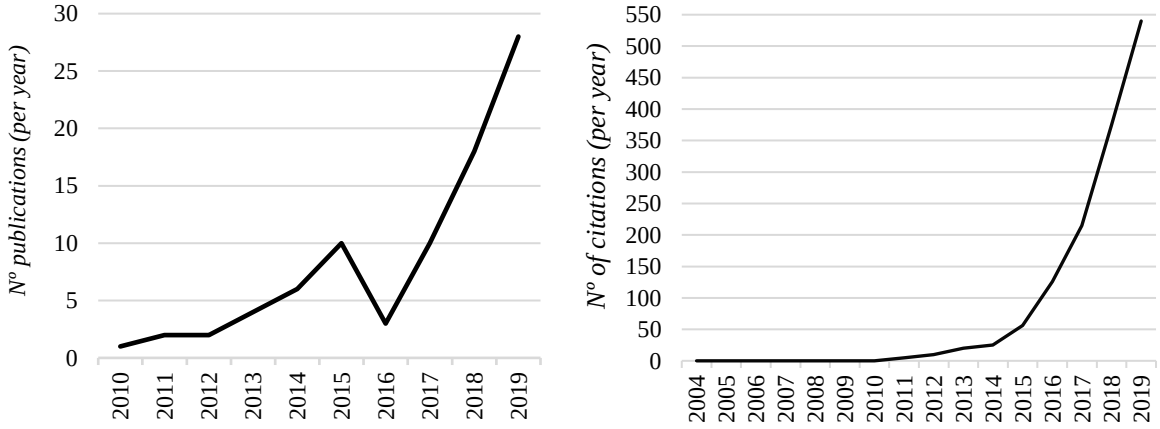

Fig.2. Yearly publications and citations of the papers identified in this review (2004-2019)

3.1.2 Most influential journals

The 84 retrieved articles were published in 16 journals. By calculating the relative frequency of papers published in these journals we found that the two most prominent journals were *Journal of Cleaner Production* (20.24%) and *Sustainability* (17.86%). The third and fourth place were occupied by *Business Strategy and the Environment* and the *Journal of Environmental Management* (with 4.76% of papers each).

Additionally, through the analysis with VOSviewer shown in Appendix B, we could analyze which journals cited which. In that graph, the distance between any two journals roughly indicates the relevance of the journals in terms of co-cited links. Hence,

the closer the distance between two journals, the stronger their kinship. For example, the *Journal of Cleaner Production* and *Business Strategy and the Environment* are very close. This indicates that the topics of the articles published by the two journals are close and co-cited articles are also quite similar.

VOSviewer software was also used to analyze the Total link strength, Number of articles, Total citations (received), Average publication years, Average citations, and Average normalized citations of journals. Overall, the total link strength, number of articles, and total citations can be used as quantitative indicators to measure a journal's productivity. Average citations and Average normalized citations serve as qualitative indices that measure the impact of the articles published in the journals (Liu, Dong, & Shen, 2020). Table 1 lists the data information of the top 10 journals, according to which, the most influential journal in this field has been the *Journal of Cleaner Production*, as it published most articles with a high average value of normalized citations.

Table 1
Number of journals identified in this review

Journal name	Nº of articles	Total Link Strength	Total Citations	Avg. Citations	Avg. Norm. Citations	Avg. Pub. Year
Journal of Cleaner Production	17	17	478	28	1.29	2016
Sustainability	15	9	119	8	0.38	2017
Business Strategy and the Environment	4	1	70	17.5	1.83	2018
Journal of Environmental Management	4	2	68	17	1.01	2017
Ecological Indicators	2	2	92	46	0.98	2015
International Journal of Production Economics	2	2	97	98.5	2.25	2014
Journal of Business Ethics	2	2	38	19	2.59	2018
Technological Forecasting and Social Change	2	2	16	8	2.7	2019
International Journal of Environmental Research and Public Health	3	2	6	2	0.68	2019
Human and Ecological Risk Assessment	2	1	15	7.5	0.23	2016

3.2 Citation of Articles

According to the Web of Science citations, Table 2 lists the top 10 most cited articles. Chiou et al. (2011) is ranked first with 283 times cited, followed by Dubey et

al. (2015) and Testa et al. (2014) with 183 and 104 times cited, respectively. However, we must consider in this comparison that older papers have more time to be cited than more recent papers.

Chiou et al. (Chiou, Chan, Lettice, & Chung, 2011) discussed the relationship between green supply chain, green innovation, environmental performance and competitive advantage. Their results showed that green innovation makes suppliers improve their environmental performance and gives them some competitive advantage. Dubey et al. (Dubey, Gunasekaran, & Ali, 2015) found that total quality management and supplier relationship management had a positive impact on enterprise environmental performance. Testa et al. (Testa et al., 2014) on the other hand, studied the impact of environmental management systems (ISO 14001 and EMAS) on environmental performance in energy-intensive industries.

Hence, this very preliminary descriptive analysis of the three most cited articles indicates that the influence of supply chain and total quality management, green innovation and environmental management systems on EP are some of the current research focus.

Table 2

10 Most-Cited Articles in this review

Rank	Article title	Citations	Author
1	The influence of greening the suppliers and green innovation on environmental performance and competitive advantage in Taiwan	283	Chiou et al (Chiou et al., 2011)
2	Exploring the relationship between leadership, operational practices, institutional pressures and environmental performance: A framework for green supply chain	183	Dubey et al (Dubey et al., 2015)
3	EMAS and ISO 14001: the differences in effectively improving environmental performance	104	Testa et al (Testa et al., 2014)
4	A performance evaluation of the energy, environmental, and economic efficiency and productivity in China: An application of global data envelopment analysis	84	Z. Wang & Feng (Z. Wang & Feng, 2015)
5	Evaluation of regional environmental efficiencies in China based on super-efficiency-DEA	81	Yang, Ouyang, Fang, Ye, & Zhang (Yang, Ouyang, Fang, Ye, & Zhang, 2015)
6	Environmental innovation practices and performance: moderating effect of resource commitment	80	Y. N. Li (Y. N. Li, 2014)

7	Effects of Green Innovation on Environmental and Corporate Performance: A Stakeholder Perspective	62	Weng, Chen, & Chen (Weng, Chen, & Chen, 2015)
8	How environmental management driving forces affect environmental and economic performance of SMEs: a study in the Northern China district	59	Zeng et al (Zeng et al., 2011)
9	The relationship between corporate environmental performance and environmental disclosure: An empirical study in China	51	Meng, Zeng, Shi, Qi, & Zhang (Meng, Zeng, Shi, Qi, & Zhang, 2014)
10	Eco-innovation, sustainable supply chains and environmental performance in European industries	45	Costantini, Crespi, Marin, & Paglialunga (Costantini, Crespi, Marin, & Paglialunga, 2017)

3.3 Analysis of paper keywords

Keywords encompass some of the most common subjects, words and core concepts of a paper. Keywords can be analyzed, summarized and classified to understand the research field and research focus of each paper (or a group of papers) (Liao, Deschamps, Loures, & Ramos, 2017). VOSviewer keyword analysis was used to identify a total of 553 keywords found in the 84 papers. As an arbitrary relevance threshold, the minimum frequency of appearance of a keyword was set to 6. 26 keywords met this criterion and they were divided into 3 clusters with 202 links. A summary of this analysis can be found in Appendix C. The three major clusters were:

- Quantitative analysis of EP influencing relationships (Red node, 10 keywords). This focuses on the influence of policy on environmental performance (Kerret & Shvartzvald, 2012). The most common research methods were Confirmatory Factor Analysis (CFA) and Structural Equation Modeling (SEM).
- EP research of Chinese companies (Blue node, 8 keywords). Most articles took Chinese companies as examples. They studied how corporate strategy (F. M. Deng et al., 2019), innovation (Long et al., 2017), social responsibility (F. M. Deng et al., 2019), governance (Răchișan, Bota-Avram, Raluca, & Grosanu, 2015) and green supply chain management (Feng et al., 2018) impact on EP.
- Research into the influencing factors of global companies (Green node, 8 keywords). Aspects of these papers paid attention to the driving factors that improve a

company's EP. Most studies emphasized the strong relationship between environmental performance and economic performance. They also analyzed the relationship between company performance, competitive advantage (Ardito & Dangelico, 2018; Chiou et al., 2011; Shi, Qiao, Shao, & Wang, 2019), the company's strategy, green innovation, and supply chain management with EP (Corsini, Appio, & Frey, 2019; Feng et al., 2018; Weng et al., 2015).

4. Category determination

4.1 Initial extraction of categories

The grounded theory approach divides the coding process into three stages: *open coding*, to identify concepts and categories; *axial coding*, to refine categories and attributes; and *selective coding*, for category integration (Given, 2008). In this study, the 84 articles were imported into Nvivo software and coded. The contents of each article were read through, and the sentences relating to EP influencing factors were extracted to identify their coding. Through the repeated review of the data, sentences not relevant to EP were removed, while key sentences were narrowed down. Eventually, 404 sentences and 38 open codes were obtained. Table 3 shows some representative examples (all cannot be shown due to space limitations). According to the definition of open encoding and the generic relationship between encoding and decoding, 20 initial categories are obtained as shown in Appendix D.

Table 3

Examples of the open decoding results of the initial factors of environmental performance

number	Typical sentences in the literature	Open decoding
1	Organizational culture has a positive impact on environmental performance.	Organizational culture
2	There are positive and negative correlation between per capita GDP and population growth rate in environmental performance	Per capita GDP Population growth rate
3	There is a statistically significant correlation between positive environmental strategies and economic and environmental performance.	Environmental strategies
4	There is a positive correlation between education level and environmental performance in a country.	Education level

5	The role of regulatory pressure from multiple authorities in improving performance and the role of autonomy enjoyed by local governments in weakening performance.	Environmental regulation
6	Changes in environmental performance are attributable to technological progress.	Technological progress

4.2 Classification of the main categories

The second stage is the axial spindle coding, which preliminarily classifies the categories identified in the previous stage. According to an in-depth analysis of the categories' relationships and attributes, the 20 initial categories were clustered into 17 tree nodes as shown in Appendix E. This initial clustering highlights the connections between the categories and allows the creation of some hierarchical and logical trees.

4.3 Identification of the core categories

The third stage is the selective coding for category integration. After a repeated review of the category attributes of the 17 spindle codes, they were integrated into 5 categories of enterprise, government, society, economy and technology (see Table 4).

Table 4

Core categories of environmental performance

Number	Core category	Main category
1	Enterprise	Corporate Environmental Strategy Corporate culture Characteristics of corporate executives Corporate economic performance Environmental information disclosure
2	Government	Environmental supervision Environmental regulation Government performance appraisal Government environmental investment Regime type
3	Society	Public participation Level of education Population size and growth rate
4	Economic	Economic development Industrial structure
5	Technology	Technical progress Technological innovations

4.4 Saturation test

The saturation test involved 10 journal papers randomly reserved before coding. When the remaining 74 papers were encoded, the remaining 10 papers were re-coded. On performing this operation, it was found that all the existing codes and categories coincided. That is, there was no new code related to the topic of the study, which meant that theoretical saturation was achieved (Glaser et al., 1968).

5. Discussion: classification of major research streams

This study systematically analyzed 84 articles published in 16 journals between 2004 and 2019. It was found that environmental performance (EP) has only attracted academic attention in the last decade, but this has been increasing. According to the bibliometric analysis and grounded theory, current research into EP influencing factors is divided in five categories of enterprise factors, government factors, economic factors, social factors and technical factors. Delving into these research categories can clarify research priorities, systematically and comprehensively identify the EP influencing factors, and propose measures for improvement.

5.1 Enterprise streams

The enterprise factors include: corporate environmental strategy, corporate culture, corporate economic performance, environmental information disclosure and corporate executive characteristics (see Fig. 3).

5.1.1 Executive characteristics

Studies have shown that differences in the attributes of corporate executives have an important impact on corporate EP (Ma, Zhang, Yin, & Wang, 2019). Similarly, Shahab et al.'s (Shahab et al., 2020) research found that chief executive officer attributes also have different effects on the company's EP. For example, a research background, financial expertise, overseas experience, and older CEOs have a positive relationship with continuous performance and EP improvement. In addition to the self-attributes of senior executives, the difference in executive compensation between various companies also affects EP. That is, high salaries encourage executives to pay

more attention to environmental activities and improve EP (Haque & Ntim, 2018; Zou, Zeng, Xie, & Zeng, 2015).

5.1.2 Corporate environmental strategy

The enterprise strategy mostly involves the environment strategy, environment management, and environment behavior. For example, Zeng et al. (Zeng et al., 2011) pointed out that market drivers have a significant impact on polluting SMEs to improve their corporate environmental performance. At the same time, some studies have shown that positive environmental strategies can help improve EP (Ardito & Dangelico, 2018; Corsini et al., 2019; F. Deng, Y. Jin, M. Ye, & S. Zheng, 2019; Payansanchez, Perezvalls, & Plazaubeda, 2019; Peng, Tu, Elahi, & Wei, 2018). Additionally, some studies have found that supply chain integration (Yubing Yu, Zhang, & Huo, 2017), governance mechanisms and objectives (Dahlmann, Branicki, & Brammer, 2019; Haque & Ntim, 2018), environmental management systems (Ardito & Dangelico, 2018), and green human resource management (S. Zhang, Wang, & Zhao, 2019) are significantly and positively correlated with environmental performance.

Hence, strengthening the internal environmental management of an enterprise can improve its EP. However, enterprises not only need to focus on management and strategy, but also need to materialize it in behaviors to achieve the purpose of improving EP. In our analysis of corporate environmental behavior, innovative behaviors (i.e. management innovation behavior, technological innovation behavior, and environmental innovation practice) produced the greatest impacts on EP (Jin et al., 2019; Y. N. Li, 2014). Similarly, companies that cultivate employees' environmental capabilities through environmental training and the way companies cooperate with suppliers, also plays an important role in reducing pollution, reducing costs, and improving EP (Golgeci, Gligor, Tatoglu, & Arda, 2019; Singh, Chen, Giudice, & Elkassar, 2019). All the above indicates that the corporate environmental strategy is a key factor affecting environmental performance.

5.1.3 Corporate culture

Sometimes conceived as soft power, corporate culture can equally affect the behavior of organizations and employees. Corporate culture is also important for EP.

Di et al. (Di, Yiqin, Dan, & Caimei, 2017) point out that the two dimensions of corporate culture (ethical social culture and emotional development culture) have a positive impact on corporate EP. Magsi et al.'s (Magsi, Ong, Ho, & Hassan, 2018) research found that companies combining their organizational culture with an environmental culture also have a bigger impact on EP. In addition, enterprises that require other enterprises they work with to assume the responsibility of protecting the environment boost their EP and achieve a more sustainable management of the enterprise (Chuang & Huang, 2018).

5.1.4 Environmental information disclosure

As one of the main pollutant emissors, enterprises are an important cause of environmental problems. Enterprises are generally required to disclose their performance on environmental issues. The main factors affecting the actual EP of a company involve regional and environmental disclosure (Bednarova, Klimko, & Rievajova, 2019). Li et al. (D. Li, Zhao, Sun, & Yin, 2017) point out that environmental performance and environmental information disclosure follow a U-shaped nonlinear relationship. When EP is low or high, companies generally disclose more environmental information. In contrast, when EP is fair, companies usually lack the pressure and motivation to disclose their environmental-related information. Strengthening the disclosure of corporate environmental information, therefore, can encourage companies to improve their EP.

5.1.5 Corporate economic performance

The ultimate purpose of an enterprise is to increase its economic performance. However, in the current global environmental crisis, companies cannot blindly pursue economic performance while neglecting environmental performance. Enterprises with high asset-liability ratios have a negative impact on environmental performance due to cost issues and insufficient investment in technical capital. Conversely, companies with a higher economic performance raise environmental protection investment and improve EP. Moreover good corporate environmental performance will enhance the company's market competitiveness and reputation. This in turn will have a positive impact on its economic performance (F. M. Deng et al., 2019; Zeng et al., 2011).

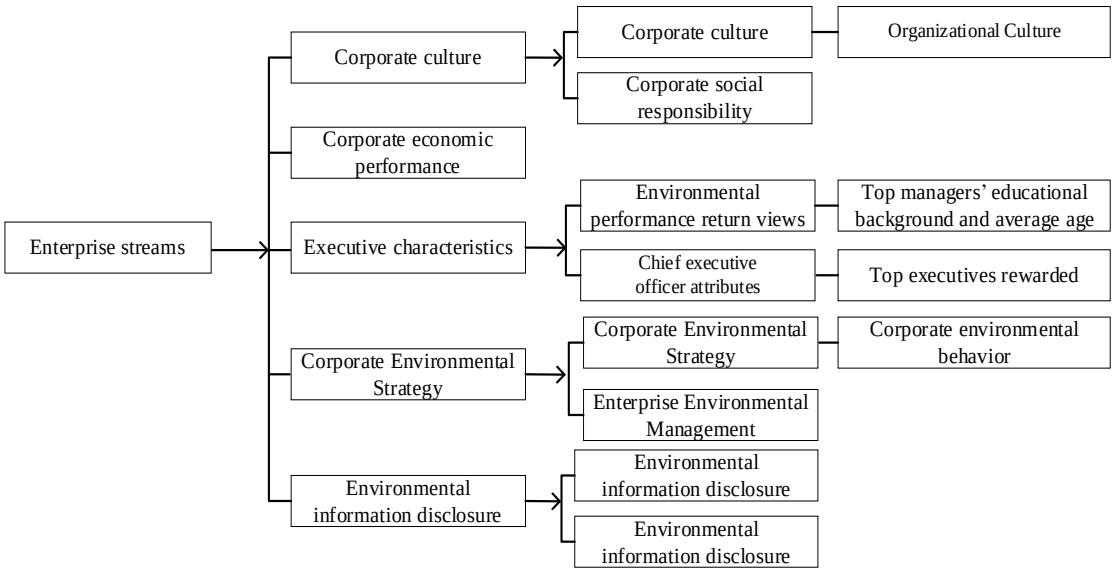

Fig.3. Corporate streams system

5.2 Government streams

Government factors include the type of government, government environmental supervision, environmental regulation, government environmental protection investment, and government performance assessment (see Fig. 4).

5.2.1 Regime type

Environmental issues are now a strategic challenge that all countries have to face. Effective government is necessary for countries to achieve sustainable development. As Gallego-Alvarez et al (Gallego-Alvarez et al., 2018)point out, the type of national political system has different effects on environmental performance. Autocratic regimes exhibit lower environmental performance than democratic regimes because of the low availability of information. In addition, countries with high levels of democracy, freedom and transparency evidence higher EP (Dkhili & Dhiab, 2019; Gallegoalvarez et al., 2014).

5.2.2 Government environmental supervision

Strengthening environmental supervision is a good approach to identify and solve (or at least reduce) environmental problems. A series of government environmental monitoring methods have been shown to affect EP. Some studies also found that the regulatory pressure of the government affects EP. For example, strengthening environmental management audits, environmental monitoring and law enforcement

prompt polluting enterprises to take environmental actions to improve their EP (F. M. Deng et al., 2019; R. X. Wang et al., 2018). Hence, environmental inspection can be used as an effective tool to overcome environmental problems and improve EP in the long term (Jia & Chen, 2019). Establishing a scientific environmental performance evaluation system can help the regulatory body and the regulatory object to clarify the difference between environmental pollution consequences and environmental goals. This allows taking corresponding measures to achieve the environmental goals, which is the basis for improving EP (Guo et al., 2017).

5.2.3 Environmental regulation

The global environment is rapidly deteriorating and the formulation and implementation of global environmental regulations affect environment's quality. Research shows that implementing environmental policies (e.g. the Climate Change Act) has a positive impact on EP. It is also recommended that climate-related environmental regulations include appraisable sustainability goals to reduce greenhouse gas emissions (Haque & Ntim, 2018). For example, He et al. (He et al., 2019) point out that the implementation of carbon tax can raise the environmental awareness of enterprises, and reduce their carbon dioxide emissions. Similarly, Shi et al. (Shi et al., 2019) found that the implementation of a pollutant charges policy promoted higher resource utilization efficiency, improved air quality, and simultaneously achieved EP and economic growth. This confirms the double dividend of environmental taxes.

5.2.4 Government investment in environmental protection

Government environmental protection investment includes direct environmental protection capital investment, government incentives, and environmental subsidies. Sun et al. (J. H. Sun et al., 2012) evaluated and ranked the dynamic performance of eight regions in Western China. Their results showed that even in regions with a higher EP, this performance decreases after reducing environmental protection investment. For companies, government incentives and government support encourage them to actively participate in environmental management activities, and effectively improve their environmental control and EP (Zeng et al., 2011). Ren et al.'s (Ren, He, Zhang, &

Chen, 2019) research found that China's implementation of the government's environmental subsidy program significantly improved EP by participating in environmental protection activities.

5.2.5 Government performance appraisal

As the main body for EP evaluation, the government should also have a mission and sense of responsibility for environmental protection when performing its duties. One of the most important environmental governance tools is performance appraisal, but it is unscientific to rely solely on top-down performance appraisal. In this vein, government officials are susceptible to political promotion motivations. Hence, performance evaluation methods should be integral and wide-ranging. Environmental performance indicators, for example, must be included in evaluation systems, and public communication and supervision mechanisms between the public and multiple government departments need to be strengthened (Wu et al., 2018; P. Zhang & Wu, 2018).

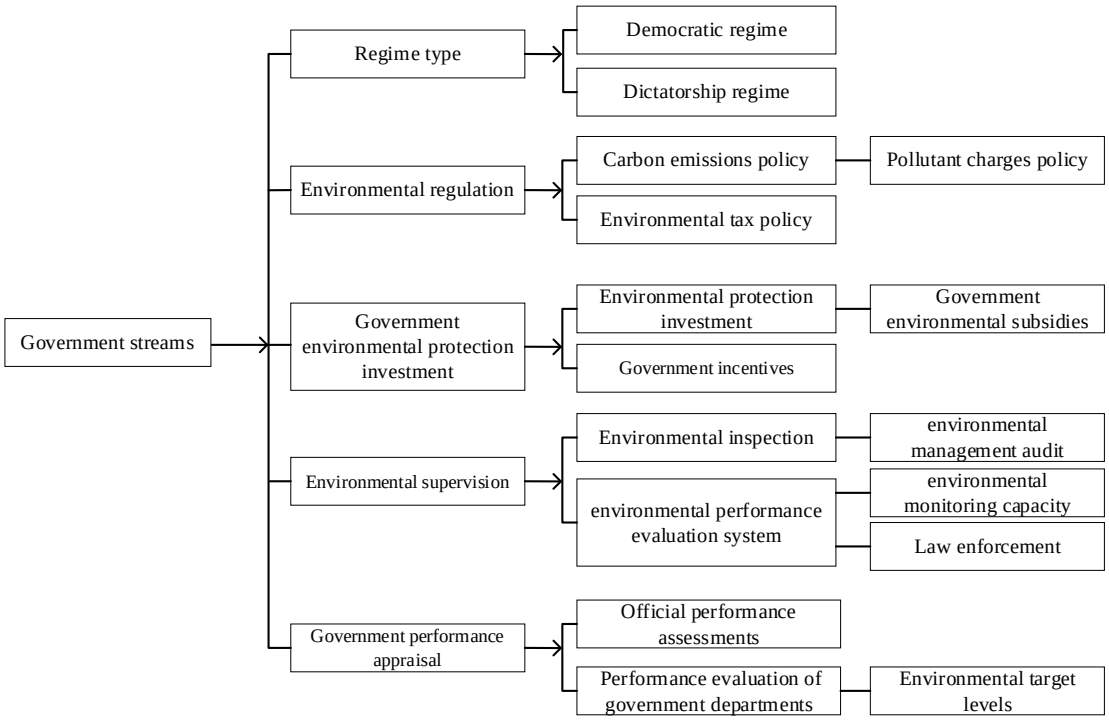

Fig.4. Government streams system

5.3 Economic streams

Economic factors include economic development and industrial structure (see Fig.5). Some studies have shown that a country's economic development positively affects EP (Song et al., 2016; Yang et al., 2015; Yanni Yu & Choi, 2015). Per capita GDP is used as a national economic indicator to represent national income levels. Studies have shown that countries with a higher per capita GDP have higher EP. Economic strength also solves some environmental problems, because these countries have more financial resources to invest in pollution control and environmentally-friendly technologies (Gallegoalvarez et al., 2014; Jain & Jain, 2016; Kumar et al., 2019).

Foreign direct investment is also significant for economic development. Li et al. (Z. Li, Dong, Huang, & Failler, 2019) point out that the both foreign direct investment and the establishment of strict foreign direct investment entry standards can improve EP. Hence, economic development helps protect the environment, but extensive economic growth can also create low resource utilization rates and environmental pollution issues. It is necessary to shift the economic growth mode and pay attention to environmental protection to obtain high environmental efficiency and better EP (Song et al., 2013). To obtain better EP, companies need to invest in social capital and take advantage of it by environmental collaboration (Golgeci et al., 2019).

Industrial structure and industrial agglomeration are other factors that affect economic growth. Similarly, industrial structure and industrial agglomeration can also have different effects on the environment. Wang et al. (Y. Wang & Wang, 2019) used environmental efficiency to measure environmental performance. Their empirical research found that industrial agglomeration and environmental efficiency have a U-shaped relationship. This means environmental efficiency decreases in the early stages of industrial agglomeration, but improves in the later stages. Song et al. (Song et al., 2013) also point out that the proportion of industry in the GDP has a significant negative impact on environmental efficiency. They suggested that the development of the tertiary

industry should optimize industrial structure, as progress of the industrial structure can reduce the intensity of pollution.

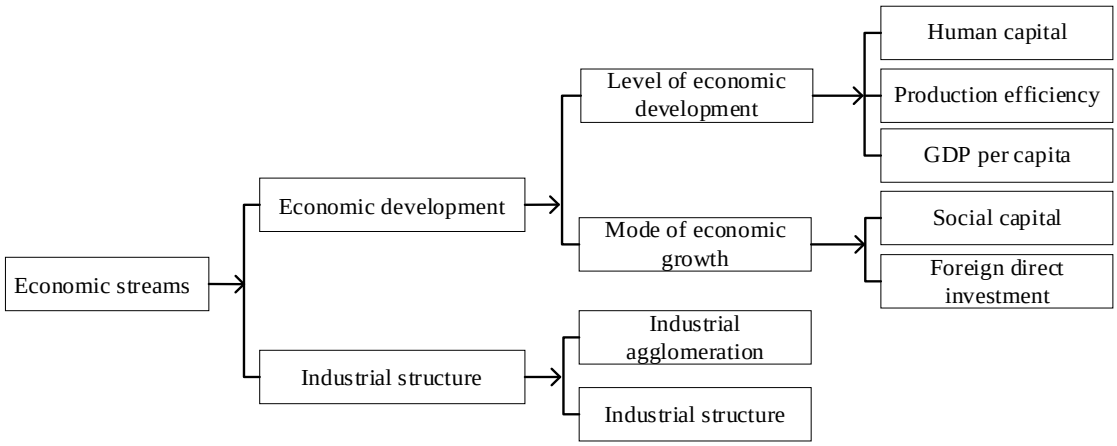

Fig. 5. Economic streams system

5.4 Society streams

Social factors include public participation, education level, population size and growth rate, as shown in Fig. 6. As the main body of the society, the public also is the major environmental stakeholder. It needs to play a decisive role in improving the environment and be conducive to more sustainable development.

Hence, as an effective means of environmental governance, public participation is significantly related to the discharge of non-binding environmental pollutants (e.g. industrial wastewater) (Wu et al., 2018). Generally, the greater the number of social petitions, the worse is the environmental performance of a region. Cheng et al.'s (Cheng & Liu, 2018) research found that most companies pay attention to public reputation, and as public attention shifts towards them, they will significantly improve their EP. Analogously, the stronger the public's awareness of environmental protection, the more actively enterprises will take care of the environment, and help the government to formulate more scientific environmental regulations (F. M. Deng et al., 2019).

National cultural and educational level are also important factors. It has been found that education level is a decisive factor for the EP of a country (Gallego-Alvarez et al., 2018; Gallegoalvarez et al., 2014). Similarly, Kumar et al (Kumar et al., 2019) discussed the strong relationship between national culture and EP. For example,

individualism, uncertainty avoidance, and long-term orientation in the cultural dimension positively affect environmental performance. Conversely, power distance achieves the opposite. Finally, more organizations are currently required to implement environmental ethics. Environmental ethics encourages managers to coordinate the balance between business, society, and nature. Eventually, they also help improve EP (Singh et al., 2019).

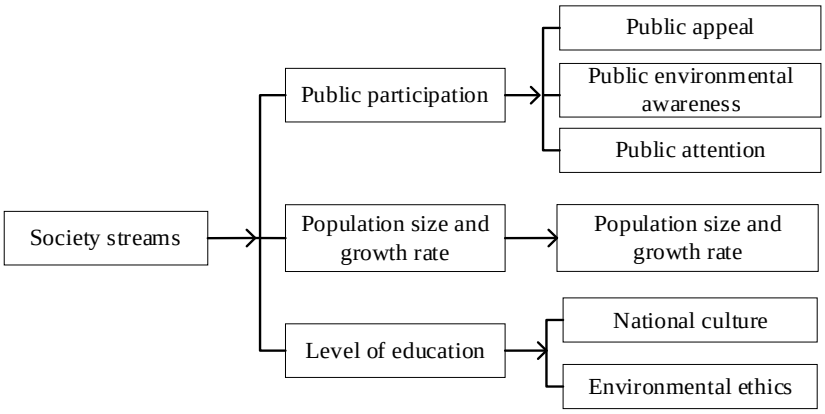

Fig. 6. Society streams system

5.5 Technology streams

The impact of technology on environmental performance is mainly divided into technological progress and technological innovation, as shown in Fig. 7. For example, Wang et al. (Z. Wang & Feng, 2015) point out that technological progress has been the most powerful factor for China's energy, environmental, and economic efficiency growth. However, technological progress not only promotes EP, but also reduces the intensity of pollutant emissions. Advances in manufacturing technology and sewage technology play a key role in this. In this vein, Song et al. (Song et al., 2016) evaluated the operational and environmental performance of three regions in China. They found that the Eastern region outperformed the others because of its higher economic development, environmental management practices, and cleaner energy technologies. Sun et al.'s (Z. Sun, An, & Sun, 2018) research found that changes in energy and EP are mainly attributed to technological progress. This progress can be broken down into changes in technical efficiency and technological changes. Both promote the exchange of technical experience, which is conducive to closing the gap in EP. In addition to technology sharing, technological progress can also be achieved through technology

introduction and technological innovation. Namely, technological innovation can improve energy efficiency, reduce pollutant emissions, and eventually increase EP (Ai, Deng, & Yang, 2015).

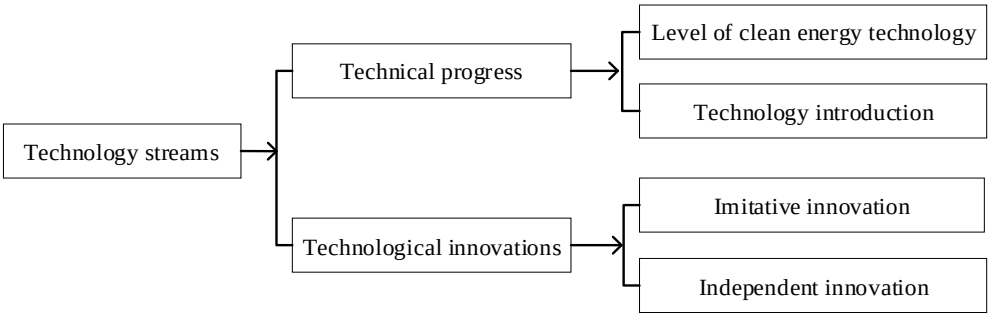

Fig. 7. Technology streams system

6. Agenda for future research

Environmental pollution has become a global problem and is attracting significant research attention. Based on the metareview literature above, a research agenda is formulated here to highlight current knowledge gaps and suggestions for future research.

6.1 Application of advanced technology for environmental performance

The previous technology section has shown that technology plays a leading role in improving EP. Common indicators for measuring technology progress are patent data, technology investment, and technical personnel. However, the application of advanced technologies in the field of environmental protection is still in its very early stages. To date, pollution problems, deficient monitoring techniques, and low-efficiency environmental governance have led to low EP. However, a new generation of advanced technologies (such as artificial intelligence, big data, Internet of Things, 5G, and cloud computing) can substantially facilitate the retrieval of environmental data. These data will strengthen law enforcement, offer a better emergency response to environmental sanitation problems, allow instantaneous pollution monitoring and control, etc. All these possibilities are expected to reduce environmental protection costs, improve environmental monitoring quality and monitoring efficiency.

6.2 Cross-regional environmental collaboration

Cross-regional environmental collaboration provides an effective means of improving EP. Environmental issues are not limited to a certain area, but involve multi-regional joint law enforcement. However, there is currently insufficient research into cross-regional environmental collaboration (Golgeci et al., 2019). Unfortunately, there is usually a lack of trust and disputes between regions due to the complexity of the collaboration dynamics when addressing joint environmental problems. Hence, a necessary path to explore seems to be to strengthen regional collaboration, share environmental information between regions, and jointly address environmental problems.

6.3 Third-party supervision

Third-party supervision refers to an institution that is established and operates separately from the government and environmental protection organizations. Its purpose is to scientifically formulate annual EP targets and measure progress towards them. The failure of the government in the process of environmental supervision is manifested in local protectionism. Traditionally, in order to accomplish other economic goals, local governments have reduced their supervision. This has resulted in many environmental pollution problems going unnoticed. The establishment of third-party supervisory organizations may support the government's environmental supervision tasks in a timely manner. It may also encourage companies to actively reduce pollutant emissions and improve their environmental management. Overall, the creation of a third-party supervisory organization to assess EP impartially, objectively, transparently and scientifically could be conducive to enhancing the social credibility of environmental management.

6.4 Scope of environmental performance research

All countries need to try to meet 2030 global sustainable development goals. Most of the studies of EP have focused on enterprises, industries, regions, and countries. Yet, the 2018 Global Environmental Performance Index (EPI) report (Wendling, 2018) showed that the gap between EPI scores and regional rankings between countries is significant. Hence, future research needs to also focus on how to remove current

inequalities at the regional, national, and even continent level. This research will involve some complexities as it will need to consider current heterogeneities in economic, energy and industrial structures between regions.

6.5 Measures to improve environmental performance

Core research into improving EP has been mostly focused on formulating corporate environmental management measures and making policy recommendations. There are hardly any 'systematic' measures aimed at improving EP, which is why future research should include the innovation of environmental supervision measures. These measures should enable long-term effective and scientific supervision mechanisms, and provide environmental protection for sustainable economic and social development.

6.6 Improve the level of environmental education

A country's education level and the public's environmental awareness have a positive impact on EP. However, existing research mainly proposes strengthening, and paying attention to, national education, as the level of a country's education determines the country's level of scientific and technological development, and innovation capabilities. The level of public awareness of environmental protection on the other hand, directly affects the effectiveness of environmental protection. The main way to improve public environmental awareness and cultivate citizens' environmental involvement is to include environmental education in the academic curriculum. Therefore, new environmental education methods need to be explored, involving the formulation of a new framework and knowledge system for environmental education.

6.7 Environmental protection investment

The level of economic development has a positive impact on EP. Higher economic development allows more instruments and equipment to be purchased, introducing greener technologies and guaranteeing financial support for specialized personnel. However, at present most of environmental protection investments are from the government. Research attention needs to be paid to the alternative generation, use and effectiveness of special funds for ecological environmental protection. The adequate and effective use of environmental protection funds, either from governments or the

public, constitute an economic guarantee for addressing the environmental problems that most worry people (e.g. air pollution, soil pollution, and water pollution).

7. Conclusion

With environmental pollution becoming a global challenge, the study of environmental performance has attracted great attention from academia, governments, and companies. Improving environmental performance has a positive impact on global sustainable development. In this paper, five research streams have been identified through a systematic literature review. This systematic review has identified the most relevant factors influencing environmental performance while providing new directions for future research. The development of this future research agenda will clarify existing trends and gaps in environmental performance.

In this paper, articles have been retrieved from the Web Of Science, Science Direct, Scopus and Emerald databases. After filtering the initial dataset of papers, 84 articles concerning environmental performance were obtained and analyzed by a mixture of quantitative and qualitative methods. The VOSviewer software was used to analyze the distribution of journals, citations and keyword clustering. Then, based on the grounded theory method, the filtered literature was imported into Nvivo software, and sentences related to environmental performance factors marked, coded, and their content items gradually classified. Finally, five major research topics (clusters) of enterprise, government, economy, society and technology were identified. Based on these research results, a research agenda was developed that proposed further research into such topics as advanced technology applications, cross-regional environmental collaboration, third-party supervision, re-scoping environmental performance research, measures to improve environmental performance, environmental education, and investment in environmental protection. These research results allowed us to establish the current research frontiers and knowledge gaps in environmental performance and hint at some preliminary actions to achieve global sustainable development.

A limitation of this study is the possible (unintentional) omission of some environmental performance-related documents due to the choice of keywords used. The

increasing popularity of this area may also have resulted in some relevant but very recent documents being omitted (from 2020). Therefore, it is envisaged that an updated version of this metareview may be necessary in the short term. In the meantime, we believe current research findings will bridge the knowledge gap to future research agendas and be of some assistance to the world achieving the 2030 sustainable development goals.

Acknowledgment

This research is supported by the National Natural Science Foundation of China (No.71301013) and National Social Science Fund Post-financing projects (No.19FJYB017), and this support is gratefully acknowledged.

Appendices

Appendix A

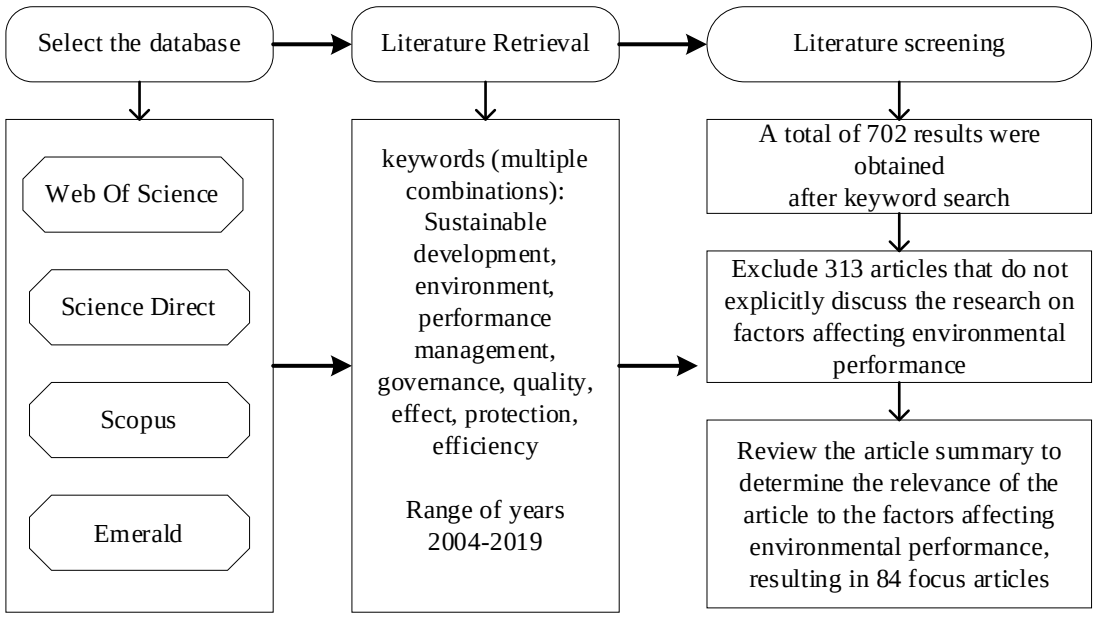

Fig. A.1 Literature retrieval and screening process

Appendix B

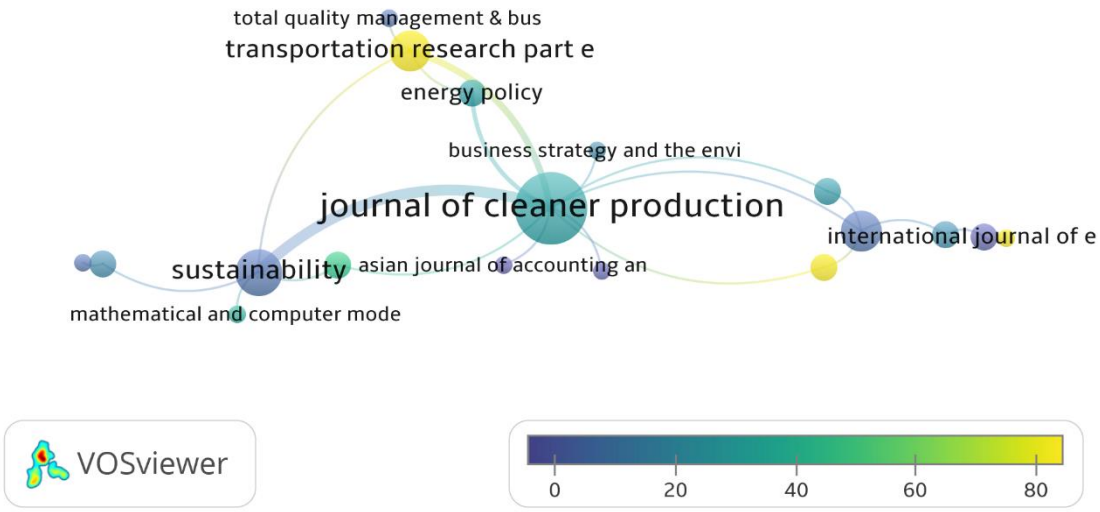

Fig. B.1 Distribution of publications and citations in the 16 journals

Appendix C

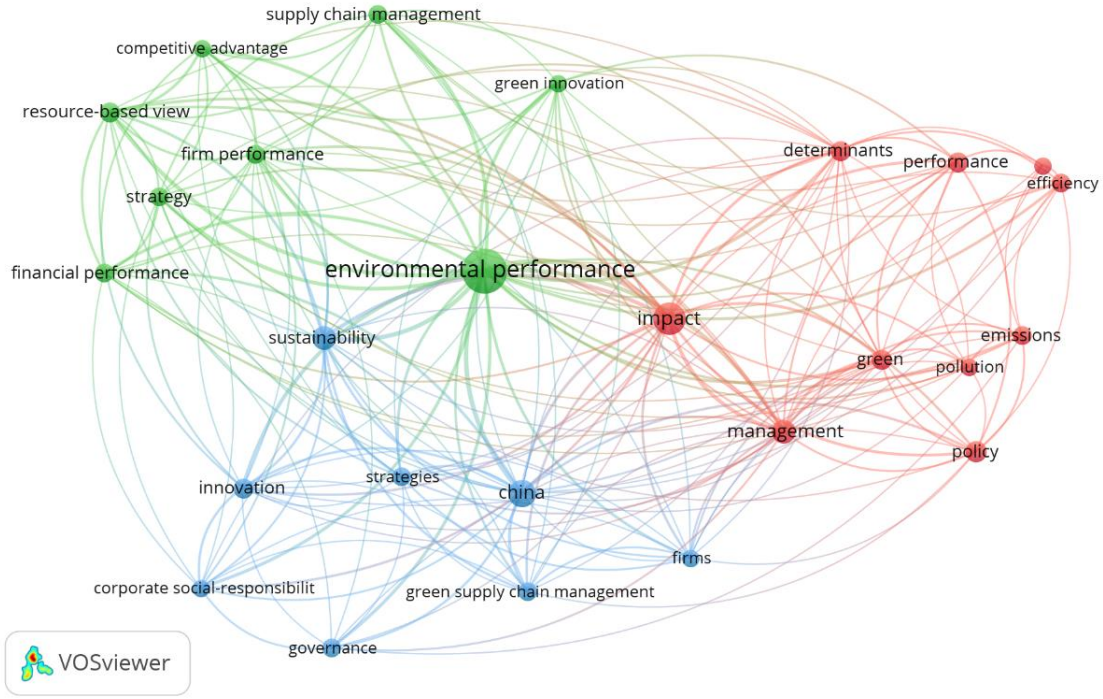

Fig. C.1 Keyword cluster analysis based on keyword classification

Appendix D:

Table D.1

Initial categories of Environmental performance

Nº	Initial category	Open decoding
1	Corporate environmental management	Green supply chain management Supply chain quality integration Corporate governance mechanisms and goals Environmental management orientation Green human resource management
2	Corporate economic performance	Economic performance Asset-liability ratio
3	Corporate culture	Corporate social responsibility Organizational culture Corporate culture
4	Characteristics of corporate executives	Top executives rewarded Environmental performance return views Chief executive officer attributes Top managers' educational background and average age
5	Environmental behavior	Management innovation behavior Technology innovation behavior Environmental training Environmental collaboration Environmental innovation practices
6	Corporate environmental strategy	Environmental strategies Clean production Market driving forces Product structure
7	Environmental supervision	Environmental protection inspection Environmental monitoring capacity Law enforcement Environmental audit Environmental performance evaluation system
8	Environmental information disclosure	Environmental disclosure Environmental information disclosure
9	Environmental regulation	Carbon emissions policy Environmental tax policy Pollutant charges policy
10	Regime type	Dictatorship regime Democracy regime
11	Government environmental protection investment	Environmental protection investment Government's environmental subsidy Government incentives
12	Government performance appraisal	Official performance assessments Performance evaluation of government departments

		Environmental target levels
13	Public participation	Public appeal Public attention Public environmental awareness
14	Level of education	Level of education National culture Environmental ethics
15	Population size and growth rate	Population size and growth rate
16	Economic development	GDP per capita Production efficiency
17	Mode of economic growth	Mode of economic growth Social capital Foreign direct Investment
18	Industrial structure	Industrial agglomeration Industrial structure
19	Technical progress	Level of clean energy technology Technology introduction
20	Technological innovations	Imitative innovation Independent innovation

Appendix E

Table E.1

Environmental performance main category

Nº	Main category	Initial category
1	Corporate Environmental Strategy	Corporate environmental strategy Corporate environmental management Environmental behavior
2	Corporate culture	Corporate culture
3	Characteristics of corporate executives	Characteristics of corporate executives
4	Corporate economic performance	Corporate economic performance
5	Environmental supervision	Government environmental supervision
6	Environmental regulation	Environmental regulation
7	Environmental information disclosure	Environmental information disclosure
8	Government performance appraisal	Government performance appraisal
9	Government environmental investment	Government environmental investment
10	Public participation	Public participation
11	Level of education	Level of education
12	Population size and growth rate	Population size and growth rate
13	Economic development	Economic development level Economic growth model
14	Industrial structure	Industrial structure
15	Technical progress	Technical progress

16	Regime type	Regime type
17	Technological innovation	Technological innovation

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