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The impact of green supply chain management on corporate environmental performance and the moderating roles: A meta-analysis

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Abstract

The adoption of Green Supply Chain Management (GSCM) and its impact on firm's performance is gaining importance in both academic and corporate fields. While past studies found a positive relationship between GSCM and Corporate Environmental Performance (CEP), there is no evidence of either which are the green practices that improve CEP the most or the moderating roles that affect such relationship. In order to provide clarity as to which tools are key in leading to a stronger CEP, this study aims to examine how GSCM relates to CEP, under the effect of several moderating roles. To that end, 166 articles published between 2001 and 2023 were included in our meta-analysis sample. Our central results reveal that the link between the variables is significantly positive, with investment recovery being the practice with the strongest impact. Moreover, it is confirmed that moderators do have an impact in this relationship. Practical implications are relevant for policy makers and upper management that is willing to introduce environmental thinking in their business strategy.

KEYWORDS
environmental performance, green practices, Green supply chain management, meta-analysis, sustainable development, sustainable supply chain management

1 | INTRODUCTION

In the present scenario where our planet is suffering dramatic consequences caused by pollution, the commitment to sustainability and Green Supply Chain Management (GSCM) in particular, is a requirement for organizations that want to improve their Corporate Environmental Performance (CEP) (Wiredu et al., 2023).

The definition of GSCM has evolved considerably over the years (see Balon, 2020; Tseng et al., 2019). Prior literature suggested that environmental strategies were single isolated actions such as green purchasing (Chen, 2005), supplier development (Seuring & Müller, 2008b), transportation (Murphy et al., 1996; Murphy & Poist, 2000) or product development (Baumann et al., 2002; Chen, 2001). The concept of GSCM emerged in order to integrate all those particular actions (Srivastava, 2007). It is also known as Sustainable Supply Chain Management (SSCM), concept that according to Beamon (1999), integrates sustainability and the traditional supply chain management through the implementation of sustainable

practices in the product cycle, with the aim of minimizing the environmental impact that arises from the supply chain. More recently, GSCM has been considered as a tool to satisfy shareholders' environmental concerns, by implementing sustainable practices in the manufacturing and distribution processes (Singh et al., 2022). It refers to the way of managing the supply chain with the aim of reducing CO_2 emissions and waste and preserving biodiversity (Tseng et al., 2019).

The implementation of GSCM is recognized as a significant strategy to improve CEP (Cousins et al., 2019; Fang & Zhang, 2018; Fu et al., 2022; Geng et al., 2017; Qorri et al., 2018; Qorri et al., 2021; Samad et al., 2021; Wiredu et al., 2023; Zhu et al., 2005; Zhu & Sarkis, 2004) and to build competitive advantage (Akdoğan & Coşkun, 2012; Raut et al., 2019; Sarkis et al., 2011; Uddin et al., 2023). Not only that but, recent studies reveal that companies would achieve a strategic change adopting a SSCM with the help of Industry 4.0 (Luu et al., 2023). In addition, when we were under the negative effects of the pandemic, companies with higher levels of GSCM suffered less from economic loss (Eggert & Hartmann, 2023).

According to past research about the environmental benefits of adopting GSCM practices, cooperation with customers improves the environmental performance of the company (Green et al., 2012; Zhu & Sarkis, 2007; Zhu et al., 2007; Green et al., 2019; Seman et al., 2019), as well as collaboration with suppliers (Large & Thomsen, 2011; Theyel, 2006; Vachon & Klassen, 2008). Eco-design is also considered a relevant practice to increase CEP (Eltayeb et al., 2011; Green et al., 2012; Zhu et al., 2007; Zhu & Sarkis, 2004; Zhu & Sarkis, 2007). As for green purchasing, according to many authors, it has a positive significant effect on CEP (Zailani et al., 2012; Zhu et al., 2007; Green et al., 2019; Laosirihongthong et al., 2013) but, other studies did not find a significant impact between those two variables (Eltayeb et al., 2011; Green et al., 2012).

However, these studies provide information about isolated practices, and do not make a comparison between all of them to see which ones work best. Apart from that, it is necessary to analyze the moderators that may explain conflicting findings of past empirical research. To this end, a meta-analysis of these empirical studies would provide interesting insight.

With regard to existing meta-analyses, most of them are oriented to analyze the GSCM-financial performance link, concluding by the majority that a positive relationship exists (Golicic & Smith, 2013; Govindan et al., 2020; Pakurár et al., 2020), whereas others found a nonsignificant relationship between those two variables (Leuschner et al., 2013). Although these researches do not consider CEP, according to Russo and Fouts (1997), CEP and economic performance are positively linked.

Regarding the meta-analysis studies analyzing GSCM-CEP link, findings show that GSCM leads to a better financial, environmental and operational performance (Fang & Zhang, 2018; Geng et al., 2017). Fu et al. (2022) agree that the relationship is positive but they found that the impact is moderate. Finally, the meta-analyses by Qorri et al. (2018) and Qorri et al. (2021) state that GSCM practices are significantly positively correlated with the four dimensions of firm performance: social, operational, economic, and environmental.

However, previous meta-analyses do not clarify the directionality and sign of the particular relationships and do not provide insight about the moderators that could affect the relationship under study.

Therefore, with the intention to bridge this gap, we conduct a meta-analysis with a sample of 166 empirical studies that were published between 2001 and 2023, which is a large sample and over a long period of time. This way, the results that we get from the present meta-analysis are relevant and accurate. In addition, this is the first reported meta-analysis in this particular research stream that attempts to clarify the directionality of the particular relationship, as well as the moderators that may explain the mixed findings of past empirical studies.

In addition, making a comparison to existing empirical research analyzing particular GSCM practices, the present meta-analysis includes a higher number of practices in order to make clear which practices most improve CEP. In particular, the present meta-analysis evaluates the effect that reverse logistics practices, sustainable sourcing, collaboration with customers, eco-design, Environmental Management System (EMS) certification, and investment recovery have on CEP. Although some of the existing meta-analysis did disaggregate some of these practices when evaluating the impact on CEP, such as Fang and Zhang (2018), Geng et al. (2017), and Qorri et al. (2018), this is the first meta-analysis that focuses the study on analyzing the effect of so many different practices. Not only that but, it is the first meta-analysis that compares the effect of each practice considering the moderating role of the nature of the practice whether internal or external, the source of measuring the CEP, the size of the company as well as the environmental awareness of the country.

In the end, making a comparison to existing reviews, the aim of this study is to discover, which are the key tools of the GSCM that contribute towards a stronger CEP.

Therefore, this study is important for companies that are interested in implementing sustainable practices in their supply chains in an efficient and effective way, as they would be able to focus their strategy and resources in the key tools that have more impact on their CEP. Furthermore, it is useful for policy makers, as it provides evidence about many practices that they require in their policies. Lastly, this study may aid in the protection of the planetary environment, as it could encourage corporations to adopt sustainable practices in their globalized supply chains, which are highly contaminating for the environment.

This paper is organized as follows: Section 2 establishes the research hypotheses. Section 3 describes data collection procedures, inclusion criteria and econometric notations of the meta-analytic approach. Section 4 presents the results of the empirical study. Section 5 discusses the results as well as the limitations and avenues for future research and finally, the last two sections include the conclusions and references.

2 | HYPOTHESIS DEVELOPMENT

An increasing number of companies are implementing sustainable practices in their supply chain, such as sustainable sourcing, eco-

design, sustainable manufacturing, collaboration with customers, and reverse logistics (Paulraj et al., 2017; Vachon & Klassen, 2006; Zhu & Sarkis, 2004). These sustainable practices implemented in the supply chain are commonly known as GSCM practices (GSCMP) or SSCM practices (SSCMP). By definition, SSCMP are oriented to improve the company's social, environmental and economic performance (Carter & Rogers, 2008), while GSCMP are focused on improving only the company's environmental and economic performance (Miroshnychenko et al., 2017).

In this regard, literature has tried to explain the impact that these practices have on a firm's performance. Although, the majority research was oriented to discover the impact on economic outcomes (Golicic & Smith, 2013; Govindan et al., 2020; Kuei et al., 2013; Lai et al., 2012; Pakurár et al., 2020; Rao & Holt, 2005), recently, the environmental and social performance of the companies are drawing a lot of interest (environmental performance being more prevalent as compared to research about social performance).

Moreover, the literature provides studies concerning the impact that specific sustainable practices could have on environmental performance. For example, many authors agree that collaboration, proximity, and inter-firm linkage with suppliers lead to a better environmental performance (Geffen & Rothenberg, 2000; Hajmohammad et al., 2013; Paulraj, 2011). In addition, Geffen and Rothenberg (2000) suggested that collaboration with suppliers helps the adoption and development of innovative environmental technologies, which are helpful in the reduction of pollution and cutting down environmental costs by introducing green innovation in their products. All those specific actions are considered GSCMP and as mentioned above, there is evidence to support that GSCMPs improve CEP. Therefore, based on the extensive scientific evidence in this field, the following hypothesis is posited (see all the hypotheses being tested in Figure 1):

> **Hypothesis 1.** (H1): The overall relationship between GSCMPs and improved CEP is positive.

According to Zhu and Sarkis (2004), GSCMPs have a three-fold effect on a firm's performance: impact on environmental performance by reducing all type of waste, impact on financial performance by decreasing costs of material purchases, energy consumption and waste treatments and impact on operational performance by increasing efficiency in delivery, production and inventory, among others.

The present study argues that depending on the GSCMP put into action, the impact on CEP could be stronger or weaker. Despite of the relevance that sustainable management tools, such as GSCMPs, have gained in academia and business, little is known about the real environmental impact that they have when implemented (Hörisch et al., 2015). This makes the implementation of sustainable practices even more challenging, as management has no desire to implement new strategies without having the certainty that they will work. Therefore, it is fundamental to know the level of efficiency of the sustainability management tools, such as GSCMP, so that the companies will be encouraged to support sustainable development. In this context, Hörisch et al. (2015) empirically examined the impact of sustainability management tools on corporate practice of large companies, in order to see if they are effective in reducing environmental damage. The present study is focused in the same line, analyzing the impact that each of the GSCMPs described in Table 1 may have on CEP.

GSCMPs are diverse, each green practice is different and each one has its own functionalities, as it can be seen in the descriptions of Table 1. Due to this variety, literature offers different conceptualizations of GSCM practices. Some authors support that the main GSCPs are those related to collaboration and partnership among the members of the supply chain (Green et al., 2012; Vachon & Klassen, 2008). Other researchers state that green innovation practices are the key practices to improve CEP (Seman et al., 2019). There are other authors that emphasize practices that aim to minimize waste and reduce consumption of materials and toxic emissions, such as eco-design or environmental purchasing (Zailani et al., 2012; Zhu & Sarkis, 2004). Apart from that, Seuring (2001) argues that transaction costs could arise when implementing GSCMPs and that they should

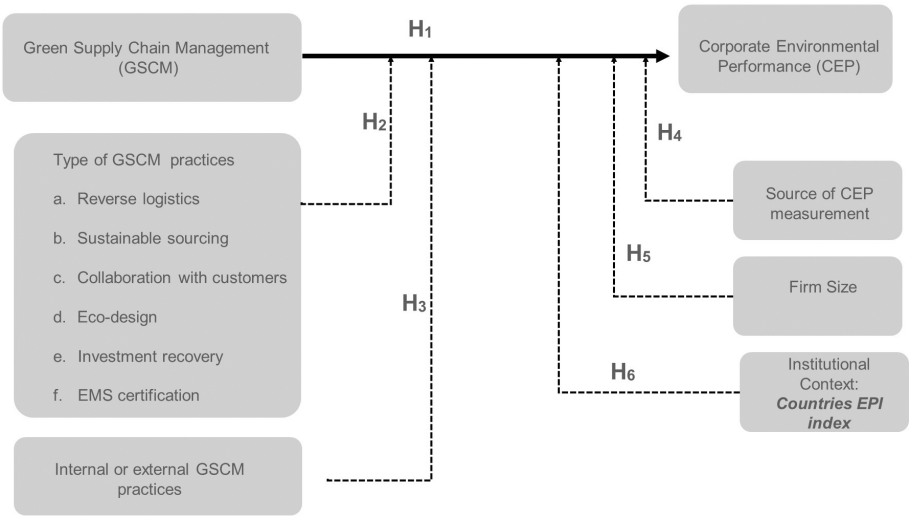

FIGURE 1 Hypotheses being tested.

TABLE 1 Description of GSCMPs.

GSCMP	Description
Reverse logistics	Reverse logistics is collecting unsold merchandise for the manufacturer to remove, sort, reassemble, or recycle (Yu et al., 2012). It consists on maximizing the recovery of the elements that have a long-term value and doing an eco-friendly disposal of the rest (Khan et al., 2021). It is a substantial component of GSCM that positively influences the operational performance of the firm (Saruchera & Asante-Darko, 2021). Reverse logistics helps firms in (Aitken & Harrison, 2013): • extracting value from used/returned goods • creating additional value through increasing product life cycles • improving customer satisfaction and loyalty by paying more attention to faulty goods • obtaining feedback and suggestions for future improvements.
Sustainable Sourcing (SS)	Sustainable sourcing (SS) is related to cross-boundary efforts made towards suppliers (Shou et al., 2020). The main goal of SS practices is to assess and monitor suppliers' environmental sustainability behaviors in order to meet environmental demands through joint efforts with suppliers (Golini & Gualandris, 2018; Zhu et al., 2013).
Collaboration with customers	Collaboration with customers consists on sharing environmental information with the intention to reduce negative environmental impact (Lee, 2008; Zhu et al., 2017). It involves activities performed by different agents of the supply chain, such as knowledge sharing activities for eco-design, collaboration to achieve a cleaner production process and less energy consumption during transportation (Famiyeh et al., 2018). Collaborating with customers a firm may contribute to the suppliers' environmental conduct by means of learning and knowledge sharing (Simpson et al., 2007). Collaborating with customers could help the firm to adapt, improve and renew its product and thus, its chances to succeed will increase (Belderbos et al., 2004).
Eco design	Eco-design consists on designing a sustainable product with the goal of minimizing negative environmental impacts in its production line and throughout its entire life cycle, as well as promoting the reuse, recycle and recovery of the product or its component materials (Sarkis, 2003). Eco-design improves CEP (Geng et al., 2017) but it requires a significant investment (Green et al., 2012). It leads the business towards implementing green practices in its entire supply chain, such as green purchasing and manufacturing, as well as reuse, recycle, and recovery practices (Khan & Yu, 2021).
Investment recovery	Investment recovery consists on selling excess inventories, scrap, used materials and excess capital equipment, generating extra income (Zhu et al., 2008a, 2008b). It could be related to reverse logistics, which deals with processing returned materials, product packaging or unsold merchandise in order to reuse, recycle or reassemble those materials (Zhu et al., 2008a, 2008b). Investment recovery plays an important role building up competitiveness and improving organizational performance (Amjad et al., 2022).
EMS certification	Having an Environmental Management System (EMS) certification, means that it has been verified that a firm meets the standards of such certification. Related to GSCM, it is found that implementation of green practices along the supply chain leads to a greater internalization of EMS requirements (Daddi et al., 2021). Having environmental management systems (EMSs) certification (e.g., ISO 14001) could be indicative of being sustainable because the quality of the environmental management of the firm may raise (Rao et al., 2009; Seiffert, 2008) or because the ecological outcomes of the firm may improve (Ferenhof et al., 2014; Nguyen & Hens, 2015). However, it could also be merely symbolic (Aravind & Christmann, 2011; Boiral, 2012) because ISO 14001 audit focuses on procedures rather than assessing environmental impact (Heras-Saizarbitoria et al., 2013).

Abbreviations: CEP, Corporate Environmental Performance; GSCMPs, Green Supply Chain Management practices.

be considered when evaluating the overall impact of each green practice on firm performance.

As green practices analyzed by researchers are different, GSCMPs defined in Table 1 will be thoroughly examined in this study, which are: reverse logistics, sustainable sourcing, collaboration with customers, eco-design, EMS certification, and investment recovery. The selection of those GSCMP was carried out considering the most cited studies of our sample. We primarily based on the classification made by Zhu and Sarkis (2004), who cataloged different GSCMPs based on existing literature. Other experts like Diab et al. (2015), Golicic and Smith (2013), and Shou et al. (2020) were also considered. Apart from the aforementioned studies, the remaining articles included in the sample of this meta-analysis were also considered. The intention is to evaluate the impact that each GSCMP has on the CEP. Therefore, we included all the GSCMPs assessed in the papers of our meta-analysis sample.

Based on the above discussion, we propose the following hypothesis:

> **Hypothesis 2.** (H2): The impact of the GSCMPs over CEP is moderated by the type of GSCMPs adopted (either reverse logistics practices, sustainable sourcing,

collaboration with customers, eco-design, EMS certification, or investment recovery).

GSCMPs could be categorized in various ways, one of them being the grouping of internal or external practices as indicated by emerging evidence (Wu, 2013; Yang et al., 2020; Zhang et al., 2020). The literature reveals that both internal and external GSCMPs result in environmental, operational and economic performance improvements (Seuring & Müller, 2008a).

Regarding internal GSCMPs, according to Zhao et al. (2011), internal environmental management implies the creation of environmental departments, sharing of environmental information and the integration of an information system. In order to implement these practices, top management commitment is essential, being one of the top three key variables to implement GSCM and achieve environmental goals (Pathak et al., 2020). In fact, according to empirical evidence, internal environmental management is a necessary precursor for implementing other GSCM practices (Habib et al., 2022) and it is a key factor that contributes to CEP (Huma et al., 2023).

According to Roehrich et al. (2017) and Vijayvargy et al. (2017), external green collaboration is a cooperation among suppliers, partners and customers that involves mutual understanding of environmental problems, joint decision making, sharing of resources and knowledge, and reaching environmental common goals. By the application of these external GSCMPs, companies build trust and commitment with their supply chain partners, which is necessary in the development of productive green practices (Feng et al., 2020; Zhang et al., 2020). Moreover, they communicate and learn from each other, which is necessary to redesign products and packages, as well as to develop changes in operations in order to reduce lifecycle costs (Zhu et al., 2012; Zhu & Sarkis, 2004).

Our study argues that depending on the type of GSCMP, whether internal or external, the impact on CEP may be different. This study categorized as internal practices those considered by the authors as internal environmental management (e.g., eco-design and investment recovery). In contrast, reverse logistics, sustainable sourcing, and collaboration with customers are considered as external GSCMPs. As regards EMS certification, this is not included in our classification of internal or external GSCMP, as it has both internal and external characteristics.

Based on the above studies, we hypothesize that:

Hypothesis 3. (H3): Internal GSCMPs have a major positive impact on CEP than external GSCMPs.

In response to the request of transparency with regard to environmental and social matters, companies disclose information about their environmental and social activities (Braam et al., 2016) and even biodiversity (Blanco-Zaitegi et al., 2022) on corporate environmental reports. Additionally, in the last two decades, the implementation of EMS standards, such as ISO 14001, gained popularity (Erauskin-Tolosa et al., 2020).

The information reported, affects the perceptions that stakeholders have towards the company, thus their legitimacy (Gray, 1992). According to the pluralist perspective of legitimacy theory, firms tend to use social and environmental disclosure to legitimize actions that may threaten their reputation, and thus, to comply with the "social contract" that exists between business and society (Brown & Deegan, 1998; Patten, 1991). There are studies that reveal that firms tend to make a selective disclosure, reporting the information that is aligned with social and environmental ends and omitting the information that may harm their reputation (Archel et al., 2009).

As for the legitimacy theory based on political economy theory, it explores how different actors use accounting information to influence in social conflicts (Gray et al., 1996). According to this approach, annual reports serve not only to legitimize the actions performed by the firm but also to legitimize the economic, social, and political system as a whole (Gray et al., 1995, 1996).

Therefore, regardless of their level of CEP, companies have an incentive to disclose environmental information, as they will gain reputation (Brown et al., 2010; Cho et al., 2012; Suchman, 1995). In fact, sustainable performance transparency indicators may be used as an incentive variable that in turn will influence their financial performance (Srouji et al., 2023). Because of that, pluralist legitimacy theory supports that the right solution for this problem would be the intervention of regulators (Deegan, 2002).

In this regard, the present study makes a distinction between firms that measure CEP by an external agent rating and firms that disclose environmental information, including CEP, on their own.

Based on the aforementioned theoretical background, companies that voluntarily and selectively disclose more environmental information may be those that have a lower CEP and they report more information with the aim of reducing stakeholders' negative perceptions of the firm's performance (Boiral, 2013; Brammer & Pavelin, 2006; Freedman & Patten, 2004).

However, firms reporting information based on quality rather than quantity could also enhance legitimacy, as it may be seen as appropriate and desirable by stakeholders (Suchman, 1995). Thus, information provided by an external agent rating may be more reliable for stakeholders and these firms may become more legitimate for them.

In line with the theoretical background, the present study supports that the level of CEP reported, could vary depending on the way that it was measured, whether by an external agent rating or by the company itself.

Therefore, the following hypothesis is suggested:

Hypothesis 4. (H4): Companies disclosing environmental information voluntarily tend to show a greater CEP than those that measure CEP by an external agent rating.

Regarding the firm size, there are several studies that support that it has a significant and positive impact on the company's CEP (Wang

et al., 2018; Weng et al., 2015), which would mean that larger firms tend to have better CEP than smaller firms.

As many authors agree, large-size firms may have easier access to resources (Álvarez Gil et al., 2001), as well as greater environmental pressure than smaller firms (Vanpoucke et al., 2014), which is why larger firms may have greater capacity and resources to adopt innovations (Huang et al., 2009; Minagawa Jr et al., 2007; Ziegler & Nogareda, 2009) and sophisticated performance management practices (Abdel-Kader & Luther, 2008).

Due to their overcapacity, large-sized companies invest more than small and medium-sized enterprises (SME) on resource efficiency, recycling, eco-design, and adopting systems that prevent environmental damage (Vanpoucke et al., 2014; Wang et al., 2018). In addition, most of the large companies have the possibility of using high-tech information technology applications while SMEs usually use lower technology due to their lack of resources (Lee et al., 2011; Watcharasriroj & Tang, 2004).

Other research supports that the size of the firm substantially conditions the level of resources available to implement certifications such as ISO 14001 (Melnyk et al., 2003; Nishitani, 2009; Szymanski & Tiwari, 2004). By contrast, small firms may fail when incorporating certain environmental practices because of their lack of resources (King & Lenox, 2001).

Therefore, based on this discussion, we propose the following hypothesis:

> **Hypothesis 5.** (H5): GSCMPs have a greater effect on CEP in large-sized companies.

When assessing CEP, the institutional context is another factor that might have a moderating effect, as the environmental awareness of each country could influence the willingness to take action towards sustainability (Zhang et al., 2020).

According to the institutional theory, cultural elements and socially accepted rules are some of the factors that influence companies' actions (Baughn et al., 2007; Selznick, 1996) such as sustainable management policies (Boiral, 2007) or Corporate Social Responsibility (CSR) practices (Frederick, 2006). In fact, it is empirically tested that the institutional background of each country has an influence when establishing priorities in the firm (Ortas et al., 2015). Isomorphism, which is one of the branches of the institutional theory, explains that organizations from the same institutional environment tend to generate an alignment in their behavior driven by the pressures that occur in their society (Sari et al., 2021). Due to the geographical diversification caused by national, social, political, and economic conditions, stakeholder pressure vary from one country to another (Baughn et al., 2007). Driven by that pressure, managers from the same institutional context tend to perceive and understand problems in a similar way (DiMaggio & Powell, 1991) and they decide to implement CSR and sustainable practices in order to comply with institutionally accepted social norms and to gain legitimacy, rather than economic benefit (Larrinaga-Gonzalez, 2007).

In this context, we think that GSCMP may have a major impact in companies located in countries that have more environmental consciousness as an institutional characteristic. The environmental awareness of a country could be measured by the Environmental Performance Index (EPI), which might have a part in the GSCM-CEP relationship (Zhou et al., 2008). The EPI measures the environmental activities performed by each country and it provides information about which countries are best addressing the present environmental challenges (Hsu & Zomer, 2014). The EPI uses a set of indicators to represent environmental health as well as indicators related to ecosystem vitality such as air pollution and water effects on ecosystems, biodiversity and habitat, productive natural resources and climate change (Esty et al., 2006). A low rank in this index, such as in the case of Pakistan or India (2022 EPI Results, 2022), indicates that the country's environmental awareness is poor (Dheeraj & Vishal, 1992).

In addition, according to Zhu et al. (2017), environmental awareness and education at the firm's level play an important role in motivating managers to implement actions towards circular economy and GSCMPs in particular. Another key finding in this area reveals that the level of development of the country could affect the level of implementation of environmental practices such as lean practices (Jasti & Kodali, 2014) and as a consequence, it may have an impact on the CEP (Maware et al., 2021; Yang et al., 2011).

Therefore, in this paper we analyze the moderating effects of environmental awareness measured by the EPI, assuming that companies from higher rated countries tend to adopt more environmental practices.

Thus, the following hypothesis is formulated:

> **Hypothesis 6.** (H6): The implementation of GSCMPs to improve CEP have a major influence in firms with higher environmental awareness.

3 | SAMPLE AND DATA COLLECTION

In the search for articles for this meta-analytical study, multi-step search techniques such as those proposed by Botella and Gambara (2006) or Field and Gillett (2010) were used. More specifically, in a first step, we proceeded to search for some combinations of the following keywords: Sustainable Supply Chain Management, Green Supply Chain Practice, Green Supply Chain Management, Supply Chain Management, Corporate Environmental Performance, EMS certification, Green Purchasing, correlation matrix, Reverse Logistic, and Ecodesign, Green innovation through the main scientific databases (e.g., Emerald, EBSCO, ProQuest, Wiley Online, Google Scholar, ScienceDirect, Scopus, Web Of Science (WOS), and Social Science Research Network). In a second step, the search for potential articles was limited to those academic journals that publish the majority of papers dealing with the study of GSCM and are included in the WOS and/or Scopus databases, two of the world's leading peer-reviewed literature databases (e.g., *Business Strategy & Environmental Strategy*,

Corporate Governance: An International Review; Corporate Social Responsibility & Environmental Management, Journal of Environmental Management, Supply Chain Management: An International Journal, Journal of Cleaner Production, International Journal of Production Economics, Journal of Purchasing and Supply Management). In the third step, the references of the selected articles were checked to ensure that no relevant studies were overlooked following Field and Gillett (2010). In a final step, those studies that did not provide the empirical relationship between the variables studied and those papers that did not publish correlation coefficients between variables or sufficient statistical data for conversion into correlation coefficients were eliminated. This led to a selection of a final sample of 166 papers (see the steps in the sample gathering in Figure 2). The above data collection procedure ended in January 2024.

The articles included in the final sample were then coded according to (i) authors; (ii) year of publication; (iii) sample size; (iv) environmental performance measurement model; (v) measured GSCM practice (vi) correlation coefficient (observed or calculated); (vii) countries included in the sample; and (viii) size of the sampled companies.

4 | METHOD

A meta-analytical study is a useful technique to systematically review, summarize and quantify the empirical results (often conflicting) related to a specific subject. Two main statistical models have been used in previous meta-analyses, namely fixed-effect and random-effects models (for more details see Borenstein et al., 2009; Hedges & Vevea, 1998). The fixed model considers the existence of a single effect size for all the studies in the sample. The random effects approach allows the division of the sample into subgroups in which the effect size differs, and also enables the researcher to make out-of-sample inferences (Lipsey & Wilson, 2001). This paper adopts the second model, as the associations between the application of GSCM and CEP will not be the same in different circumstances (moderate variables).

A meta-analytical study assesses the strength of the relationship between two variables by means of effect size (Lipsey & Wilson, 2001). This study follows the meta-analysis data processing method of Hedges and Olkin (1985) (HOMA), following a multi-step procedure, as described by Borenstein et al. (2009); Erauskin-Tolosa et al. (2020); Lipsey and Wilson (2001) and Zubeltzu-Jaka et al. (2018). The HOMA technique allows the analysis of correlation coefficients to estimate the common measure of effect size between GSCM and CEP, but such analysis requires a Fisher's *Z*-transformation of the correlation coefficient;$Z_{r_i} = \frac{1}{2} log_e\left(\frac{1+r_i}{1-r_i}\right)$, where r_i is the correlation coefficient between GSCM and CEP found in study i. To do this, from the selected articles we first extracted the reported Pearson's coefficient (*r*-value), that is, a correlation between GSCM and CEP, and when the *r*-value was not reported other statistic transformable into *r*-value such as *t*-value, *F*-value and chi-square (*r*-value). Moreover, if only standardized regression coefficients (*B*) is observed in the study, the Peterson and Brown (2005) method is used to transform the *B* coefficient into correlation coefficient, as has been done by previous meta-analyses (e.g., Erauskin-Tolosa et al., 2020; Wagner et al., 2015).

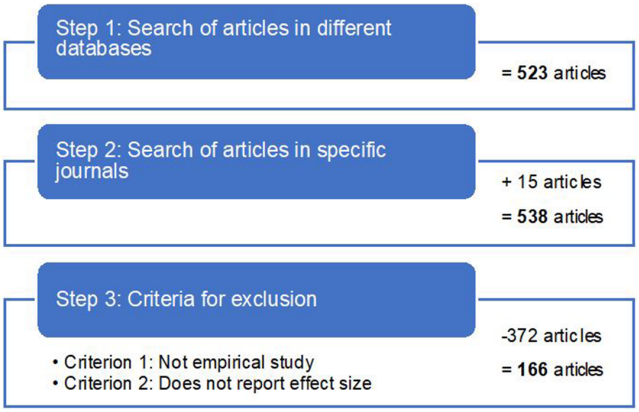

FIGURE 2 Sample gathering.

With the aim of assessing the significance of the moderating variables, the full sample has been divided into different sub-samples according to the different values of the discrete variables (i.e., moderating variables). The meta-analytical approach is then applied to each sub-sample to investigate possible differences in the effect of GSCM over CEP. In addition, *Z*-tests were applied to analyze whether the effect sizes corresponding to the different subgroups were statistically different (Busch & Friede, 2018; O'Boyle et al., 2012; Zubeltzu-Jaka et al., 2024).

5 | RESULTS

5.1 | Main effect

Table 2 (Results table) provides the HOMA method results that evaluate the GSCM-improved CEP relationship. The findings show that GSCMPs allow for improvements in a companies' environmental performance indicators. The main effect size ($\bar{r}$) is 0.398 and as the 95% confidence interval does not include zero [0.375, 0.421] the estimated statistic is significant. The main effect result is based on 335 different samples and 201.125 GSCMP's effect over environmental performance observations. The *Q*-statistic reports the heterogeneity of the effect size, the high significance of the statistic indicates that our results are not homogeneous. Therefore, the observed positive relationship (0.398) has a large variability and there must be moderating variables in which different values of the effect size are estimated that justify and decrease the variability.

5.2 | Conceptual moderators

The first moderating variable focuses on the particular practices of GSCM, differentiating the sample (238 samples) into six types of practices and allowing us to order them according to their degree of

TABLE 2 Results of the meta-analysis.

(H1) direct effect	*N*	*K*	ES ($\bar{r}$)	−95% IC	+95%IC	*Z*-value	*Q*-test	*Z*-test	*p*
H1 GSCM-EP relationship	201,125	335	0.3984	0.375	0.421	29.9***	11,153.8***		
Moderating effects									
(H2) Particular GSCM practices									
Reverse logistics practices	2493	12	0.2063	0.1068	0.3017	4.0***	71.6***	RC	
Sustainable sourcing	17,461	63	0.3974	0.3445	0.4479	13.4***	947.9***	3.32***	0.0009
Collaboration with customers	8648	39	0.3860	0.3261	0.4428	11.6***	373.5***	3.03***	0.0024
Eco-design	14,679	52	0.4562	0.4067	0.5030	15.9***	640.3***	4.41***	0.0000
Investment recovery	2847	16	0.4717	0.3585	0.5712	7.3***	197.7***	3.45***	0.0006
EMS certification exist	128,514	56	0.2699	0.2144	0.3236	9.2***	4259.1***	1.09	0.2743
(H3) Internal versus external GSCM practices									
Internal GSCM practices	34,065	134	0.4704	0.4370	0.5025	23.8***	1959.3***	RC	
External GSCM practices	32,438	133	0.3649	0.3294	0.3994	18.6***	1689.8***	−4.24***	0.0000
(H4) CEP measurement (source)									
External agent rating	22,921	30	0.2116	0.1358	0.2850	5.4***	941.5***	RC	
Firm's disclosure	178,204	305	0.4160	0.3913	0.4402	29.3***	10,060.6***	5.02***	0.0000
(H5) Firm size									
Small and medium-sized firms	14,833	42	0.3219	0.2639	0.3777	10.3***	496.7***	RC	
Large firms	67,003	80	0.4039	0.3685	0.4382	20.2***	1487.9***	2.36**	0.0182
(H6) Countries EPI index									
Countries below average EPI index	40,450	164	0.3934	0.3619	0.4240	22.2***		RC	
Countries above average EPI index	81,409	126	0.4473	0.3997	0.4925	16.3***		1.85*	0.0641

Note: This table provides the results of the meta-analytic study. *N* refers to the total sample size (number of companies); *K* is the number of effect sizes (that were variance weighted); *r* shows the mean effect size. −95% CI and + 95% CI are the limits of the mean size effect confidence intervals; Q-stat is the homogeneity test; and finally, I2-stat shows the ratio of the study variance due to heterogeneity; *Z*-test capture differences between subgroups. *, ** and *** represent statistical significance at the 10%, 5%, and 1% levels respectively.
Abbreviations: CEP, Corporate Environmental Performance; GSCMPs, Green Supply Chain Management practices.

impact on the CEP. Some studies do not specify which type of GSCMP they have applied, since they analyze them as a whole, hence the study of this variable does not include all the samples considered in the main effect (335 samples).

Although all six GSCMPs studied show a positive impact on CEP (significant at $p < .01$), this variable allows us to gauge the effect of each one. An orderly presentation of the six GSCMPs from highest to lowest incidence would be as follows: investment recovery would be the most effective ($\bar{r} = 0.4717$, $p < .01$), closely trailed by eco-design ($\bar{r} = 0.4562$, $p < .01$). Sustainable sourcing ($\bar{r} = 0.3974$, $p < .01$) and collaboration with customers ($\bar{r} = 0.3860$, $p < .01$) obtain similar values. Finally EMS certification ($\bar{r} = 0.2699$, $p < .01$) and in particular reverse logistics practices ($\bar{r} = 0.2063$, $p < .01$) are the practices that show the lowest degree of impact over CEP. The difference in effect size is statistically significant ($z = 3.03$–4.41; $p < 0.01$), confirming the validity of H2.

The second moderating variable studied considers that internal and external GCSMPs will have a different impact on CEP. To this end, we divide the sample into two subgroups and reestimate the degree of impact of each cluster of GSCMPs on CEP. The results support Hypothesis 3. The practices considered as internal have the greatest impact ($\bar{r} = 0.4704$, $p < .01$) over CEP, higher than that of external practices ($\bar{r} = 0.3649$, $p < .01$). Furthermore, the *z*-test confirms that the differences between the two effect sizes are significant ($z = -4.24$; $p < .01$), confirming the moderating role of this variable.

The third moderating variable assesses whether GSCMP's impact on CEP is conditional on whether CEP is measured through the firm's own disclosure or through an external rating agent. The meta-analytic results reveal that both measurement types of effect size are positive and significant: external agent measurement ($\bar{r} = 0.212$, $p < .01$) and a firm's disclosure measurement ($\bar{r} = 0.416$, $p < .01$). The HOMA results show a significant difference between an external rating agent and the firm's own disclosure ($z = 5.02$; $p < .01$). Our hypothesis that the type of CEP measurement may moderate the effect of SCM practices on CEP is supported.

The fourth moderating variable analyses the impact of firm size on the environmental impact of GSCMPs. The estimated effect size associated with large firms ($\bar{r} = 0.404$, $p < .01$) is higher than the one observed in small and medium-sized firms ($\bar{r} = 0.322$, $p < .01$) and the difference between the two effect sizes is again significant ($z = 2.36$; $p < .05$).

The last moderating variable studies whether the effect of GSCMPs over CEP is conditional on the environmental awareness of sample's country (i.e., that the effect of GSCMPs on CEP is greater for companies in countries with high EPI scores). We have divided the

TABLE 3 Summary of hypotheses.

Hypothesis 1	The overall relationship between GSCMPs and improved CEP is positive	Accepted
Hypothesis 2	The impact of the GSCMPs over CEP is moderated by the type of GSCMPs adopted (either reverse logistics practices, sustainable sourcing, collaboration with customers, eco-design, EMS certification, or investment recovery)	Accepted
Hypothesis 3	The internal or external nature of GSCMP determines their impact on the improved CEP	Accepted
Hypothesis 4	The impact of GSCMPs on CEP is moderated by the source of CEP measurement (i.e. external agent rating, the firm's disclosure)	Accepted
Hypothesis 5	A firm's size conditions the impact of GSCMPs on CEP	Accepted
Hypothesis 6	The impact of GSCMPs on CEP is greater among firms from countries with higher environmental awareness	Accepted

Abbreviations: CEP, Corporate Environmental Performance; EMS, Environmental Management System; GSCMPs, Green Supply Chain Management practices.

TABLE 4 Meta-regression results.

Overall size effect	
Moderator	
Countries environmental performance index	0.0082*** (0.0003)
Model additional data	
K	290
I^2	97.37%
R^2	0.09
Q	10,975.75 [0.00]
Q model (*p*)	5567.79 [0.00]
Q residual (*p*)	10,975.75 [0.00]

Note: This table shows the estimates of the meta-regression analysis. This model only considers a sample of 257 observations because the reminder were comprised of companies from different countries, thus exhibiting divergent EPI values. Unstandardized regression coefficients are reported. Standard errors are in parentheses and *p*-values are in brackets. *K* refers to the total number of effect sizes; *Q* refers to the homogeneity statistic. *, **, *** significant at the 10%, 5%, and 15% level, respectively.

sample into two categories, those above and below the average composition of EPI. The HOMA results indicate that the positive effect of GSCMPs over CEP is stronger for companies in countries with more environmental awareness ($\bar{r} = 0.447$, $p < .01$ vs. $\bar{r} = 0.393$, $p < .01$) and the difference in these effect sizes is, in fact, significant ($z = 1.85$; $p < 0.1$). Table 3 (Summary of hypothesis) presents a summary of the hypotheses tested and the results obtained.

In order to test the last working hypothesis (i.e., H6), supplementary analyses were also conducted and are herein presented. Specifically, a continuous measure of countries' EPI was considered. As this is a continuous variable a Meta-analytic Regression Analysis (MARA) must be implemented (Borenstein et al., 2009; Lipsey & Wilson, 2001; Van Essen et al., 2015). In a MARA, each study-level effect size is weighted by the inverse of its variance (Aguinis et al., 2011; Borenstein et al., 2009) and as in HOMA method, a random effects model was estimated through maximum likelihood. The results are presented in Table 4 (Meta-regression results).

The regression coefficient is positive and significant ($\beta = 0.0082$; $p < .01$), thus confirming that the higher a country's environmental awareness, the greater the impact of the firm's GSCM practices on CEP. This results are consistent with our expectations as formulated in H6.

6 | CONCLUSIONS

GSCM has gained popularity in both academic and business fields as stakeholders are becoming more and more concerned about the socio-environmental problems.

Previous research have extensively analyzed the relationship between GSCM and economic performance (e.g., Golicic & Smith, 2013; Govindan et al., 2020); few other studies analyzed the effect of GSCM on CEP (e.g., Fang & Zhang, 2018; Geng et al., 2017; Samad et al., 2021) and there is hardly any research analyzing the effect of such strategy on social performance (Qorri et al., 2018; Qorri et al., 2021). However, these studies do not explore the different dimensions of GSCM and do not provide practical insight about how to implement GSCM in organizations. In contrast, our study is focused on the implementation phase of GSCM. By disaggregating the GSCM into different practices (reverse logistics, sustainable sourcing, collaboration with customers, eco-design, EMS certification, and investment recovery), our meta-analysis tests the relationship between the two variables under the effect of several moderators (firm's size, environmental awareness, way of measuring CEP and the nature of practice adopted—whether internal or external). This way, the present study extends the analysis of GSCM-CEP link identifying important moderators regarding this link (see Table 2). This way, our results provide researchers insights to justify why green practices are more effective for certain firms or industries.

There is also extensive empirical literature on the impact of several green practices on CEP (e.g., Green et al., 2012; Zhu et al., 2007; Zhu & Sarkis, 2007). However, each of these studies has been carried out collecting data from specific contexts (i.e., activity, countries) so, results could be controversial. In order to clarify the conflicting empirical evidence, our study integrates a sample of 166 empirical studies from different contexts and analyzes the relationship between GSCM

and CEP under several moderating roles. This way, the present study provides clear insight of which are the green practices that work best in the improvement of CEP, establishing an order of priority when implementing such strategy (see Table 2).

Our findings show that GSCM leads to a better CEP, which is not an entirely unexpected result as there are several studies proving that a positive relationship exists between those two variables (e.g., Cousins et al., 2019; Fu et al., 2022; Zhu et al., 2005). However, we found that there are several moderators affecting the strength of GSCMP-CEP relationship.

First, we find that among all the GSCMPs analyzed, investment recovery is the practice with the highest impact on CEP, followed by eco-design, sustainable sourcing, collaboration with customers, EMS certification and reverse logistics, respectively. Therefore, companies should reconsider the recovery process of their products, selling the excess inventory or reassembling them, as these efforts will most improve their CEP. They should also recognize the importance of the rest of the practices, as all of them serve to achieve a better CEP.

Second, the results show that GSCM-CEP relationship has a stronger effect implementing internal environmental management practices rather than external practices. Therefore, we agree with Fang and Zhang (2018) and Fu et al. (2022), who also concluded that internal environmental management is the key tool in the achievement of a stronger CEP.

Another important finding regarding moderators, is that the type of CEP measurement does moderate the link between GSCM and CEP, as companies reporting environmental information themselves show a higher CEP.

Furthermore, our results reveal that GSCM-CEP relationship in large companies has a stronger effect than in SME companies, which confirms that firm size has a moderating effect.

Finally, the current research reveals that companies in countries with more environmental awareness tend to have a stronger CEP, as managers in these countries are more motivated to implement actions towards a circular economy (Zhu et al., 2017).

Findings of the present research have some important implications. First, the research findings may motivate managers to put GSCMPs into practice as conclusions show that GSCM improves CEP, which could lead to gain competitive advantage. Second, our detailed categorization of green practices as well as moderators, will help firms to develop an internal strategy on the implementation of GSCM in their globalized supply chain. Third, as our results indicate that investment recovery specially improves CEP, companies should consider the end-of-life management of their product by selling or reusing the excess inventory and surplus materials that arise after the use of the product so that they gain an extra income and they improve their CEP. Fourth, the identification of the five moderators that affect the relationship between GSCM and CEP can serve as an orientation guide for future studies.

Regarding policy makers, they should consider the results of our study and formulate relevant environmental standards in order to encourage organizations to adopt GSCMPs. Taking into account our analysis of moderators, policy makers could adopt win-win environmental policies (i.e., that benefit both environmental wealth and a company's financial well-being). In addition, in those countries with low environmental awareness, policy makers should develop policies aimed at creating environmental awareness, as it will help to improve the CEP of the organizations.

Finally, our meta-analysis study may encourage other researchers in similar study areas to use the meta-analysis approach to develop the GSCM discipline.

6.1 | Limitations and future research

Although a meta-analysis may be able to draw more accurate conclusions, this study is not an exemption and it has several limitations.

Firstly, it is important to notice that like all meta-analysis studies, the quality of the findings depends on the data included in the sample. In addition, the present meta-analysis does not infer causality, as studies in our sample assess the relationship of the variables rather than the causality of that association. In order to achieve consistent quality in our study, we searched for articles in the main databases and in academic journals related to GSCM studies, obtaining a sample of 166 articles. Nevertheless, studies in our sample are from different contexts (i.e., sectors, countries), so for further research, there is an opportunity to focus the study on a certain context.

It is worth to highlight that the present meta-analysis studies only the environmental dimension of firm performance. It would be interesting for further research, to also include the social and economic dimensions.

Regarding the green practices that we analyzed in our meta-analysis, we suggest that other existing practices need to be examined in future research. Moreover, as the present study suggests different moderating effects, future studies should consider other contextual factors in order to gain greater understanding concerning the moderating effects in the GSCM-CEP link.

Finally, we consider that a meta-analysis was needed in this area, as conclusions about the relationship between GSCM-CEP were few and inconsistent. However, apart from scholarly literature, collecting real data from existing companies should be interesting for further research, so that we could test our results in a real case.

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