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A bibliometric review of corporate environmental disclosure Literature

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A bibliometric review of corporate environmental disclosure Literature

Abstract

Purpose– The study identifies and discusses influential aspects of corporate environmental disclosure (CED) literature, including key streams, themes, authors, keywords, journals, affiliations, and countries. This review also constructs agendas for future CED research.

Design/methodology/approach– Using a bibliometric review approach, we reviewed 560 articles on CED from 215 journals published between 1982 and 2020.

Findings– Our insights are three-fold. First, we identified three core streams of CED research: *'legitimization of environmental hazards via environmental disclosures'*, *'the role of environmental accounting in achieving corporate environmental sustainability'*, and *'integrating environmental social and governance (ESG) reporting into the GRI guidelines'*. Second, we also deployed a thematic map that classifies CED research into four themes: niche themes (e.g., institutional theory and environmental management system), motor themes (e.g., stakeholder engagement), emerging/declining themes (e.g., legitimacy theory), and basic/transversal themes (e.g., voluntary CED, environmental reporting, and corporate social responsibility). Third, we highlighted important CED authors, keywords, journals, articles, affiliations, and countries.

Research limitations/implications – This study assists researchers, journal editors, and consultants in the corporate sector to comprehensively understand various dimensions of CED research and practices and suggests potential emerging research areas. Although our paper appears to have been thoroughly conducted, using authors' keywords to identify themes was a key limitation. Thus, we call upon using a more comprehensive data mining technique that uses keywords in abstracts, titles and the whole body of papers and then identifies inclusive trends in CED literature.

Originality– We contribute to the extant accounting literature by investigating the organizational-level CED, both mandatory and voluntary, using a systematic and bibliometric literature review model to summarize the key research streams, themes, authors, journals, affiliations and countries. By doing so, we construct a future research agenda for CED literature.

Keywords: Bibliometric Analysis; CSR Reporting; Environmental Disclosures; Environmental Reporting; ESG Disclosures; Non-Financial Reporting; Sustainability Disclosures.

1. Introduction:

Environmental deterioration on earth is one of the biggest challenges humanity faces following the massive industrialization at the end of the 20th century and the start of the 21st century. Thus, environmental issues have captured the attention of international society, governments, businesses and researchers (Cho and Patten, 2007). For example, in continuous efforts, the Paris Climate Change Conference in 2015 and the conference of the parties (COP) 26¹ in 2021 advanced the global climate talks, offering an excellent opportunity to look at the effects of climate change on humankind (Savaresi, 2016). Crucially, these international environmental conferences and accords were, indeed, significant milestones in creating awareness regarding ecological challenges created and confronted by humans (Gerged, 2021). The solution to these environmental challenges is a step-by-step process, wherein acceptance of these challenges as a more significant threat than first realized was the first step. This has already been acknowledged at a global level. Following this comes the solution side and an operational plan to mitigate this issue, where corporate environmental disclosure (CED) is the first step in the operational part of the solution (Gallego-Álvarez, 2018; Braam et al., 2016). Several stakeholders, therefore, such as environmental watchdogs, government agencies, legislators and researchers, are looking at how organizations address these issues for environmental stability by demanding CED as a part of financial reporting (Wiseman, 1982; Gerged et al., 2021). In some countries, such as the UK and Hong Kong, stock exchanges have made it mandatory for firms to disclose environmentally relevant

¹ COP26 is the United Nations Climate Change Conference that was the 26th United Nations Climate Change conference, held at the SEC Centre in Glasgow, Scotland, UK, between 31 October and 13 November 2021.

information in Environmental, Social, and Governance (ESG) reports. In contrast, these disclosures are still voluntary in other emerging and developed countries. This whole process of CED has evolved, and it is this that we try to gauge.

Although the bibliometric analysis approach has been increasingly employed in recent business management and accounting literature (e.g., Dharmani et al., 2021; Donthu et al., 2021; Gössling et al., 2021; Kumar et al., 2021; Xu et al., 2021; Xu et al., 2021b; Tan et al., 2021; Losse & Geissdoerfer, 2021; Zhang et al., 2021), there is no a single review study has adopted a bibliometric approach to analyze CED literature. Our systematic and bibliometric review, therefore, extends prior CED review studies (e.g., Berthelot et al., 2003; Cho and Patten., 2013; Deegan & Gordon, 1996; Elsakit & Worthington, 2014; Guidry & Patten, 2012) by identifying and analyzing influential aspects, such as trends in CED analysis (streams) and the key themes of CED research.

The current situation in the evolution of CED research raises many questions that need to be answered. These questions are not *only* related to CED themes and streams but also are concerned with CED researchers, journals and institutions. Thus, our bibliometric review considers the following questions to help identify the dynamics of the evolution of CED research and provide the holistic means for future research: (i) What are the main streams of CED from the beginning to the current status? (ii) What are the key themes of CED literature? (iii) Who are the notable researchers, articles, journals, universities and countries involved in CED research? (iv) For future insights, what directions can we take from previous CED literature to set the best future research agenda in the field?

The current study reviewed 560 research articles on CED from 215 academic journals published from 1982 to 2020 via bibliometric analysis. We have identified three core research streams: 'legitimization of environmental hazards via environmental disclosures'; 'the role of environmental accounting in achieving corporate environmental sustainability'; and 'integrating ESG practices into the global reporting initiative (GRI) guidelines'. Besides, the study has deployed a thematic map that classifies CED research into four themes: niche themes (e.g., institutional theories and environmental management systems), motor themes (e.g., stakeholder engagement), emerging/declining themes (e.g., legitimacy theory), and basic/transversal themes (e.g., voluntary CED, and corporate social responsibility).

Additionally, the study has identified important journals, articles, notable authors, keywords, affiliations, and countries involved in CED research. Based on our bibliometric review, *Business strategy and the environment* tops the ranking in articles production with 36 articles produced on CED literature, which is significantly higher than other journals. The *Journal of Cleaner Production* followed this in second place with 23 articles, and *Corporate Social Responsibility and Environmental Management* journal is third with 19 articles. Concerning papers' citations, *Accounting, Organizations and Society* has the highest number of cited CED papers (6537 citations) in the first place; then *Accounting, Auditing and Accountability Journal* is second with 5350 citations, and the *Journal of Business Ethics* occupies the third position with 1884 citations on CED-related literature. The most globally cited journal article is written by Craig Deegan from RMIT University in Australia and published in the *Accounting, Auditing and Accountability Journal* in 2002. Environmental disclosures, environmental reporting, environmental performance and

corporate social responsibility are the top keywords used in CED literature. Patten, Dennis, Cho, Charles, Cormier, Dennis, Magnan, Michel, and Deegan, Craig are the top authors having a maximum impact on environmental disclosure literature. Illinois state university, the University of Zaragoza and Concordia university are the top affiliations for environmental disclosure literature. This entrepreneurial role of the top authors and universities can be used as a benchmarking tool by other researchers and institutions seeking to develop or reinforce CED topics into their research agenda. The USA is the number one country in corresponding authors with correspondence in 45 articles, 40 in single-country publications (SCP) and 5 in multiple-country publications (MCP). The primary collaboration of research is between the USA and Canada. Consistent with Thomson (2014) and Bebbington and Larrinaga-Gonzalez (2012), this paper suggests reformulating CED research from a sustainability science perspective and using sustainability theories to develop transformative environmental accounting and disclosure practices for a sustainable world.

The remainder of the paper is described as follows. We provide research background, methodology and techniques used for the inclusion and exclusion of studies, defining the research terms and analysis of previously published research in the directory of Taylor and Frances' database. Then, a comprehensive and detailed bibliometric analysis is carried out with valuable findings. Finally, we conclude the main findings, limitations, and implications and suggest agendas for future CED research.

2. Research Background:

Environmental disclosure as an emerging and significant stream of research has gained the attention of a community of researchers. Burritt et al. (2002) define environmental

accounting as "activities, methods and systems as well as recording, analysis and reporting of environmentally induced financial impacts and ecological impacts of a defined economic system (e.g. firm, plant, region, nation, etc.)". In this regard, Burritt (2002) divides environmental accounting into monetary and non-monetary aspects and claims that environmental disclosures are relevant to the latter. To understand the reasons behind corporate engagement in CED, Hahn et al. (2015) identified three theoretical aspects of environmental disclosure: economic theories of disclosures, sociopolitical theories and institutional theories. Environmental disclosure based on economics theories suggests that companies opt for voluntary information disclosure on a cost-and-benefit basis (Clarkson et al., 2008). On the other hand, socio-political theories view CED as an answer to social or political pressure by several stakeholders (Hahn & Lülfes, 2014), while CED, based on arguments from institutional theory, focuses on meeting the requirements of government and institutions, without sacrificing the aim of maximizing the profits (Hahn et al., 2015).

Numerous countries worldwide have implemented regulative mechanisms to encourage firms to enhance their engagement with CED activities. Of these², Australia, the USA and the UK have CED regulations to push firms toward disclosing their carbon performance in annual reports (Luo et al., 2013; Gerged et al., 2021). Collectively, the growing interest of governments, institutions and policymakers in ESG information has motivated researchers to thoroughly discover this area theoretically and empirically.

² In 2007, the Australian government enacted the National Greenhouse and Energy Reporting Act (NGER) to deal with CED engagement in the country. Similarly, listed firms in the US were required to comply with the environmental disclosure requirements of the Securities and Exchange Commission in 2010. Likewise, starting in October 2013, the Carbon Disclosure Project in the UK requires public and private firms operating in the country to disclose information about their efforts to reduce carbon emissions in annual reports.

Two substantially different approaches to studying CED have appeared in earlier work. First, CED may be dealt with as a supplement to traditional accounting practices and researched with the same preconceptions and assumptions which inform mainstream accounting research. This approach considers the financial community as the main user of environmental information (e.g., Gray et al., 1995; Gray et al., 1987; Mathews, 1984; 1993). The second research approach places environmental reporting at the heart of examining the role of information in organization-society dialogue (e.g., Preston, 1975; 1981; 1983).

Regarding previous review studies of CED literature, several prominent scholars carried out several articles (e.g., Berthelot et al., 2003; Cho and Patten., 2013; Deegan & Gordon, 1996; Elsakit & Worthington, 2014; Guidry & Patten, 2012; Gray et al., 1995; Thomson, 2014). For example, the review study of Berthelot et al. (2003) indicated that investors highly value voluntary environmental disclosure that is publicly accessible and consistent with accounting standards requirements. Likewise, Guidry and Patten's (2012) review explored whether CED is mainly aimed at the market and, as such, attempted to assess the relationship between financial control variables and CED from the perspective of the voluntary disclosure theory. This review failed to find, except for firm size, evidence indicating any systemic link. Similarly, Watson (2015) reviewed social and environmental disclosure literature published in the top13 accounting journals over the last decade. This review focused on four parts: (i) CSR determinants, (2) the CSR-financial performance nexus, (3) CSR consequences, and (4) the value of CSR disclosure and assurance. This study summarized CED literature from an accounting perspective and provided suggestions on how researchers and accountants can use their skills concerning these

issues. Another systematic literature review of carbon disclosure studies was conducted by Hahn et al. (2015). This study aimed to identify the trends, caveats, and coherences of carbon reporting research based on arguments from sociopolitical, economic and institutional theories. They find that many prior scholarly efforts lacked theoretical links to determining the antecedents and consequences of carbon disclosure. However, such links can be spotted in the financial disclosure literature, for instance. Recently, Velte et al. (2020) systematically analyzed the governance-related determinants and financial consequences of environmental disclosure based on legitimacy theory.

A shortcoming of these review studies is that they do not consider a generalizable number of CED-related articles. For example, Guidry and Patten (2012) were confined to 13 papers, while Velte et al. (2020) only considered 73 articles in their review of CED literature. Besides, a bibliometric review of CED research that identifies the keywords, influential authors, papers, journals, affiliations, countries, and CED themes and streams is virtually non-existing. Therefore, we respond to Thomson's (2014) call for constructing a contemporary sustainability accounting research agenda that poses questions aligned with the unfolding sustainability discourse by investigating the organizational-level environmental disclosure, both mandatory and voluntary, using a systematic and bibliometric literature review model to help determine emerging streams and themes of CED research, notable CED scholars, keywords, journals, authors, institutions and countries involved in CED literature, which eventually lead to reconstructing a future agenda for CED research. In our review, we surveyed 560 articles on CED from 215 journals published between 1982 and 2020 to obtain more generalizable and comprehensive outcomes than those of previous review studies of a similar nature.

3. Research Design:

Drawing on a growing trend in recent business management and accounting research (e.g., Dharmani et al., 2021; Donthu et al., 2021; Gössling et al., 2021; Kumar et al., 2021; Xu et al., 2021a; Xu et al., 2021b; Tan et al., 2021; Losse & Geissdoerfer, 2021; Zhang et al., 2021), we use a bibliometric analysis model to identify and evaluate CED studies in order to analyze influential aspects, including streams of CED analysis, CED themes, keywords, notable researchers, journals and countries involved in CED-related research. Crucially, we answer the questions of this study with descriptive analysis and identify core sources, authors, countries, publications, and affiliations in CED research. Source impact, total citations (TC), and net publications (NP) per year are used to identify core sources and authors. Publication frequency and total citations are used to identify top countries and affiliations.

Identifying main CED themes is vital to integrate research streams taken from the evolution of CED-related topics and also plays a key role in directing the future research agenda. For this purpose, some technical tools are adopted, including co-occurrence maps, thematic maps, and thematic evolution. Research streams and themes are identified with the help of keywords, keywords plus, and 'biblioshiny', which are bibliometric tools provided by the R-program (Li et al., 2016).

3.1. Objectives, Methods, and Techniques

This study aims to provide a bibliometric review of the literature regarding the evolution of environmental disclosures. Thus, the areas that need more attention must be identified

and focused on for future research and identification is also required of the less focused dimensions of CED from the practitioners' and regulators' points of view.

The first objective is to identify influential keywords, publications, authors, journals, institutions and countries. For this purpose, descriptive analysis is done with the help of 'biblioshiny', a web-specific R package ('bibliometrix 3.0'). The second objective is to identify primary CED research streams and themes. A Science mapping technique of conceptual structure with a keyword plus fulfils the study's second objective. The third objective is to provide a comprehensive direction for future research agendas based on the outcomes of fulfilling the first two objectives.

3.2. Composition of Bibliometric Data

The composition of bibliometric data has two segments. The first step is to scrutinize the quality source of the research papers. The second is the comprehensive query for holistic data collection, which covers all the relevant sources of papers. The Web of Science, Scopus, Emerald and Google Scholar are the main sources (databases) from where relevant published articles have been taken. Furthermore, the following is the search query made after applying filters to fulfil the objectives and obtain optimal results. This search query is (TITLE-ABS-KEY ("environmental disclosure*") AND TITLE-ABS-KEY ("compan*" OR "firm*" OR "organization*" OR "corporat*")) AND (EXCLUDE (DOCTYPE , "cp") OR EXCLUDE (DOCTYPE , "re") OR EXCLUDE (DOCTYPE , "ch") OR EXCLUDE (DOCTYPE , "bk") OR EXCLUDE (DOCTYPE , "no") OR EXCLUDE (DOCTYPE , "cr") OR EXCLUDE (DOCTYPE , "er") OR EXCLUDE (DOCTYPE , "tb")) AND (LIMIT-TO (LANGUAGE , "English")).

Initially, the search query resulted in 648 documents published in a period spanning between 1982 and 2020 from different countries and institutions. Four additional documents were also present in the list, but these were excluded because of the publication language. Three of the four were in Portuguese, and the other one was in Spanish. As this study focuses on bibliometric analysis, better results will be obtained if all documents are in a single language (Dharmani et al., 2021). For this reason, we have initially excluded documents in other languages from our basic query search. Next, after reading the titles and abstracts of these 648 articles, we further excluded 88 irrelevant documents from the first query search, leaving a total of 560 papers. The final 560 documents are from Business, Management and Accounting (316), Social sciences (88), Econometrics, Econometrics and Finance (77), Environmental Science (59), and Energy (20).

4. Results and Discussion:

Bibliometric analysis is used to statistically evaluate published material, such as books, journal articles and media communication. 'Biblioshiny' is the tool within the R-package, which is designed for non-coders to conduct scientometric and bibliometric analysis to explore the impact of a set of researchers, the effect of a particular journal, and specifically to identify the set of impactful papers in a specific field (Gössling et al., 2021; Kumar et al., 2021; Xu et al., 2021a). The 'Biblioshiny' analysis results are in the form of tables, precise images, and distinctive graphs, which are not common in other software (Moral-Muñoz et al., 2020). Table 1 provides the descriptive characteristics of CED literature, which is indispensable to making progress in our analysis. We finalized 560 documents from 215 journals covering the period from 1982 to 2020. All these journals use 535

keywords plus, 994 authors' keywords, although some articles missed author keywords. There are commonalities in the keywords plus and authors' keywords, based on which double-counting has adjusted the number to 535 and 994, respectively. A total of 1140 authors wrote these documents, with 86 single-authored documents. This shows a high collaboration in CED publications with a high collaboration index of 2.25. The documents per author ratio is 49.1%, which suggests that, on average, two authors have written one document.

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Figure 1 shows the annual production of the documents related to environmental disclosures. It seems that CED received attention from the literary circle when, in 1997, the Kyoto protocol plan was announced. The topic was given attention globally, and then, over time, more and more documents started to be published in relevant journals. Another leap in CED publications came in the second term of the Obama administration in the USA and, ultimately, with the Paris climate agreement that was signed by 198 countries worldwide in 2016. The Paris climate agreement set annual and five-year targets regarding carbon emissions reductions. Although the Trump administration pulled out from the agreement, the importance of CED increased tremendously, as seen in the number of publications after 2016: 36 in 2017, 48 in 2018, 71 in 2019 and 85 in 2020. There is an upward trend in the number of CED publications per year, which confirms the current acceptability of the topic in literary circles globally.

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In addition to the annual production of articles regarding environmental disclosures, it is imperative to see CED's main keywords, scholars, affiliations and places

to identify key future trends in CED research and encourage other scholars and universities to contribute to CED literature by acknowledging the role of the leading researchers, institutions and countries. Figure 2 presents the three-fold analysis of environmental disclosures with the keyword plus on the left side of the figure, institutions of publications on the right side, and the countries of these institutions in the middle of the figure. This three-fold figure shows that the USA (171 publications) has contributed the most by its universities to CED publications. This scholarly effort has been followed by additional contributions to CED literature by China (129 publications), Australia (123 publications), the UK (117 publications), Malaysia (91 publications), Spain (90 publications), Indonesia (85 publications) and Canada (75 publications).

Furthermore, single universities that have produced the largest amount of CED publications are the Illinois state university from the USA (22), the University of Zaragoza from Spain (19), the Concordia University from Canada (18), the University of South Australia from Australia (13) and the China University of Mining and Technology from China (12).

----- INSERT FIGURE 2 RIGHT HERE -----

Also, Figure 2 shows some universities' tendency to focus on a limited number of CED terms or keywords in contrast to other universities having a wider range of coverage of environmental topics. For example, the University of Zaragoza in Spain has primarily focused on the environmental disclosure term, with little attention being devoted to environmental performance. In contrast, Illinois State University has a wider coverage of various CED terms, such as environmental disclosure, environmental accounting, environmental performance and environmental and social disclosures.

Additionally, the most frequent keywords or terms, according to Figure 2, are environmental disclosure (203), environmental performance (55), corporate social responsibility (53), environmental reporting (46) and legitimacy theory (32).

4.1. *Influential Aspects of Environmental Disclosures Literature*

4.1.1. Core Journals

We have applied the source impact technique to find the top journals involved in publishing CED-related literature. Table 2 ranks the articles based on h, g and m-indices, total citations (TC), net production (NP) and publication starting year (PY). Based on our bibliometric analysis, *Business strategy and the environment* tops the ranking in terms of articles production, with 36 articles produced on CED literature, which is significantly higher than other journals. The *Journal of Cleaner Production* followed this in second place with 23 articles, and *Corporate Social Responsibility and Environmental Management* journal is third with 19 articles. Concerning papers' citations, *Accounting, Organization and Society* has the highest number of cited CED papers (6537 citations) in the first place; then *Accounting, Auditing and Accountability Journal* is second with 5350 citations, and the *Journal of Business Ethics* occupies the third position with 1884 citations on CED-related literature. The former classification (i.e., number of publications) shows the journals associated with the quantity of CED research, and the latter (i.e., number of citations) indicates those linked with the quality of CED papers.

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Figure 3 shows the growth in CED publications by the top journals. Loess' smoothing technique is used in creating Figure 3 to understand the growth in CED research in the top journals. This technique also helps understand CED research trends

over time (Royston, 1992). Figure 3 has, interestingly, divided all publications into three categories of journals. The first category represents journals with steep growth in CED publications, including *Business Strategy and Environment*; *Sustainability Accounting, Management and Policy*; and the *Journal of Cleaner Production*. These journals have been undergoing tremendous growth in CED publications from 2010 onward. This trend can be associated with the Obama presidency's first and second tenures (i.e., 2008-2016) when the Dodd-Frank act has been enacted to encourage firms toward more participation in practical environmental transparency (Dalla et al., 2018). At the same time, the Paris climate change accord in 2015 was also an important global event that seemed to trigger the growth of publications on environmental disclosure globally. The second category consists of journals with a flattening trend in CED publications, such as *Corporate Social Responsibility and Environmental Management*, *Social Responsibility Journal*, and *Journal of Business Ethics*. These journals have shown strong growth in social and environmental disclosure publications after 2000, which is, in essence, the time of corporate social responsibility awareness at the global level. The third category involves journals that show a downward slope of article production in CED studies, such as *Accounting Organizations and Society*, *Accounting, Auditing and Accountability Journal*, and *Social and Environmental Accountability Journal*. In these journals, the inception points for the growth of article production came in 1997 after the Kyoto protocol agreement. The importance given to CED studies by this category, which comprised accounting journals, can be attributable to the fact that social and environmental disclosures were initially addressed in the financial statements in the 90s, which sparked this interest in their calls for papers.

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4.1.2. Core Journal Articles

This section highlights the most influential articles in the field of environmental disclosures. The most influential papers on CED have been listed in Table 3. The top four papers will be discussed in an orderly manner as follows.

The most cited paper is by Deegan (2002), with 1275 citations, explaining the role of social and environmental disclosure as one of the many possible motivations for legitimizing companies' operations. Clarkson et al. (2008) is the second most cited paper (1041 citations), which develops a content analysis index for CED information that is based on the Global Reporting Initiative (GRI). This study confirms a significant positive relationship between environmental performance and environmental disclosures in line with the argument of economic disclosure theory.

The third-ranked paper, written by Hackston and Milne (1996), is cited 945 times. This paper examines the main patterns and determinants of social disclosures of firms in New Zealand, including CED. While reporting social disclosures, companies in New Zealand tend to prioritize human resources spending as the basic content, with environmental and societal themes being only secondary content in their reports.

In the fourth position with 866 citations, Neu et al. (1998) examine the antecedents and consequences of CED in Canadian environmentally sensitive industries. Results of the study show that shareholders' concerns are positively associated with increased environmental disclosures. In contrast, concerns for creditors are negatively associated with increased environmental disclosures. This demonstrates that creditors are more

interested in higher profit numbers on the financial statements of companies in comparison to spending more on social welfare. Criticism from regulators and environmentalists is negatively associated with the level of disclosures, which also identifies that societal pressure influences firms' spending on environmentally related matters. It is also seen that a high level of societal attention and concerns are associated with more environmental disclosures.

These most influential papers and others on the list (e.g., Al-Tuwaijri et al., 2004; Deegan and Gordon, 1996; Cho and Patten, 2007; Patten, 1992) sought to achieve two main objectives. First, they explored CED practices' levels, trends and patterns, mainly in the context of developed economies. Second, they explained the reasons behind corporate engagement with CED from three theoretical views: economic theories, sociopolitical theories and institutional theories.

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4.1.3. Core Keywords

Table 4 presents the most frequently used authors' keywords in CED literature. The top three authors' keywords are *environmental disclosures* (203 occurrences), *environmental performance* (55 occurrences) and *corporate social responsibility* (53 occurrences). Furthermore, we see that articles among the top most frequently cited and top-cited papers have also discussed these three keywords, with their interrelation, in detail. Annual reports occurrence as a keyword is 34. In this context, it is worth mentioning that the top three keywords were identified based on data derived from annual reports. Some other important authors' keywords, including content analysis (28 occurrences), corporate governance (27 occurrences), voluntary disclosures (21 occurrences), financial

performance (19 occurrences) and climate change (17 occurrences), are also present in the top authors' keywords.

To sum up, our analysis of authors' keywords shows that CED as a voluntary type of disclosure is measured mainly by a content analysis technique using data published in annual reports and can be influenced by, or have influences on, corporate governance, CSR and financial performance.

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Figure 4 represents the word cloud developed by the frequency of authors' keywords, which again reconfirms the significant keywords. The important authors' keywords in CED-related studies are environmental performance, environmental reporting and corporate social responsibility. In contrast, some other keywords identified by this word cloud are annual reports, legitimacy theory, corporate governance, content analysis and stakeholder theory. Legitimacy and stakeholder theories are frequently used in literature to justify environmental disclosures in firms' annual reports to improve financial and non-financial performance. Firms also use CED to establish a positive image in society by reducing pollution while practising good corporate governance policies.

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4.1.4. Main Authors, Affiliations, Institutions and Countries

This section provides information regarding CED literature's most influential authors, top affiliations, top institutions, and top countries. Firstly, we would like to state that Rob Gray's and Jeffrey Unerman's publications are important contributions to the scholarly establishments of social and environmental accounting literature and a fitting memorial to their recent death.

Table 5 presents the most influential authors in CED literature. The authors are rated based on H-index and G-index³. Dennis Patten from Illinois State University is the top author in the US, with the highest h-index (17) and g-index (23). Patten has produced 23 environmental disclosure documents and received 4053 citations for his CED papers. He has carried out extensive work on the role of environmental disclosures in improving corporate reputation from legitimacy and stakeholder theories views (Cho & Patten, 2007; Patten, 2002; Patten, 1992).

The second most influential author in CED-related literature is Charles Cho from York University in Canada, with an h-index of 12 and a g-index of 14. Cho has produced 14 documents on CED research, which have had 1862 citations. More interestingly, Cho has collaborated with Patten in some of their CED publications. In response to environmental disasters, Cho has worked on legitimizing strategies (Cho, 2009) by firms to improve their reputation and has identified organizational hypocrisy in CED by firms (Cho et al., 2015). Cho has also worked on the relationship between political expenditures, environmental performance and environmental disclosures (Cho et al., 2006).

The third most influential author is Denis Cormier from the Universite de Quebec Montreal Ecole des sciences de la gestion in Canada, with an h-index of 10 and a g-index of 14. Cormier has produced 14 documents on various CED topics and received 1643 citations from different authors. Cormier's research has primarily focused on the impact of CED on investors' decision-making and the financial markets overall response to CED (Cormier et al., 2011; Aerts et al., 2008; Cormier & Magnan, 2007). Cormier has also

³ We calculate these indices for authors based on their CED papers, only.

discussed the role of media pressure in enhancing firms' reputations based on arguments from the legitimacy theory (Aerts & Cormier, 2009).

Another top-cited Canadian author is Michel Magnan from Concordia University, who is ranked fourth on our list, with an h-index of 10 and a g-index of 13. Magnan has produced 13 documents on environmental disclosures and has been cited by 1345 researchers. Magnan and Cormier have also collaborated on different dimensions of environmental disclosures, such as the impact of CED on firms' earnings and valuation (Cormier & Magnan, 2007), the effect of ESG reports on investors' perception (Cormier et al., 2011), and the economic policy perspective of CED (Cormier & Magnan, 2015).

From Australia, Craig Deegan from RMIT University ranked fifth with an h-index of 9 and a g-index of 11, producing 11 CED documents, though he is ranked first based on citations received (4148). His research focuses on the antecedents and consequences of CED engagement mainly from a legitimacy theory perspective (e.g., Deegan & Gordon, 1996; Deegan & Rankin, 1997; Brown & Deegan, 1998; Deegan & Rankin, 1996; Deegan, 2002).

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Table 6 comprises countries with the number of articles produced on CED and the total citations received by the authors within those countries. The highest numbers of CED-related articles were produced in the USA (171), China (129), and Australia (123). The scenario of citations received by the different countries changes the second and third ranks of articles produced, with Australia and the UK being placed second and third, respectively. Specifically, the USA had the highest number of citations from the published CED work of its authors, with 4873 citations from 171 articles, Australia is second with

4774 citations from 123 CED articles, and the UK is in third place with 3749 citations from 117 documents.

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Table 7 presents the most influential institutions globally with the number of articles produced by each institution. Illinois state university is at the top of the list of world-class US universities in terms of producing articles regarding CED; its Environmental Systems Science and Sustainability Department, for example, has produced 22 high-quality articles on CED. The university has provided vital support to its alums and scholars for publications on research regarding pollution, climate change, environmental performance, environmental management, and social disclosures. The University of Zaragoza comes second with 19 CED-related articles. This Spanish university was founded in 1542 with an enriched history of research and development, discovery and learning. The University of Zaragoza is one of Spain's leading research institutions.

Concordia University is the top-ranked Canadian university, ranked third in this list with 18 CED studies. It has also integrated sustainability practices into its operations by issuing a 25-million US dollar unsecured 20-year bond at 3.626 cents in February 2019.

The fourth university on the list of highly influential institutions is the University of South Australia, established in 1991. Within a short span of time, the university has achieved many milestones in research and development and was ranked 295 according to the QS world university rankings in 2021. It has produced 13 CED articles. China University of Mining and Technology occupies the fifth position on this list. It is a double first-class discipline university established in 1909 and works under the direct supervision of the Chinese Ministry of Education. This university has many research-oriented

departments, for instance, Geosciences, the School of Chemical and Environment, the School of Energy and Mining and the School of Management. This explains why sustainability received significant attention in their academic output, resulting in 12 documents on sustainability, environmental and climatic disclosures.

----- INSERT TABLE 7 RIGHT HERE -----

Table 8 presents the list of the top 10 corresponding authors' countries, with the USA at the top of the list. Corresponding authors from the USA have published 45 articles on environmental disclosures, with 40 single-country publications (SCP) and only five multiple-country publications (MCP). Australia is in the second slot with 37 CED articles. Thirty of this total number of articles are SCP, while 7 are MCP. The United Kingdom is third on this list, with 31 CED articles; of these, 27 articles are SCP, and only 4 are MCP. China comes fourth with 26 articles, including 20 SCP and 6 MCP, while Canada is ranked fifth, producing 19 articles, 11 being SCP and 8 being MCP.

----- INSERT TABLE 8 RIGHT HERE -----

Environmental problems and climatic issues are not country-specific issues but rather global issues, and global efforts for awareness and betterment are required to mitigate the consequences of these problems. For this reason, a collaboration between different countries was necessary, although these collaborations are not as extensive as the issues themselves are. The USA has collaborated on nine CED articles with Canada and on seven articles with France. China has collaborated with the USA on six CED articles, while Australia's collaboration with Malaysia amounts to four CED publications. The remaining countries in the table have four and three collaborations, each regarding CED publications.

----- INSERT TABLE 9 RIGHT HERE -----

4.2. CONCEPTUAL Framework

This section helps us understand various streams in CED literature. Tracking this new domain's emergence has been done through the relationship between the keywords involved. At first, the study is a co-occurrence network that helps us identify multiple topics in CED literature over the proposed time. Next, these keywords are analyzed on a thematic map that will explain the network's centrality and density. Finally, a thematic evolution has been produced to demonstrate the evolution of CED literature over time.

Figure 5 represents the co-occurrence of keywords plus developed by Biblioshiny and the R package. The co-occurrence network of environmental disclosures has divided this literature into three main streams with three different colours: red, green and blue. The red cluster represents the role of firms' social and environmental disclosures in legitimizing their operations in the eyes of stakeholders. This stream also describes media coverage of environmental hazards created by highly polluting industries and the consequent implementation of environmental management systems. We call this research stream the *legitimization of environmental hazards via environmental disclosures*.

----- INSERT FIGURE 5 RIGHT HERE -----

The blue cluster represents the stream of CED literature that addressed corporate governance's role in enhancing CED engagements by firms. This role is explicitly motivated by environmental accounting. Specifically, this stream of CED research discusses the costs incurred by companies to remediate contaminated sites, environmental fines, penalties and taxes, and spending on pollution-preventive

technologies and waste management. This combination of environmental accounting and corporate governance policies sometimes results in the development of corporations dedicated to environmental accountability and transparency. This stream is named *the role of environmental accounting in achieving corporate environmental sustainability*.

The third cluster is the green cluster, representing the broader picture of the social disclosure stream of research. Crucially, it focuses on corporate social disclosure as a combined package in which ESG issues have been discussed within the literature. It also describes methodologies, such as content analysis and disclosure indices, that are employed to understand the combination of ESG disclosures. Additionally, this research stream covers the role of the global reporting initiatives (GRI) framework in understanding and communicating the impact of issues, such as climate change, human rights and corruption, on organizations and economies at large. We call this stream in CED research *the integration of ESG practices into the GRI Framework*.

4.3. Thematic Map

CED research themes are further analyzed using strategic diagrams based on density and centrality measures (He,1999). Callon et al. (1991) divided the strategic diagram into four quadrants, representing four different themes of certain literature. Our thematic mapping analysis indicates that stakeholder engagement is among the motor theme. This is the upper right corner of the thematic map that explains the higher potential of internal development. It is also linked to other related research fields, such as business management and strategy. Figure 6 shows the thematic map. The mainstream of CED literature has this integral focus point to support society's welfare and meet stakeholders' expectations; that is why stakeholder theory is in the upper right quadrant.

----- INSERT FIGURE 6 RIGHT HERE -----

Since the early 1980s, legitimacy theory and institutional theory have been extensively employed by CED researchers to underpin the levels, determinants and outcomes of CED practices. These themes, nevertheless, occupy the upper left quadrant, representing very developed yet totally isolated themes. Specifically, one part of the legitimacy theory is located in the upper left quadrant, while the other part is present in the lower left quadrant. The former part of legitimacy theory represents an emerging theme, and the latter denotes a declining theme. This implies that legitimacy theory either has insufficient significance to CED research as an emerging theme or it will have no marginal significance in future CED research as a declining theme.

Additionally, voluntary disclosures, environmental reporting, environmental information disclosures and corporate social responsibility are present in the lower right quadrant. This quadrant represents the basic and transversal themes, having low internal development yet being relevant to CED literature and elaborating on future trends in environmental disclosure research.

4.4. Thematic Evolution

Figure 7 shows the evolution of environmental disclosure research themes over time in a sequential manner. This thematic evolution is constructed through Biblioshiny using keywords plus as input in the software. The output shows the evolution of themes in the study while dividing all the themes into four segments of time. The first segment is from 1982 to 2009, the second covers 2010 to 2015, the third is from 2016 to 2019, and the last is from 2019 to 2020. In our analysis of the period from 1982 to 2009, CED literature was concerned with environmental disclosures as a part of corporate governance; the

promotion of these disclosures was used to improve the image of firms. Thus, applying legitimacy theory from the beginning of the emergence of CED literature in this period has evolved over time. From a practical perspective, initially, as a part of accounting disclosures, CED has evolved into separate fully-fledged environmental reports. From 2010 to 2015, more attention was devoted to separate CSR disclosures and applying environmental management systems to mitigate carbon footprint globally. Again, the application of legitimacy theory was consistently applied by firms for better corporate image building.

----- INSERT FIGURE 7 RIGHT HERE -----

During the 2016-2019 period, CED research became more significant due to the Paris climate change accord; hence, environmental disclosures gained objectivity during this tenure. Also, as a global agreement, the Paris accord highlighted the importance of the GRI guidelines in shaping CED practices. Now companies and countries are trying to seriously pursue a set of strategic environmental and climate change targets. The role of institutional theory in explaining corporate engagements with environmental and social disclosures started to gain momentum during this period. At the same time, ESG reports are now being appreciated and complimented by stock exchanges, for example, the Hong Kong and the UK stock exchanges.

4.5. Reconstructing future CED research agenda

Gray (2010) suggested numerous challenges to future environmental reporting research and the development of environmental accounting practices. Crucially, it is possible to construct a set of characteristics related to effective environmental accounting that would overcome these challenges. For example, environmental accounts must contribute to the

environmental narratives within and about a firm as part of environmental and social dialogues in the context of managing transformation towards sustainable communities (Gray, 2002). Therefore, we believe there is an urgent need to reconstruct a new environmental accounting research agenda with research questions linked to the unfolding sustainability science discourse (Thomson, 2014). Sustainability science has specific attributes associated with building on the environmental accounting research programme (See Bebbington and Larrinaga-Gonzalez, 2012). The sustainability science programme seeks to create knowledge that can diminish negative environmental influences and positively contribute to sustainable transformations, as should CED research.

Drawing on Thomson (2014), we argue that a new CED research agenda should employ sustainability science programmes to produce knowledge that is underpinned by concepts of participatory and democratic involvement and seek to contribute to policy and practice debates. We would also argue that there is a need to use sustainability theories (i) to disrupt accounting processes, practices and expertise directly; and (ii) as the basis for appreciating new forms of environmental accounting and accountability. In this context, CED researchers have employed established social and organisational theories from other domains to disrupt social and environmental accounting (e.g., legitimacy, institutional, and stakeholder theories). Then, they attempted to conclude the implications for sustainable development from their investigation. We believe there are expected merits in reframing CED research from a sustainability science perspective to develop transformative accounting practices for a sustainable world.

5. Conclusion:

The growing interest of powerful stakeholders in environmental information has motivated academic researchers to theoretically and empirically explore this area. Prior review studies of CED literature (e.g., Cho and Patten., 2013; Deegan & Gordon, 1996; Elsakit & Worthington, 2014; Guidry & Patten, 2012; Gray et al., 1996) were confined to assessing the financial determinants of CED (Guidry and Patten, 2012), identifying the trends, caveats, and coherences based upon sociopolitical, economic and institutional theories of carbon disclosure research (Hahn et al., 2015), discussing the possible influence of voluntary CED on firms' environmental performance (Cho and Patten, 2013), and examining the governance-related determinants and financial consequences of carbon disclosure. However, the extant review studies have not used the bibliometric approach to explore influential aspects of CED, including CED research streams, themes, notable researchers, journals, and countries involved in CED research. Thus, we use a bibliometric review model to address this prevailing research need in order to determine emerging CED trends and reconstruct a new CED research agenda.

We have identified three core research streams from CED literature. These research streams are '*legitimizing environmental hazards via environmental disclosures*', '*the role of environmental accounting in achieving corporate environmental sustainability*', and '*integrating ESG practices into the GRI guidelines*'. Furthermore, in conceptual structure, the study has deployed a thematic map to put the themes and subthemes on a graph, which divides them into four parts: niche themes (e.g., institutional theory and environmental management system), motor themes (e.g., stakeholder engagement),

emerging/declining themes (e.g., legitimacy theory), and basic/transversal themes (e.g., voluntary CED, environmental reporting, and corporate social responsibility).

Illinois state university, the University of Zaragoza, and Concordia University are the top affiliations for CED literature. Similarly, *Accounting, Organization and Society*, *Accounting, Auditing and Accountability Journal*, and *Journal of Business ethics* are the leading journals in terms of total citations and key CED studies and authors. At the same time, *Business strategy and the environment*, *Journal of Cleaner Production* and *Corporate Social Responsibility and Environmental Management* are associated with the largest amount of CED publications. Likewise, according to our review, Dennis Patten, Charles Cho, and Denis Cormier are the top authors who have had the maximum impact on CED research.

The main limitation of the study is that it has used authors' keywords to identify CED research streams, themes, key authors, journals, affiliations and countries. There is a need for a comprehensive data mining technique that uses authors' keywords and analyses keywords from abstracts, titles and the whole body of research papers, removes any duplication of similar keywords and terminologies, and then identifies comprehensive future trends in CED research.

After reviewing various vital aspects of CED literature, we can identify some critical directions for future research based on thematic evolution, thematic maps and co-occurrence networks, and some other important aspects of the topic. For example, we recommend reformulating CED research from a sustainability science perspective and using sustainability theories to develop transformative environmental accounting practices for a sustainable world. These research directions will be helpful for

researchers, and more specifically for regulators, corporations, and different climate monitoring bodies, to investigate the correct aspects that may answer the alarming issues in this domain. We also recommend providing funds for influential journals, such as *Accounting, Organization and Society*, *Accounting, Auditing and Accountability Journal*, *Journal of Business Ethics*, and *Business Strategy and the Environment*, to advance high-quality and quantity CED research. Also, there is a need for collaboration between core authors and affiliations, as diverse and highly intellectual opinions may result in high-quality future CED research.

With the number of documents produced and citations, the USA, China and Australia are the research hubs for CED studies. These research hubs are recommended to collaborate with the relevant departments in developing economies for climate standards' development. Our review of CED literature shows that climate issues are lower on the priority list of developing economies. Thus, there is a need to apply a carrot-and-stick policy for developing economies on climate issues to strengthen their willingness to participate in global practices for climate change initiatives.

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Table 1. Descriptive characteristics of CED literature.

Description	Results
Main information about the data	
Timespan	1982:2020
Sources (Journals)	215
Documents	560
Average years from publication	7.88
Average citations per document	59.31
Average citations per year per doc	4.439
References	27474
Document types	
Article	538
Review	22
Document contents	
Keywords plus (id)	535
Authors' keywords (de)	994
Authors	
Authors	1140
Author appearances	1446
Authors of single-authored documents	74
Authors of multi-authored documents	1066
Authors' collaboration	
Single-authored documents	86
Documents per Author	0.491
Authors per Document	2.04
Co-Authors per Document	2.58
Collaboration index	2.25

Table 2. Top 10 journals in CED literature according to source impact

Source	h_index	g_index	m_index	TC	NP	PY
BUSINESS STRATEGY AND THE ENVIRONMENT	16	36	0.762	1347	36	2001
JOURNAL OF CLEANER PRODUCTION	12	23	0.414	1452	23	1993
CORPORATE SOCIAL RESPONSIBILITY AND ENVIRONMENTAL MANAGEMENT	13	19	0.929	1192	19	2008
JOURNAL OF BUSINESS ETHICS	14	19	0.636	1884	19	2000
SOCIAL RESPONSIBILITY JOURNAL	12	16	0.750	282	18	2006
ACCOUNTING, AUDITING AND ACCOUNTABILITY JOURNAL	14	17	0.824	1600	17	2005
SUSTAINABILITY ACCOUNTING, MANAGEMENT AND POLICY JOURNAL	6	8	1.000	82	13	2016
ACCOUNTING, ORGANIZATIONS AND SOCIETY	12	12	0.300	6537	12	1982
BRITISH ACCOUNTING REVIEW	11	12	0.550	1410	12	2002
SOCIAL AND ENVIRONMENTAL ACCOUNTABILITY JOURNAL	7	10	0.250	105	12	1994

Note: TC is the total citations, NP is the net production, and PY is the publication starting year.

Table 3. Most cited CED papers

Papers	Authors	Total Citations	Citations per Year
Introduction: The legitimizing effect of social and environmental disclosures- a theoretical foundation	Deegan, Craig	1275	63.75
Revisiting the relation between environmental performance and environmental disclosure: An empirical analysis	Clarkson, Peter M., Yue Li, Gordon D. Richardson, and Florin P. Vasvari.	1041	74.36
Some determinants of social and environmental disclosures in New Zealand companies	Hackston, David, and Markus J. Milne.	945	36.35
Managing Public Impressions: Environmental Disclosures in Annual Reports	Neu, Dean, Hussein Warsame, and Kathryn Pedwell.	866	36.08
The relations among environmental disclosure, environmental performance, and economic performance: a simultaneous equations approach	Al-Tuwaijri, Sulaiman A., Theodore E. Christensen, and K. E. Hughes li.	839	46.61
A Study of the Environmental Disclosure Practices of Australian Corporations	Deegan, Craig, and Ben Gordon.	736	28.31
The role of environmental disclosures as tools of legitimacy: A research note	Cho, Charles H., and Dennis M. Patten.	727	48.47
Intra-Industry Environmental Disclosures: In Response To The Alaskan Oil Spill: A Note on Legitimacy Theory	Patten, Dennis M.	695	23.17
The relation between environmental performance and environmental disclosure: a research note	Patten, Dennis M.	640	32
Exploring the reliability of social and environmental disclosures content analysis	Milne, Markus J., and Ralph W. Adler.	638	27.74
Environmental disclosures in the annual report. Extending the applicability and predictive power of legitimacy theory	O'donovan, Gary.	593	29.65
Do Australian companies report environmental news objectively? An analysis of environmental disclosures by firms prosecuted successfully by the Environmental Protection Authority	Deegan, Craig, and Michaela Rankin.	569	21.88
An examination of the corporate social and environmental disclosures of BHP from 1983-1997 A test of legitimacy theory	Deegan, Craig, Michaela Rankin, and John Tobin.	540	27
Corporate Communication and Impression Management - New Perspectives Why Companies Engage in Corporate Social Reporting	Hooghiemstra, Reggy.	535	24.32
An Evaluation Of Environmental Disclosures Made In Corporate Annual Reports*	Wiseman, Joanne.	515	12.87
The public disclosure of environmental performance information—a dual test of media agenda setting theory and legitimacy theory	Brown, Noel, and Craig Deegan.	504	21
Corporate social responsibility in the mining industry: Exploring trends in social and environmental disclosure	Jenkins, Heledd, and Natalia Yakovleva.	477	29.81
Environmental disclosure quality in large German companies: Economic incentives, public pressures or institutional conditions?	Cormier, Denis, Michel Magnan, and Barbara Van Velthoven.	417	24.53
Social and Environmental Disclosure and Corporate Characteristics: A Research Note and Extension	Gray, Rob, Mohammed Javad, David M. Power, and C. Donald Sinclair.	383	18.24
Factors Influencing the Quality of Corporate Environmental Disclosure	Brammer, Stephen, and Stephen Pavelin	380	27.14

Table 4. Authors' keywords on the basis of occurrence

Author Keywords	Occurrences	Author Keywords	Occurrences
Environmental Disclosures	203	Global Reporting Initiative	22
Environmental Performance	55	Environmental Information Disclosure	21
Corporate Social Responsibility	53	Voluntary Disclosure	21
Disclosure	53	Social Disclosure	20
Environmental Reporting	46	Environmental Management	19
Annual Reports	34	Financial Performance	19
Legitimacy Theory	32	Environmental Accounting	18
Content Analysis	28	Legitimacy	18
Corporate Governance	27	Climate Change	17
Environmental And Social Disclosure	24	Environment	17

Table 5: Top authors of CED publications according to source impact

Author	h_index	g_index	m_index	Total Citations	Net production	Publication Starting Year
Patten, Dennis	17	23	0.567	4053	23	1992
Cho, Charles	12	14	0.75	1862	14	2006
Cormier, Denis	10	14	0.435	1643	14	1999
Magnan, Michel	10	13	0.435	1345	13	1999
Deegan, Craig	9	11	0.346	4148	11	1996
De Villiers, Charl	7	7	0.438	622	7	2006
Freedman, Martin,	7	7	0.333	439	7	2001
Gallego-Alvarez, Isabel	3	5	0.75	25	6	2018
Moneva, Jose	5	6	0.227	303	6	2000
Roberts, Robin W	6	6	0.375	673	6	2006
Van Staden, Chris J	6	6	0.375	778	6	2006
Wang, Yutao	3	4	1	22	6	2019
Yao, Shujie	3	4	0.6	17	6	2017
Gerged, Ali Meftah	3	5	0.75	39	5	2018
Laine, M	4	5	0.308	189	5	2009
Llena, Fernando	4	5	0.182	321	5	2000
Michelon, Giovanna	4	5	0.4	343	5	2012
Pucheta Martínez, María Consuelo	3	4	0.75	22	5	2018
Chen, Jennifer C	3	3	0.214	37	3	2008
Djajadikerta, Hadrian Geri	2	4	0.2	53	4	2012

Note: authors' h index, g index and m index were computed based on the citations of their CED publications only.

Table 6. Top countries in terms of CED publications and citations

Country & regions	Frequency	Country & regions	Total citations
USA	171	USA	4873
CHINA	129	AUSTRALIA	4774
AUSTRALIA	123	UNITED KINGDOM	3749
UK	117	CANADA	3520
MALAYSIA	91	NEW ZEALAND	1108
SPAIN	90	SPAIN	727
INDONESIA	85	CHINA	631
CANADA	75	NETHERLANDS	578
BRAZIL	68	FRANCE	386
ITALY	47	FINLAND	363

Table 7: Most influential affiliations (universities) in CED publications

Affiliations	CED Articles
ILLINOIS STATE UNIVERSITY	22
UNIVERSITY OF ZARAGOZA	19
CONCORDIA UNIVERSITY	18
UNIVERSITY OF SOUTH AUSTRALIA	13
CHINA UNIVERSITY OF MINING AND TECHNOLOGY	12
ISLAMIC AZAD UNIVERSITY	11
UNIVERSITY OF GRANADA	10
DIPONEGORO UNIVERSITY	9
MASSEY UNIVERSITY	9
RMIT UNIVERSITY	9
TAMKANG UNIVERSITY	9
UNIVERSIT� DU QU�BEC � MONTR�AL	9
UNIVERSITI UTARA MALAYSIA	9
UNIVERSITY OF SALAMANCA	9
INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA	8
NOTREPORTED	8
UNIVERSITY OF DELHI	8
UNIVERSITY OF SOUTHERN QUEENSLAND	8
UNIVERSITY OF TAMPERE	8
FEDERAL UNIVERSITY OF BAHIA (UFBA)	7

Table 8. Corresponding authors' country representation

Country	Articles	Frequency	Single Country Publication	Multi-Country Publication	Multi-Country Publication Ratio
USA	45	0.16245	40	5	0.1111
AUSTRALIA	37	0.13357	30	7	0.1892
UNITED KINGDOM	31	0.11191	27	4	0.129
CHINA	26	0.09386	20	6	0.2308
CANADA	19	0.06859	11	8	0.4211
SPAIN	17	0.06137	16	1	0.0588
MALAYSIA	13	0.04693	8	5	0.3846
NEW ZEALAND	10	0.0361	6	4	0.4
BRAZIL	8	0.02888	6	2	0.25
FRANCE	8	0.02888	2	6	0.75

Table 9: Collaboration network

From	To	Frequency
USA	CANADA	9
USA	FRANCE	7
CHINA	USA	6
AUSTRALIA	MALAYSIA	4
AUSTRALIA	SOUTH AFRICA	4
CANADA	FRANCE	4
ITALY	UNITED KINGDOM	4
AUSTRALIA	KENYA	3
CANADA	BELGIUM	3
CHINA	AUSTRALIA	3

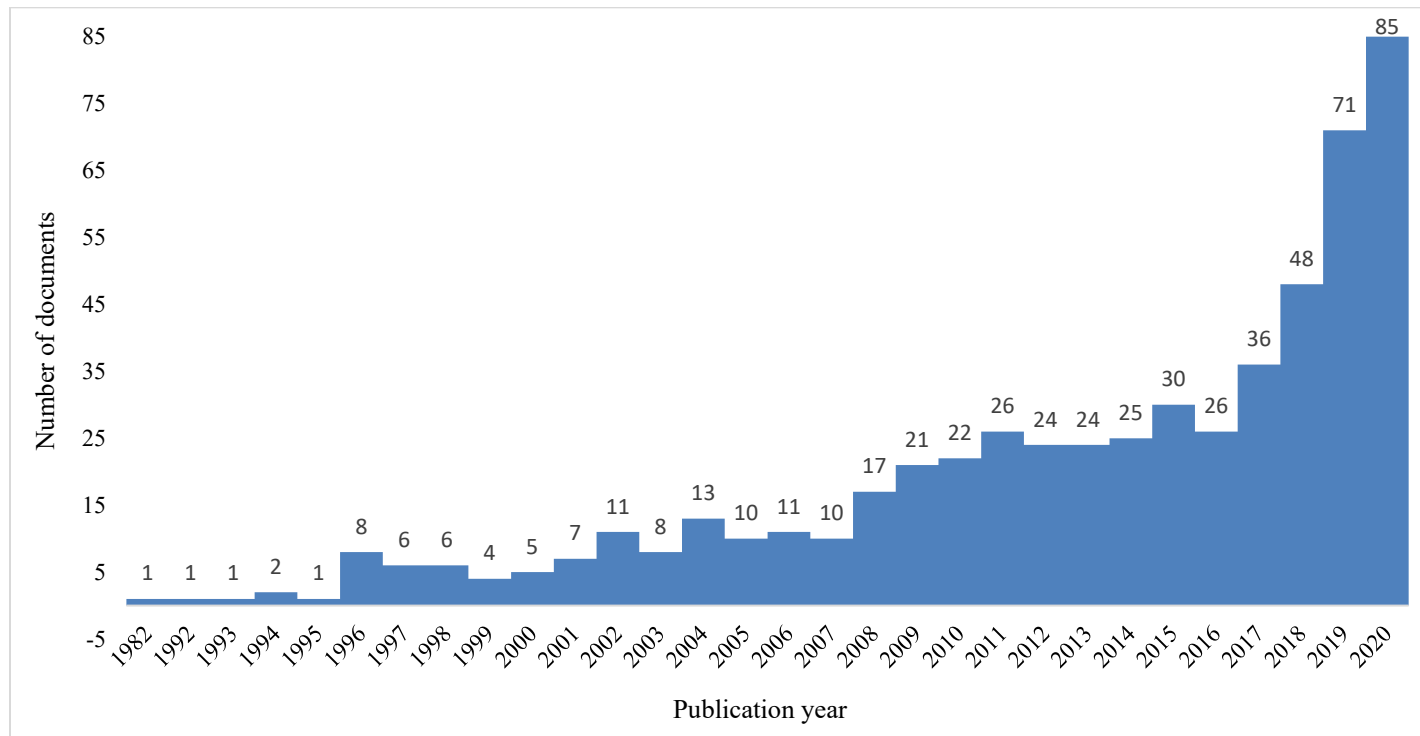


Figure 1. The Production of CED-related Publications Per Year

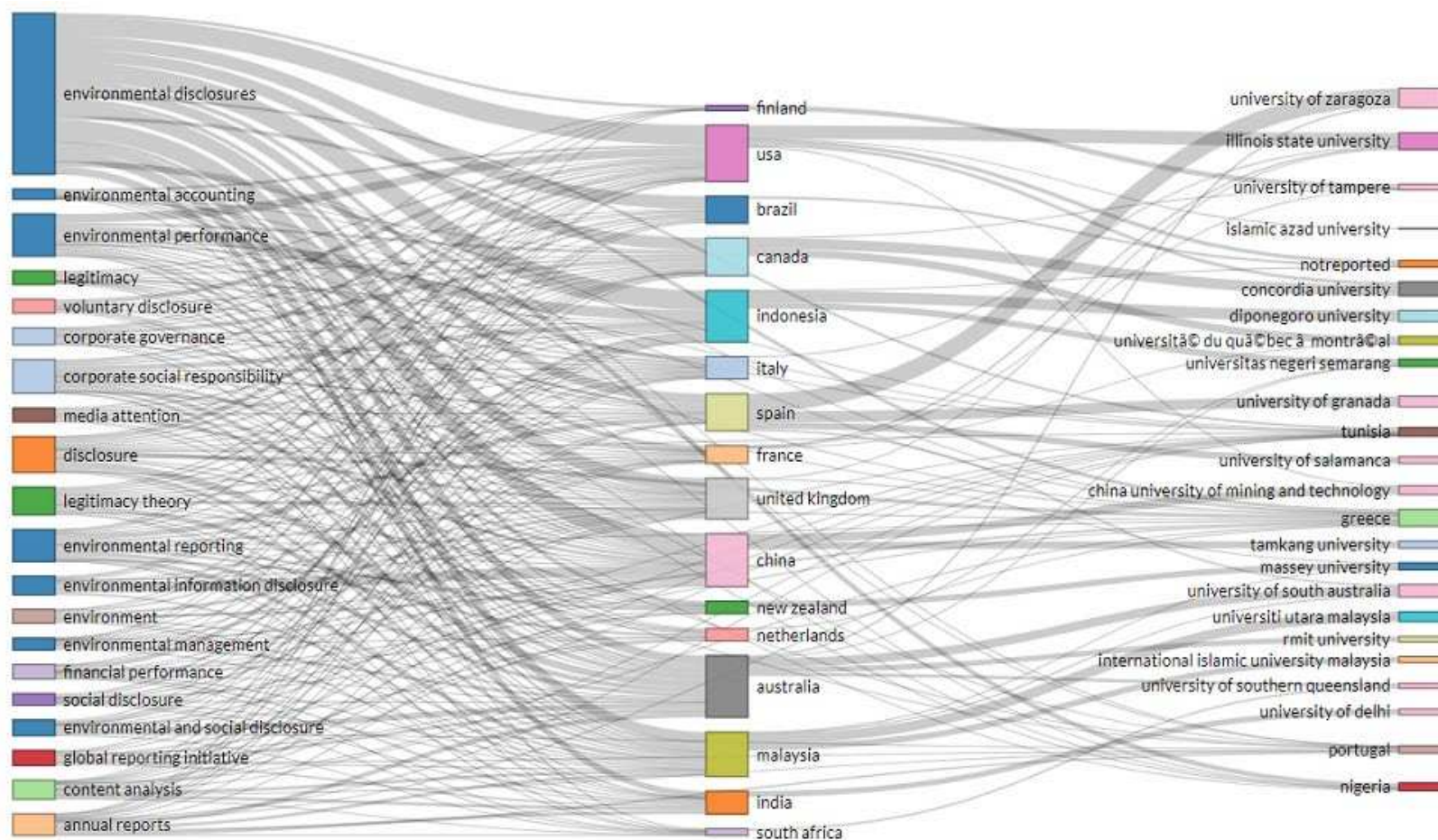


Figure 2. Three-field analysis of environmental disclosures linking universities to countries to themes

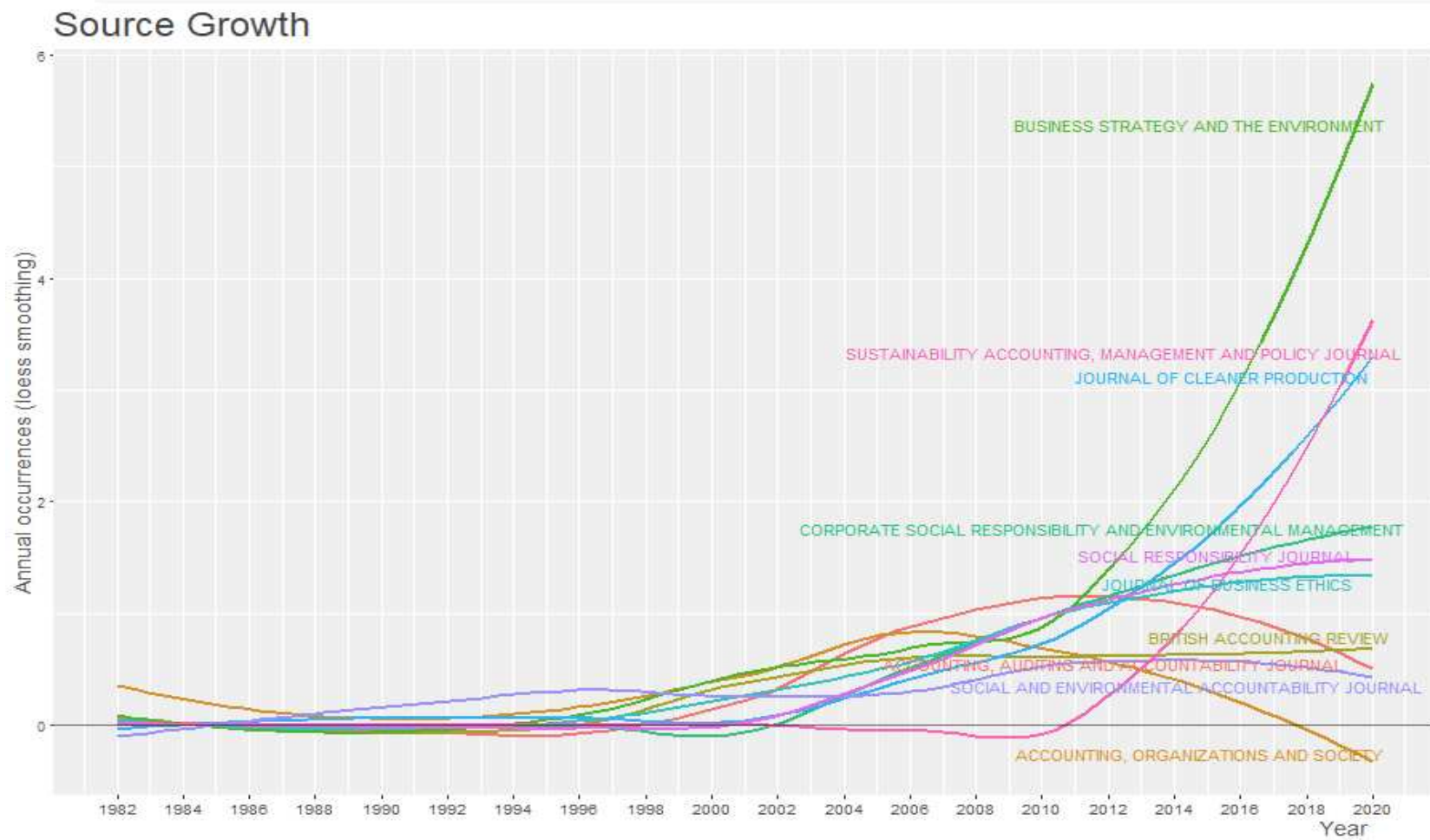


Figure 3. Trends in CED research in the top journals over time



Figure 4. Word cloud developed by the frequency of authors' keywords



Figure 5: Co-occurrence network of keywords plus that categorises CED research into three streams

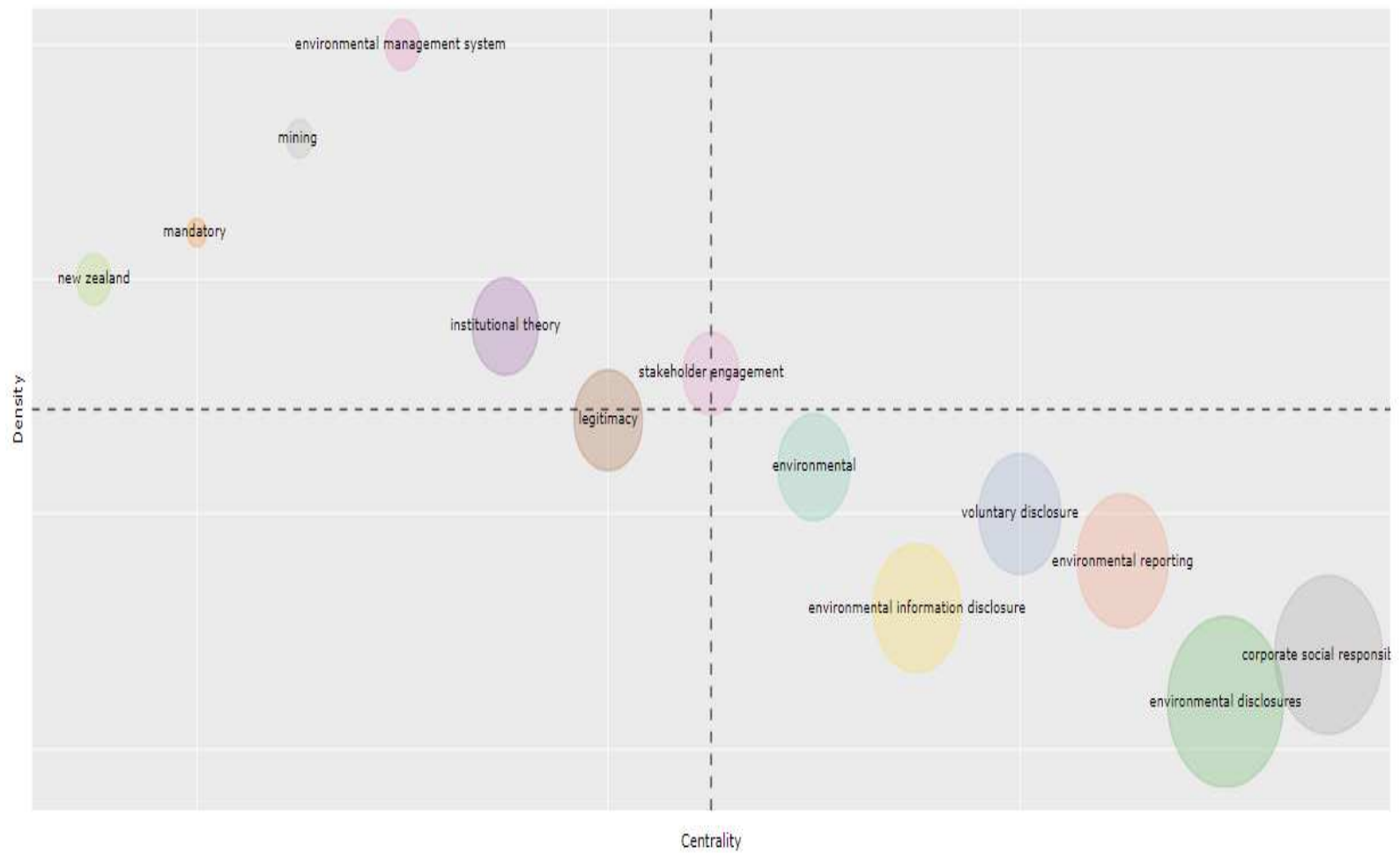


Figure 6. A thematic map that classifies CED literature into three main themes

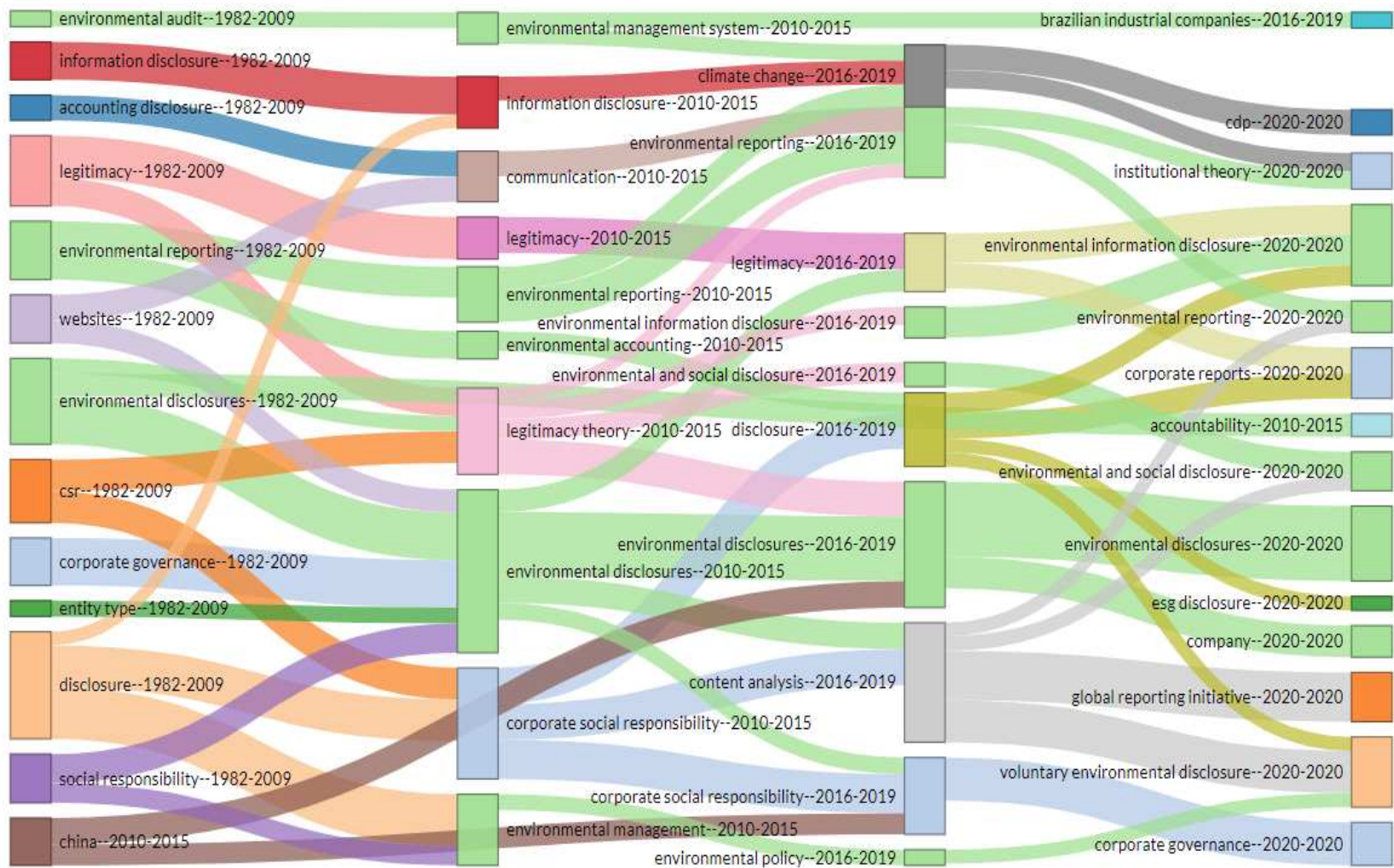


Figure 7. Thematic evolution of CED research themes over time in a sequential manner