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'ON CLIMATE CHANGE AND SUSTAINABLE DEVELOPMENT'

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The Grey Journal

An International Journal on Grey Literature

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The Grey Journal is a flagship journal for the international grey literature community. It crosses continents, disciplines, and sectors both public and private.
The Grey Journal not only deals with the topic of grey literature but is itself a document type classified as grey literature. It is akin to other grey serial publications, such as conference proceedings, reports, working papers, etc.

The Grey Journal is geared to Colleges and Schools of Library and Information Studies, as well as, information professionals, who produce, publish, process, manage, disseminate, and use grey literature e.g. researchers, editors, librarians, documentalists, archivists, journalists, intermediaries, etc.

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About GreyNet

The Grey Literature Network Services was established in order to facilitate dialog, research, and communication between persons and organizations in the field of grey literature. GreyNet further seeks to identify and distribute information on and about grey literature in networked environments. Its main activities include the International Conference Series on Grey Literature, the creation and maintenance of web-based resources, a Global Distribution List and Social Media, and The Grey Journal. GreyNet is also engaged in the development of distance learning courses for graduate and post-graduate students, as well as workshops and seminars for practitioners.

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EDITOR'S NOTE

The role of grey literature publishers much like that of commercial publishers is to provide value added information to publications in advance of their dissemination. Today, this involves the inclusion of rich metadata and actionable persistent identifiers. Together they enhance both the generation and transfer of knowledge. Likewise, for grey literature to meet and benefit from compliance with FAIR data principles, publishers must be proactive in the inclusion of PIDS and their associated metadata.

This approach to enhanced publication further demonstrates the value of crosslinking in the publication trail. For example, by incorporating PIDS, research data associated with full-text can appear openly accessible in a data archive even prior to the publication of the manuscript. Likewise, video recordings of conference presentations can be published in an audio-visual portal prior to their publication as conference papers. Similarly, conference papers can appear published and openly accessible in a federated or institutional repository independent of their publication in the conference proceedings.

The more accessible a publication is upon its introduction in the information chain the greater the potential impact it can have. This is of course the significant benefit open access offers grey literature. When the publication further contains actionable persistent identifiers such as the DOI, ORCiD, ROR, and Funder ID along with associated rich metadata the researcher and end-user stand to further gain. Today, the inclusion of PIDS is no longer seen as an added benefit but rather becomes a precondition.

Not only are grey literature publishers responsible for the inclusion of PIDS and metadata related to their publications but also the authors and researchers are invited, if not mandated to do so. When they are provided with standardized online templates accompanied by scope notes, this can both enhance the quality of the publication, while decreasing the time in which their work becomes findable, (openly) accessible, interoperable, and (re)useable.

Dominic Farace
Journal Editor

Collection Development and Maintenance of Accurate Grey Literature on Climate Change: A Case Study of the Law and Policy in the United States*

Tomas A. Lipinski and Joyce Lee
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Abstract
The United States exists in a Post-truth Era with false beliefs such as the moon landing was a hoax, the 2020 presidential election was stolen, the Chinese government created, then distributed the Covid-19 virus and many others. Conspiracy theorists abound in the U.S. cultural and political landscape. Another such belief is that climate change is a myth; it is not occurring.
*This study explores in a U.S. Constitutional context the ability of public librarians and public libraries to collect and maintain truthful (trusted) grey content regarding climate change. One element of many collection development policies in libraries is accuracy. See, ACLU v. Miami-Dade County School Board, 557 F.3d 1177, 1184 (11th Cir.), cert. denied 130 S. Ct. 659 (2009). Accuracy is also used to assess collection maintenance. Prior content including grey literature created and collected at time when climate change was unproven is no longer accurate and should be withdrawn. Likewise requests by patrons to keep or add content presenting an alternative and inaccurate viewpoint regarding climate change should be withdrawn or refused. In the United States the First Amendment guarantees not only the right to speak but also to receive information, including in a public library, the "**quintessential locus** of the receipt of information." Kreimer v. Bureau of Police for Town of Morristown, 958 F.2d 1242, 1255 (3d Cir. 1992). Under First Amendment Forum analysis, a public library collection would be considered a non-public forum while the public spaces within the library are a limited public forum. See, Faith Center Church Evangelistic Ministries v. Glover, 462 F.3d 1194, 1204 (9th Cir. 2006). In a non-public forum, government policies that regulate speech must be rationale and viewpoint neutral. See, Case v. Unified School District No. 233, 908 F. Supp. 864, 875 (D. Kan. 1995).*
The constitutional framework poses the following questions: Do public library patrons have a right to require that inaccurate grey content regarding climate change be retained or added to the collection? Must a public library accept gifts of such content, adding it to its collection? Likewise do those same patrons have the right to object when librarians withdraw inaccurate grey content regarding climate change reflecting an alternative viewpoint?
A textual analysis of the extant case law regarding the rights of public librarians and their patrons is undertaken in order answer these questions. In addition to relevant U.S. Supreme Court, the following cases among others are analyzed and discussed. ACLU v. Miami-Dade County School Board, 557 F.3d 1177 (11th Cir.), cert. denied 130 S. Ct. 659 (2009); Elgi v. Chester County Library System [CCLS], (E.D. Pa. 2019); and Via v. City of Richmond, 543 F. Supp. 382 (D.C. Va. 1982).
Anticipated results of the research: The cases reviewed should prove instructive regarding the rights and limitations of public librarians and libraries to collect and maintain accurate content including grey literature regarding climate change as well as the rights and limitations of patrons possess to impact that collection development and maintenance process. Strategies and responses to interactions with patrons holding alternative viewpoints on climate change are forwarded to assist public libraries and its librarians in their efforts to collect and maintain truthful, trusted grey content regarding climate change.

Keywords: *Free Speech, Public Forum Analysis, Content Challenges and Removal, Library Discretion in Collection Building and Maintenance*

* First published in the GL25 Conference Proceedings, February 2024 https://doi.org/10.26069/greynet-2024-000.499-gg

Introduction

While climate change impacts every individual, certain individuals have access to avenues to promote literacy and awareness of the climate change phenomenon. Public libraries and public librarians are, in fact, "in a critical position with the potential to be educational leaders in their communities" (Trotter & Komarnytska, 2023, p. 209) on the topic of climate change. However, there are several issues public libraries face when educating individuals on the topic of climate change. These issues include interfacing with individuals who do not believe in the climate change phenomenon, such as climate change denialists living in a "post-truth" era, and, as a result, individuals who wish to remove items from libraries' collection reflecting the reality about specific conditions which they deny, or adopt inaccurate materials reflecting an "alternate truth."

This paper is divided into several sections. The first section will explore the foundations of the philosophy of truth and the problem of post-truth. The second section will explore the United States context of post-truth narratives involving the restriction and censorship of sensitive topics as well as science and climate change denial and what that means for in a post-truth world. Third, we will bring forth several legal cases in the United States to analyze the First Amendment, including prior restraint and viewpoint discrimination. Then, we will discuss legislation impacting grey resources and put forth recommendations for library sustainability strategies, as well as for public library collection building and maintenance of trusted climate resources, grey or otherwise. We argue that in terms of collection development and maintenance, accurate grey literature on climate change will guide public libraries' role in developing awareness of the climate change phenomenon among their patrons.

Part I Truth Theories and the Problems with Post-Truth

Although this paper will not delve deeper into truth theories, a philosophical foundation through truth theories will be discussed in this section, which serves as a basis for the discussion of the concepts of truth and post-truth narratives. These concepts can be evaluated particularly through the correspondence theory, consensus theory, and constructivist theories of truth. The concept of truth is not limited to these theories and is also not limited to the discussion below.

The correspondence theory of truth considers truth as correspondence between a fact, statement, or belief and objective reality (Russell, 1906). As it is arguable that "we have no access to objective reality independent of ourselves against which to match our claims and beliefs," (Porpora & Sekalala, 2019, p. 940), the concept of objective reality is disputable. This theory is applied to a universal and indisputable reality. Although this theory is applicable to the factual conditions of the planet, it falls short when individuals do not acknowledge the state of the world *is* the reality, in which much of these conditions are the result of human actions. Anthropogenic causes of climate change are the accumulation of the economic usage of fossil fuels and carbon dioxide emissions, resulting in environmental injustice (Oreskes, 2023). There are many who simply deny this reality or believe they play no part in it.

Another truth theory, the consensus theory, considers truth to be agreed upon among a community or society. With the paradox of post-truth, "it appeals to consensus (for post-truth) as a way of undermining another consensus (for truth)" (Bufacci, 2020, p. 355). In an ideal world, elements of Jürgen Habermas' concept of the public sphere, or a place for discourse to develop public opinion, would apply. However, the concept of the public sphere, with the original rules and expectations of "a collective willingness to cooperate in the search for meaningful agreement on how the world is and should be" (Foust & Pratt, 2021) was reconstructed over time and ultimately faced its downfall. The proliferation and deregulation of sensationalist online news, forums, and other networking sites (including social media) on the Internet "…made consensus on post-truth much easier to manufacture" (Bufacci, 2020, p. 356) even though a superficial means which reflect a 'public sphere.' This is inevitably problematic with the evolution of artificial intelligence (AI) to repost misinformation[1], thus increasing the number of these posts available for others to consume and continues to create an echo chamber lacking critical discourse. Misinformation about climate change is also occurring through native

advertising, or a form of paid content embedded within real news articles even from widely circulating news distributors, often "misrepresent[ing] the full extent to which fossil fuel companies are responsible for climate change" (Colarossi and Ricciardi, 2023). It is difficult to dismiss the potential attribution of these misinformation reposts and ads to a disinformation campaign. These insidious ads fabricated by predatory companies and sanctioned by traditionally trusted resources ultimately influences individuals into the false and captivating narrative that humans are faultless in their contribution to the problem of climate change.

Finally, constructivist theories of truth can differ depending on the evaluative lens. Building on the concept of reality, this theory of truth does not consider a shared reality as "facts are contingent upon consciousness and human activities and are created or 'constructed,'" (Brahms, 2020, p. 13) which rejects the correspondence theory of truth. Those who view such ads and articles previously mentioned with false narratives and do not see any physical evidence of climate change around them or do not equate global disasters with climate change may deny that the phenomenon is occurring. This is a point of view, or a perspective, which allows those who deny climate change to shift blame and accountability for climate change conditions away from themselves and to other entities.

Climate change denialists and skeptics fall victim to manufactured arguments as "alternative truths," allowing doubt to further influence both individual and political decision-making and obstructing the actions needed to combat climate change. This action occurs in what is called post-truth crisis (Sher, 2022) or epistemological crisis (Friedman, 2023), in an era where individuals "believe information that appeals to emotions or existing personal beliefs" (Cooke, 2017, p. 212) and fail to think critically. Post-truth itself is the irrelevance of truth (McIntyre, 2018), where properties of soundness and validity are insignificant. However, the lack of the significance of truth threatens its value, which has profound effects on not only the value of truth but what humanity does because of the loss of the value of truth. Although post-truth is a phenomenon throughout the globe, we will discuss post-truth narratives in the context of the United States in the next section.

Part II United States Context of Post-Truth Narratives

Post-truth narratives are prevalent in post-truth politics and present in any realm where there is evidence; emotions or feelings of an event, phenomena, or such evidence; and a platform to provide feedback. Two post-truth narratives in the United States discussed below, restrictions on library collections and science and climate change denial, will provide a framework for the discussion of several cases exploring First Amendment challenges in the following sections.

Restrictions on Library Collections and Classroom Censorship on Sensitive Topics

The American Library Association (ALA) has seen challenges to nearly 1,915 unique titles and 3,923 total titles in the year 2023 alone (American Library Association, 2023b; American Library Association, 2023c) with the majority occurring at public libraries, school libraries, and schools. These challenges "attempt to remove materials from curricula or libraries, thereby curtailing the ability of others to access information, views, ideas, expressions, and stories" (American Library Association, 2023b). Reasons for book bans or challenges are subjective, but the consensus and those who subsequently participate in authoring legislation, can influence the choices made for their community, predominantly in places that should be providing and promoting access and education. One of the problems with bans or challenges is that it is the attempt to "eliminate narratives…elucidat[ing] the truths of marginalized groups" (Cooke, 2023) as seen in the United States, where 7 out of 13^2 of the top challenged books of 2022 reported by the American Library Association centered around LGBTQIA+ content including gender identity and sexuality. Other highly challenged topics are race and critical race theory (CRT), in which these challenges bring forth fallacious arguments such as "the critical race theory is defamatory…forc[ing] feelings of racial guilt and distress upon white students," (Shearer, 2022) when the goal is to examine racism as a social construct, and historically—particularly the reality of systemic racism.

Individuals who identify with a certain group and lack intergroup contact, or contact with other social groups other than their own, may believe certain conditions are lies or that a specific phenomenon is false. These statements are repeated frequently within their group and may be sensationalized on the news. When presented with the truth, these individuals will doubt it, in contrary to the evidence available and even against their own judgment, leading to prejudices.

Challenges continue to arise ranging from claims of obscenity to lifestyle differences in misalignment with the requestor's moral values. In terms of legality, United States public schools can "exercise discretion to restrict the range of permissible materials," (Fiore, 2011, p. 98) specifically through decisions made by local school boards. Such valid exercise of discretion can lead to skewed or inaccurate content in the curriculum or library shelves. For example, in one school district in a suburb of Milwaukee, science teachers are forbidden from using the phrase "climate change,"[3] but teaching and discussing the impact that humans have on the environment is possible without using the phrase.

The topic of climate change depicted in books is not excluded from the list above, even though it is not the most popular topic to challenge. In Kutztown, Pennsylvania, the attempt to remove a middle-school academic curriculum teaching a book about climate change occurred in early 2023. A school board member spearheaded this attempt by claiming educators were "pushing a politically charged book about climate change [and] questioned if the other side would be presented" (Mitchell, 2023) exemplifying the two-sides fallacy (Froehlich, 2017, p. 8). As discussed in the next section, facts about climate change or any other topic are not opinion, apolitical, or impermissible viewpoint discrimination. As one appellate court posed rhetorically for example, "what about a book that talked about the life of German children during the Third Reich? …Hitler is out of favor now. Political orthodoxy views his regime as evil… And what about a book about life in the antebellum South …Would we describe that book as 'apolitical'?"[4] It goes without saying that climate change has been observed over many years and that there is evidence for anthropogenic causes. However, some still deny science and climate change regardless of the overwhelming amount of evidence.

Science and Climate Change Denial

Science denial includes many categories such as rejecting the benefit and safety of vaccinations, the theory of evolution, pseudoscientific beliefs about the shape of the Earth ("flat earth"), the revolution of the planets in our solar system, and the human impact on climate change. Individuals who lack the basic literacy of such phenomena may deny scientific evidence at a superficial level. However, post-truth composes another story about those who deny science; not because there is not a lack of understanding, but rather the truth is irrelevant to them.

Lee McIntyre calls the climate change phenomenon, the "most egregious case" (McIntyre, 2018, p. 27) of science denial. Like book bans or challenges due to certain topics, individuals denying climate change believe it is a "direct and intentional assault on their personal lifestyles and moral attitudes" (Rubin, 2017, p. 105). Arguments of the denial of climate change in the era of post-truth can be described by more logical fallacies or biases, such as the appeal to false authority fallacy where opinions of individuals lacking real authority on a subject are treated as authoritative and laypeople put trust in those opinions. This fallacy is a result of corporate attempts[5] to create counternarratives such as the fossil fuel industry and its motive of self-preservation or the politics of geography such as states or regions economically dependent upon the fossil fuel industry. Social media posts from Donald Trump who frequently posted about climate change and global warming skepticism before and during his presidency (Matthews, 2017) are other examples of this fallacy, with numerous grey literature reports (Anderson, 2016; Borick et al., 2017; Greenpeace, 2019) which followed in attempt to invalidate his claims and provide input for policy issues the posts would affect.

More recently, the Pew Research Center (2023) released a report noting that Americans' climate change perceptions are tied strongly to their partisan affiliation rather than to the actual conditions of their area. However, it is not just beliefs that set these individuals apart as

"ideology trumps science" (McIntyre, 2018, p. 34), because the actions of those who deny science and climate change affect others. Several states possessing a conservative political background or have conservative leadership, including Florida, Montana, and Oklahoma, are partnering with PragerU, a conservative non-profit which developed classroom education materials containing misleading information about climate change and other climate change denial material, further pushing the conservative agenda (Branch, 2023a; Branch, 2023b; Reuters, 2020). These choices will not only affect young individuals learning about climate change for the first time, but also the choices of materials and resources made available through places traditionally prescribed to provide and promote access and education.

In the next section, the issues above will be put into perspective with the discussion of several cases regarding collection development and maintenance the First Amendment.

Part III First Amendment and the Legal Framework for Content Review in Library Collections

In the United States the Free Speech provision of the First Amendment guarantees not only the right to speak but also to receive information, including the right to read. The "public library, the ***quintessential locus*** of the receipt of information"[6] plays an important role in facilitating citizens exercise of these right. Under First Amendment Forum analysis, a public library collection would be considered a non-public forum. In a non-public forum, where free speech rights are the least robust, government policies that regulate speech need only be rationale and viewpoint neutral.[7] Patrons do have a First Amendment right derived from the Free Speech clause to be in a public library due to a Liberty Interest.[8] Courts view the public spaces of a public library, as opposed to administrative or staff workspaces, as a limited public forum.[9] In a limited public forum, the exercise of patron speech rights can be limited to that which conforms to the nature of the forum: "Its [public library] very purpose is to aid in the acquisition of knowledge through reading, writing and quiet contemplation… exercise of other oral and interactive First Amendment activities is antithetical to the nature of the Library."[10] While patrons have a Liberty Interest to be in the service areas of a public library, but the nature of the collection itself is that of a nonpublic forum. Where again, the regulations of the speech is subject to a mere reasonableness standard and be viewpoint neutral: "the First Amendment prohibits the removal of books from libraries based on either viewpoint or content discrimination."[11] These standards are often expressed in the collection development policy of the library.

In the context of trusted grey literature on climate change the constitutional framework poses the following questions: Do public library patrons have a right to require that inaccurate grey content regarding climate change be retained or added to the collection? Must a public library accept gifts of such content, adding it to its collection? Likewise do those same patrons have the right to object when librarians withdraw inaccurate grey literature or other library content for that matter, regarding climate change that reflects an alternative viewpoint? A textual analysis of the extant case law regarding the rights of public librarians and their patrons is undertaken in order answer these questions.

As the literature regarding climate change has evolved over the past several decades, there may in fact be outdated or otherwise questionable content that the library desires to deaccession. For example, in one review there were 108 "English-language books that reject the strong scientific evidence that global warming is occurring, that human activities are the predominant cause, and that negative impacts to humans and natural systems may occur" published between 1982 and 2010.[12] What are the legal standards involved in the deaccessioning of such titles? The legal (constitutional) standards are offered by the United States Supreme Court. Writing for the plurality in *Board of Education, Island Trees Union School District No. 26 v. Pico*, Justice Brennan saw a distinction, between the **removal** of school library items and the **acquisition** of school library items: "Furthermore, even as to library books, the action before us does ***not*** involve the ***acquisition*** of books. Respondents have not sought to compel their school Board to add to the school library shelves any books that students desire to read. Rather, the only action challenged in this case is the removal from school libraries of books originally placed there by the school

authorities, or without objection from them."[13] Removals are therefore permissible but must comply with constitutional standards. "Petitioners rightly possess significant discretion to determine the content of their school libraries. But that discretion may not be exercised in a narrowly partisan or political manner… Thus whether petitioners' removal of books from their school libraries denied respondents their First Amendment rights depends upon the **motivation** behind petitioners' actions."[14] The Court cautioned that content may not be removed because of the viewpoint or ideas expressed in the item. "If petitioners intended [motivated] by their removal decision to deny respondents access to ideas with which petitioners disagreed… then petitioners have exercised their discretion in violation of the Constitution."[15] The Court proceeded to offer examples of the impermissible motivation, whereby there is an attempt to suppress the ideas expressed by the content. "If a Democratic school board, motivated by party affiliation, ordered the removal of all books written by or in favor of Republicans, few would doubt that the order violated the constitutional rights of the students denied access to those books. The same conclusion would surely apply if an all-white school board, motivated by racial animus, decided to remove all books authored by blacks or advocating racial equality and integration."[16] There are, however, constitutional standards for removal of material from a public school library or public library. "On the other hand, respondents implicitly concede that an ***unconstitutional motivation*** would **not** be demonstrated if it were shown that petitioners had decided to remove the books at issue because those books were ***pervasively vulgar***. Tr. of Oral Arg. 36. And again, respondents concede that if it were demonstrated that the removal decision was based solely upon the '***educational suitability***' of the books in question, then their removal would be 'perfectly permissible.' In other words, in respondents' view such motivations, if decisive of petitioners' actions, would **not** carry the danger of an official suppression of ideas, and thus would **not** violate respondents' First Amendment rights."[17] The Court did not define how much vulgarity rises to a level "pervasively." However, such content is unlikely to be found in grey literature regarding climate change. "Furthermore, while the Book Review Committee appointed by petitioners was instructed to make its recommendations based upon criteria that appear on their face to be permissible—the books' "educational suitability," "good taste," "relevance," and "appropriateness to age and grade level," the Committee's recommendations that five of the books be retained and that only two be removed were essentially rejected by petitioners."[18] A court will view library professionals, and in school settings affiliated individuals such as a Reading Specialist, Head of Curriculum, etc., as best positioned to decide if material is educationally suitable or not.[19]

When Administrators or Library or School Boards ignore and override the decision of these individuals during a "book challenge" or reconsideration process, courts are more apt to suspect an improper ill-motive, with removal often based on impermissible viewpoint discrimination.[20] Likely content that is outdated regarding the topic of climate change is no longer educationally suitable and may be permissibly removed for the collection of a public or public school library.

Part IV Viewpoint Discrimination and its Application in the Accuracy of Library Collections

If the goal is viewpoint neutrality, must a library acquire contain content that both forwards as well as denies the occurrence of climate change? In other words, must the library present both "viewpoints" or can the outdated climate change content be removed from the collection? To answer this question an understanding of what is meant by viewpoint discrimination is required. Second, a viewpoint must be distinguished from an opinion or belief and a fact.

These issues were addressed by a federal Court of Appeals decision.[21] The Miami-Dade County School Board collection policy consisted of "fifteen criteria for selecting library materials: educational significance, appropriateness, **accuracy**, literary merit, scope, authority, special features, translation integrity, arrangement, treatment, technical quality, aesthetic quality, potential demand, durability, and lack of obscene material."[22] A book entitled *Vamos a Cuba* was challenged and removal of it from the public school library requested, as it contained f*actual errors* on 7 of its 32 pages.[23] As the court observed: "if we find that the Board was motivated by the factual errors in the book, the plaintiffs have no chance of success on the merits, much less

a substantial one."[24] The court discussed the relevant standards from the *Pico* decision that applied: "Even assuming that standard *[Pico]* applies, however, the plaintiffs still lose if the School Board removed *Vamos a Cuba not* for those prohibited reasons but instead, as the Board insists, for legitimate pedagogical reasons such as concerns about the accuracy of the book."[25] Factual inaccuracy is a legitimate reason to deaccession of library material whether the inaccuracy stems from "commission or omission. There is no constitutional right to have books containing misstatements of objective facts shelved in a school library."[26] The School Board voted to remove the book as it "contain[ed] factual errors and does not present an accurate picture of life in Cuba.[27] In the words of the court: "What *Vamos a Cuba* fails to mention, and takes great pains to cover up with its 'like you do' misrepresentations, is that the people of Cuba live in a state of subjugation to a totalitarian communist regime with all that involves."[28] In the context of climate change as opposed to geography, is the library required to collect material offering, for example, an alternative viewpoint on climate change (denying its occurrence) and could it deaccession material that presents that now outdated view of climate change. As with the factually inaccurate view of Cuba present in *Vamos a Cuba*, the library need not collect and may remove material reflective of that position, i.e., that climate change is not occurring. "A preference in favor of factual accuracy is not unconstitutional viewpoint discrimination."[29] As the court further stated: "Facts about the conditions inside a country are not a viewpoint. They are facts. A book that recounts those facts accurately would not, for that reason, be political in nature.[30] An example of unconstitutional viewpoint discrimination in the deaccessioning process would be found where content that expressed a positive impression of LGBTQIA2+ attitudes or realities is removed but content critical of those attitudes and realities remains untouched.[31]

Post-truth narratives on the fallacy of climate change are simply that, untruths and inaccurate. A library may deaccession such content under the U.S. Constitution and is under no obligation to collect such content in attempt to comport with viewpoint neutral collection building and maintenance objectives. A public library possesses broad discretion in building and maintaining its collections. Furthermore, the individual collecting and maintenance decisions in a public library reside with the librarians.[32]

Pico and its progeny established standards for permissible removals. What if a patron insisted that the library add content to its collection that questions or outright denies climate change? Patrons do not have a constitutional right to command a library to add content to its collection. Even if the item is donated, at no cost to the library. In *Via v. City of Richmond*,[33] the Richmond Public Library was within its discretion to refuse a gift subscription to *The American Atheist* magazine. The senior librarian indicated "that the publication was of ***low quality***, that there was little or ***no indication of interest*** by the reading public, and that the subject matter was dealt with by ***better quality*** publications and books."[34] These factors parallel the collecting criteria of most libraries. Adherence to these criteria is reasonable. Further as the court observed there was no evidence that the gift subscription offer was refused due to unwillingness to espouse the cause of atheism, i.e., a viewpoint on the existence of a divine being.[35] Such refusals are permissible. Likewise, in *Elgi v. Chester County Library System*,[36] involving both a book acquisition request and a programming (speaker) request, the library refused to acquire a copy of *The Phantom Ogre; Exploring the Upside-Down World of anti-Semitism*, following its Materials Selection Policy. Programming was also limited to those "that promote and extend the Library's collections, services, goals and mission [of the library] … sponsored program must not promote the services, products, or philosophy of an individual group."[37] The court commented extensively on the discretion libraries possess in determining material for its collections; "Libraries have broad discretion in determining the content of their collections… public libraries require and merit 'broad discretion' to make content-based decisions in collection and internet management since their purpose is to offer selective access of information to the public… Libraries are not required to accommodate every book or proposed talk."[38] The court found no evidence of viewpoint discrimination in the refusal to acquire Elgi's book or invite him to speak regarding it.[39] Concluding that authors do not have a constitutional right be included library

collections or programming the court observed that Elgi "alleges only that his book and proposed talk were not accepted, but as Plaintiff does not have a constitutional right to be included in a library collection…"[40] The Supreme Court has further stated that in order to "fulfill their traditional missions, public libraries must have broad discretion to decide what material to provide to their patrons."[41] Alluding to collection criteria employed by a public library the Court added that the goal is to "facilitate research, learning, and recreational pursuits by furnishing materials of requisite and appropriate quality."[42] Further, this discretion extends to what content the library makes available online to its patrons. "A library's need to exercise judgment in making collection decisions depends on its traditional role in identifying suitable and worthwhile material; it is no less entitled to play that role when it collects material from the Internet than when it collects material from any other source."[43]

Subsequent lower court decisions have echoed the concept that the Internet and other online sources are an extension of the collection over which the library possesses the same discretion whether to make certain content available or not. A "public library has discretion to make content-based decisions about which magazines and books to include in its collection, it has discretion to make decisions about Internet content."[44] Alluding again to use of the collection development criteria when deciding what content to make available online the court observed that viewing the access to content online "not comparable to removal of items from NCRL's collection, but rather acquisition of materials to add to its collection."[45] If a library would not acquire material denying climate change it need not allow patrons to access such content online either. The right to receive information protected by the First Amendment "would still exist only with respect to the materials that are actually in a library's collection. A patron would not have a right to receive information in a public library if that information was not part of the library's collection."[46] Reaffirming the *Elgi* court, a "patron does not have the constitutional right to force a public library to acquire a particular book or type of book. Analogously, this right would not exist with respect to Internet sites that have not been added…collection decisions about Internet materials are not… subject to public forum analysis."[47] Such collecting and access decisions are permissible under the constitution as such discretion is "reasonable and accords with its mission and these policies and is viewpoint neutral."[48] As the physical collection as well as access to online content is considered a nonpublic forum "under rational review, the Court finds NCRL's use of FortiGuard to filter its patrons, Internet access and its decision to not disable the filter upon an adult patron's request complies with the First Amendment."[49] The physical collection and access to content online are considered one and the same. A public library need not collect material denying climate change nor need it allow patrons to access such content online, if for example, access to such content is blocked by a filter or the library decides not to subscribe to a database from a publisher that espouses that position.

Table 1. Application of legal principles to library collecting practices regarding trusted grey sources on climate change.

Legal Decision	Legal Principle Espoused	Impact on Grey or other Climate Change Content in Library Collections
Board of Education, Island Trees Union School District No. 26 v. Pico, 457 U.S. 853 (1982).	Permissible removal of items from a public school library. Court: "educational suitability" Id. at 871. From Oral Argument Transcript: "pervasively vulgar." Id. Book Review Committee: "educational suitability," "good taste," "relevance," and "appropriateness to age and grade level." Id. at 873.	It is constitutionally permissible to deaccession out of date material on climate change / global warming.

United States v. American Library Association, 123 S. Ct. 2297 (2003).	"To fulfill their traditional missions, public libraries must have broad discretion to decide what material to provide to their patrons." Id. at 204. Library discretion extends to what resources are made available online to patrons as well	A library could use technology (filtering mechanism) to block sites and content denying the occurrence of climate change / global warming. As a library might choose not to not collect such content for its physical collection, it need not make such content available to patrons online either.
ACLU v. Miami-Dade County School Board, 557 F.3d 1177 (11th Cir.), cert. denied 130 S. Ct. 659 (2009).	Inaccurate content, whether by "commission or omission" can be considered educationally unsuitable. Accuracy is an acceptable criterion to use in collection development. "There is no constitutional right to have books containing misstatements of objective facts shelved in a school library." Id. at 1202. "A preference in favor of factual accuracy is not unconstitutional viewpoint discrimination." Id. at 1222.	It is constitutionally permissible to deaccession content that is factually inaccurate. Content denying that climate change / global warming is occurring would be considered factually inaccurate. Content denying that climate change / global warming is occurring is not expressive of a viewpoint. Likewise, content that forwards that climate change / global warming is occurring is not a viewpoint, it is a fact.
Via v. City of Richmond, 543 F.Supp. 382 (D.C.Va. 1982).	A library is not required to accept any gifts if the content is inconsistent with its criteria for collection development. Senior librarian indicated "that the publication was of *low quality*, that there was little or *no* indication of *interest* by the reading public, and that the subject matter was dealt with by *better quality* publications and books." Id. at 384	A library is not required to accept content denying that climate change / global warming is occurring even if it is offered as a gift, such content would not meet the "quality" or accuracy criterion of a collection development policy.
Elgi v. Chester County Library System, 394 F.Supp.3d 497 (E.D. Pa. 2019).	"Libraries have broad discretion in determining the content of their collections… public libraries require and merit 'broad discretion' to make content-based decisions in collection and internet management…" Id. at 504. "Plaintiff does not have a constitutional right to be included in a library collection…" Id.	The discretion of a library in determining the content of its collection extends to the programming it offers. A library, if requested to invite a speaker or provide programming denying that climate change / global warming is occurring, need not fulfill that request.
Bradburn v. North Central Regional Library District, 231 P.3d 166 (Wash. 2010) (en banc).	"Given the traditional and historical role of a public library, and the discretion necessarily entailed to make content-based judgments about what to include in its collection…" Id. at 180. Use of a filter "advances the duty of education and fulfills NCRL's mission and traditional role." Id. "A public library has traditionally and historically enjoyed broad discretion to select materials to add to its collection of printed materials… the	Library discretion in collection development extends to the content it makes available online to its patrons. It is constitutionally permissible for a library to refuse to restore or disable a filter blocking access to content denying that climate change / global warming is occurring. Library collection decisions that provide scientific content, including

	same discretion must be afforded a public library to choose what materials from millions of Internet sites it will… make available to its patrons. Id. at 181. Standard of Review: "Protecting patrons (including minors) from obscene material and increasing the library's capacity to provide literary, *scientific*, historic, and other materials clearly satisfies the rational basis test." Id. at 182 (Johnson, J., concurring).	the topic of climate change / global warming are consistent with its educational mission.
Bradburn v. NCRLD, 2012 WL 1200448, (E.D. Wash.) (unpublished).	Standard of Review: "under rational review, the Court finds NCRL's use of FortiGuard to filter its patrons, Internet access and its decision to not disable the filter upon an adult patron's request complies with the First Amendment." Id. at *2.	Library discretion in collection development extends to the content it makes available online to its patrons. It is constitutionally permissible for a library to refuse to restore or disable a filter blocking access to content denying that climate change / global warming is occurring or to refuse to subscribe to a database from a publisher that espouses that position.

Part V Libraries in Green Space: Sustainability Strategies

Since libraries have the right and the ability to choose the items adopted into their library and the right to refuse gifts and donations, this means that libraries also have the responsibility to choose accurate resources reflecting the causes and conditions of climate change. Additionally, libraries must set forth an example for its patrons by participating in practices unconducive to the further development of climate change. These actions can occur within the library as an organization or as part of a larger institution, such as reducing carbon footprints by reducing electric use, promoting green programs and services such as gardening or nature walks. Finally, selection of green resources in their library collection, as well as "green de-selection" which involves "recycling or reusing weeded materials" (Kurbanoğlu & Boustany, 2014, p. 52). Beyond the public library or school setting, academic libraries may participate in university-led green initiatives to conserve energy through smart technology or by going 'paperless' by reducing printing.

At an international level, the United Nations' Department of Economic and Social Affairs has developed seventeen Sustainability Goals including building safe and sustainable cities, ensuring responsible consumption and production patterns, and providing inclusive and equitable education. With respect to climate change, the concern is lower in the United States than other countries, specifically those with advanced economies (Poushter et al., 2022) that are often reliant on fossil duels. It was reported that many countries have partisan problems like the United States when it comes to accepting the reality of climate change and the threats of climate change and responses to those threats.

The co-author is also on an ALA Task Force developing core values of the profession. One core value identified is Sustainability, defined as "making choices that are good for the environment, make sense economically, and treat everyone equitably. Sustainable choices preserve physical and digital resources and keep services useful now and into the future. By supporting climate resiliency, library workers create thriving communities and care for our common good for a better tomorrow."[50]

For individuals in the library profession experiencing eco-anxiety, or the "chronic fear of environmental doom" (Wakeman, 2020), one way to combat this issue is to "improve engagement with the subject of climate change [by] having materials that focus on and encourage sustainability" (Mathur, 2022 as cited in Trotter & Komarnytska, 2023). The ALA's Sustainability Roundtable (SustainRT) as well as the Sustainable Libraries Initiative (Sustainable Libraries Initiative, 2023) bring together library staff and libraries of all types with the goals of exchanging ideas to build sustainable environments and futures in the library and beyond.

Conclusion and Recommendations for Library Collection of Trusted Climate Resources

In conclusion, libraries may face unprecedented times in terms of adopting accurate climate change resources in the collection development process during the age of misinformation due to existing post-truth narrative its supporters. With the rise of more states choosing to adopt materials reflecting alternative truths or post-truths including the topic of climate change as well as the rise of book bans and challenges, libraries and library professionals have a responsibility to not only develop a collection of accurate resources, but also participate in sustainability strategies. The discussion of various cases on the analysis of the First Amendment and what constitutes free speech regarding library materials acquisitions and removals as well as what does not constitute viewpoint discrimination should empower librarians and library staff to take ownership of their abilities to choose and adopt accurate climate change resources for their patrons. Below are some strategies to be included when creating a library collection development policy as well as trusted grey resources to assist in the collection development process.

Library Collection Development Policy

- Review the library collection development policy ensuring that "climate change as a priority factor in a library's collection policy ... Collections must also acknowledge the barriers that exist in getting people to engage with climate change in a sustainable way, some of the most difficult factors to overcome being climate change denial and the resulting climate change denial materials." (Trotter & Komarnytska, 2023)
- Include accuracy as a criterion in the collection development policy, applying to acquisition and deaccession decisions as well as acceptance of gifts; using it to judge whether material on climate change is accurate. Deaccession or refuse to add material that does not meet this standard and is not trusted.
- Be aware keep abreast of sources that produce and disseminate questionable material regarding climate change.
- Vest collection or programming decisions with trained professionals, librarians and not with elected official or some subset of the service population.[51]

Trusted Resources to Assist in Collection Development and Design of Literacy Programs on Climate Change

Library staff develop relationships with their patrons and develop an understanding of the types of resources they seek over time. In their case studies, Trotter & Komarnytska (2023) described the launch of a climate change collection at Thunder Bay Public Library in Ontario, Canada, which was "formed due to requests from Thunder Bay community members who wanted to see better access to climate change resources" (Hardy, 2022). Although the Thunder Bay community specifically requested these types of materials in their library, it serves as an example of how the library can partner with climate-focused organizations who can assist them in suggesting and gathering accurate materials, which will still require collection development expertise for the adoption process. Based on the suggested policies above, libraries can determine whether a climate change collection is missing and what might be needed to develop it, along with any accompanying literacy programs. From a practical standpoint, Connell (2010) discussed 'green' practices in collection development, including the consideration of the environmental impacts

of print and electronic resources, areas in which collection development staff must also develop awareness.

In the matter of keeping abreast of adjacent areas of collection development and climate change, several non-profit organizations have created their own databases to track book bans and censorship attacks (Magnusson & EveryLibrary Institute, 2023; PEN America, 2023). Just like databases to track library book bans and book challenges, there is a need for individuals to track challenged climate change resources. On the legal side, there is a Climate Change Litigation Database which tracks both United States and global climate change litigation, breaking the items up into appropriate categories such as claims, regulations, and suits (Sabin Center for Climate Change Law & Arnold & Porter Kaye Scholer LLP, 2023). These grey resources advocate for the systems thinking methodology and encourage library professionals to think outside of the box.

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Endnotes

[1] Disinformation attacks are performed by using artificial intelligence (AI) to create human-like accounts which bypass the verification process. After these accounts are created, followers are gained (both attacker-controlled and real individuals) and the accounts post disinformation and allow it to "propagate…through replies and likes." See Villasenor, 2020.

[2] Three books tied for 10th place in this list. The books on this list challenged for LGBTQIA+ content included other challenge reasons, such as providing sexual education, claimed to be sexually explicit, containing depictions of sexual abuse, drug use, and profanity. See American Library Association, 2023a.

[3] Author conversation with Kim Liepert, Library Technology Lead at Pilgrim Park Middle School, Elmbrook Schools, Brookfield, Wisconsin, United States (October 13, 2023).

[4] "It confuses interest with motive…the argument, for example, render constitutionally suspect the votes of Jewish school board members to remove our hypothetical book about life in the Third Reich. It would do the same to the votes of any African American board members who wanted to remove our hypothetical book about life in the antebellum South. Interest does not necessarily equate with improper motive." Id. a 1224.). See *ACLU v. Miami-Dade County School Board*, 557 F.3d 1177, 1223-1224 (11th Cir.), cert. denied 130 S. Ct. 659 (2009).

[5] In *Post-truth*, McIntyre discussed the creation of the Tobacco Industry Research Committee created in the 1950s to promote a "positive value of scientific skepticism of science itself." See McIntyre, 2018, p. 25. See also Brandt, 2011.

[6] *Kreimer v. Bureau of Police for Town of Morristown*, 958 F.2d 1242, 1255 (3d Cir. 1992).

[7] See, *Case v. Unified School District No. 233*, 908 F. Supp. 864, 875 (D. Kan. 1995).

[8] *Little v Llano County*, 2023 WL 2731089, *9 (W.D. Tex.) ("The Court follows our many sister courts in holding that there is a protected liberty interest in access to information in a public library...").

[9] *Kreimer v. Bureau of Police for Town of Morristown*, 958 F.2d 1242, 1259 (3d Cir. 1992) ("In our view… the [public] Library constitutes a limited public forum, a type of designated public fora.").

[10] *Kreimer v. Bureau of Police for Town of Morristown*, 958 F.2d 1242, 1261 (3d Cir. 1992).

[11] *Little v Llano County*, 2023 WL 2731089, *9 (W.D. Tex.), citing *Board of Education, Island Trees Union School District No. 26 v*. Pico, 457 U.S. 853 (1982).

[12] Christine Russell, Attack of the climate-denial books: Conservative think tanks fuel publishing boom that spreads misinformation. *Columbia Journalism Review* (March 12, 2013), https://archives.cjr.org/the_observatory/climate_change_denial_skeptic.php.

[13] *Board of Education, Island Trees Union School District No. 26 v. Pico*, 457 U.S. 853, 862 (1982).

[14] *Board of Education, Island Trees Union School District No. 26 v. Pico*, 457 U.S. 853, 871 (1982).

[15] *Board of Education, Island Trees Union School District No. 26 v. Pico*, 457 U.S. 853, 871 (1982).

[16] *Board of Education, Island Trees Union School District No. 26 v. Pico*, 457 U.S. 853, 870-871 (1982).

[17] *Board of Education, Island Trees Union School District No. 26 v. Pico*, 457 U.S. 853, 871 (1982).

[18] *Board of Education, Island Trees Union School District No. 26 v. Pico*, 457 U.S. 853, 873 (1982).

[19] *Sund v. City of Wichita Falls, Texas*, 121 F. Supp. 2d 530, 541 (N.D. Texas 2000) ("Linda Hughes, the Library Administrator… is the real heroine… of the censorship of two children's Books-and the unconstitutional interference with her ability to perform her duties in running the Library as a trained, skilled, and very competent professional…Ms. Hughes has a master' degree in library science, and she follows the code of ethics that governs professional librarians."). See also, *Fayetteville Public Library v Crawford County Arkansas*, 2023 WL 4845636, *3 (W.D. Ark.) (finding unconstitutional an Arkansas statue that shifted collection decisions "from ***professional librarians*** to the politically elected members of local county quorum courts and city councils… empower a vocal minority to dictate to the entire community what its citizens may and may not read").

[20] See, e.g., *Case v. Unified School District No. 233*, 908 F. Supp. 864, 875 (D. Kan. 1995); *Parents, Families, and Friends of Lesbians and Gays, Inc. v. Camdenton R-III School*, 2012 WL 510877 (W.D. Mo. 2012); *Hunter v. City of Salem*, 2012 WL 1205137, *1(E.D. Mo.) (unpublished) (decided on other grounds but the complaint claimed impermissible viewpoint discrimination).

[21] *ACLU v. Miami-Dade County School Board*, 557 F.3d 1177 (11th Cir.), cert. denied 130 S. Ct. 659 (2009).

[22] *ACLU v. Miami-Dade County School Board*, 557 F.3d 1184 (11th Cir.), cert. denied 130 S. Ct. 659 (2009).

[23] *ACLU v. Miami-Dade County School Board*, 557 F.3d 1184, 1207 (11th Cir.), cert. denied 130 S. Ct. 659 (2009) (a list of errors is recounted on pages 1211-1214 of the opinion).

[24] *ACLU v. Miami-Dade County School Board*, 557 F.3d 1184, 1198-1199 (11th Cir.), cert. denied 130 S. Ct. 659 (2009).

[25] *ACLU v. Miami-Dade County School Board*, 557 F.3d 1184, 1202 (11th Cir.), cert. denied 130 S. Ct. 659 (2009).

[26] *ACLU v. Miami-Dade County School Board*, 557 F.3d 1184, 1202 (11th Cir.), cert. denied 130 S. Ct. 659 (2009).

[27] *ACLU v. Miami-Dade County School Board*, 557 F.3d 1184, 1206 (11th Cir.), cert. denied 130 S. Ct. 659 (2009).

[28] *ACLU v. Miami-Dade County School Board*, 557 F.3d 1184, 1213 (11th Cir.), cert. denied 130 S. Ct. 659 (2009).

[29] *ACLU v. Miami-Dade County School Board*, 557 F.3d 1184, 1222 (11th Cir.), cert. denied 130 S. Ct. 659 (2009).

[30] *ACLU v. Miami-Dade County School Board*, 557 F.3d 1184, 1222 (11th Cir.), cert. denied 130 S. Ct. 659 (2009).

[31] See, e.g., *Case v. Unified School District No. 233*, 908 F. Supp. 864, 875 (D. Kan. 1995); *Parents, Families, and Friends of Lesbians and Gays, Inc. v. Camdenton R-III School*, 2012 WL 510877 (W.D. Mo. 2012); *Hunter v. City of Salem*, 2012 WL 1205137, *1 (E.D. Mo.) (unpublished) (decided on other grounds but the complaint claimed impermissible viewpoint discrimination); *Little v Llano County*, 2023 WL 2731089, *10 (W.D. Tex.) ("a list of books [] considered inappropriate [] LGBTQ books' and advocating for their removal and relocation").

[32] *Fayetteville Public Library v Crawford County Arkansas*, 2023 WL 4845636, *4 (W.D. Ark.) (Librarians—much like doctors and lawyers—are afforded significant professional responsibility and deference with respect to their area of expertise.").

[33] *Via v. City of Richmond,* 543 F.Supp. 382 (D.C.Va. 1982).

[34] *Via v. City of Richmond,* 543 F.Supp. 382, 384 (D.C.Va. 1982).

[35] *Via v. City of Richmond,* 543 F.Supp. 382, 384 (D.C.Va. 1982).

[36] *Elgi v. Chester County Library System*, 394 F.Supp.3d 497 (E.D. Pa. 2019).

[37]*Elgi v. Chester County Library System*, 394 F.Supp.3d 497, 501 (E.D. Pa. 2019).

[38] *Elgi v. Chester County Library System*, 394 F.Supp.3d 497, 504 (E.D. Pa. 2019), citing *United States v. American Library Association*, 123 S. Ct. 2297 (2003) and *Pico* by footnote.

[39] *Elgi v. Chester County Library System*, 394 F.Supp.3d 497, 514 (E.D. Pa. 2019).

[40] *Elgi v. Chester County Library System*, 394 F.Supp.3d 497, 514 (E.D. Pa. 2019).

[41] *United States v. American Library Association*, 539 U.S. 194, 204 (2003).

[42] *United States v. American Library Association*, 539 U.S. 194, 206 (2003).

[43] *United States v. American Library Association*, 539 U.S. 194, 207-208 (2003).

[44] *Bradburn v. North Central Regional Library District*, 231 P.3d 166, 178 (Wash. 2010) (en banc).

[45] *Bradburn v. North Central Regional Library District*, 231 P.3d 166, 175 (Wash. 2010) (en banc).

[46] *Bradburn v. North Central Regional Library District*, 231 P.3d 166, 179 (Wash. 2010) (en banc).

[47] *Bradburn v. North Central Regional Library District*, 231 P.3d 166, 179-180 (Wash. 2010) (en banc).

[48] *Bradburn v. North Central Regional Library District*, 231 P.3d 166, 180 (Wash. 2010) (en banc). See also, "collection decisions to allocate scarce resources are not subject to strict scrutiny, but instead are subject to the rational basis test… increasing the library's capacity to provide literary, scientific, historic, and other materials clearly satisfies the rational basis test." Id. at 182 (Johnson, J., concurring).

[49] *Bradburn v. North Central Regional Library District*, 2012 WL 1200448, *2 (E.D. Wash.) (unpublished).

[50] ALA Core Values Task Force December 2023 draft goals and preamble (Not for public distribution as the Core Values are yet to be adopted by the ALA Council. The final draft will be presented to Council for review at LibLearnX in Baltimore, Maryland in January, 2024, citing "ALA Task Force on United Nations 2030 Sustainable Development Goals," ALA, accessed November 28, 2023, https://www.ala.org/aboutala/ala-task-force-united-nations-2030-sustainable-development-goals..

[51] See, *Sund v. City of Wichita Falls, Texas*, 121 F. Supp. 2d 530, 533-534 (N.D. Texas 2000) (Finding unconstitutional a Library Board resolution that allowed anyone collecting 300 signatures from adults in the service population to request relocation of library materials); and *Fayetteville Public Library v Crawford County Arkansas*, 2023 WL 4845636 (W.D. Ark.) (politically elected members of local county quorum courts and city councils). See also, *Little v Llano County*, 2023 WL 2731089 (W.D. Tex.) ("the Commissioners Court also voted to dissolve the existing library board and to create a new one…residents who advocated for book removals were appointed to the new board… Board then instituted a policy that all new books must be presented to and approved by the board before purchasing them." Id. at *3.)

https://doi.org/10.26069/greynet-2025-000.510-tgj

Czech National Repository of Grey Literature

NUSL is

a digital repository for grey literature

Free

online access

Goals

- Central access to grey literature and the results of research and development in the Czech Republic
- Support of science, research and education
- Systematic collection of metadata and digital documents
- Long-term archiving and preservation
- Cooperation with foreign repositories

Features

Provider:
National Library of Technology
Prague, Czech Republic

Records:
over 500,000 records

Collection provenance:
Czech Republic

Partners:
over 150 organizations (Academy of Science, Public Research Institutions, Universities, State Offices, Libraries, NGOs etc.)

International Cooperation:
OpenGrey, OpenAire, ROAR, OpenDOAR, BASE, WorldWideScience

What else?

Conference on Grey Literature and Repositories
https://nusl.techlib.cz/en/conference

Informative Webpages
https://nusl.techlib.cz/en/

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NTK 90° 105° 25°
Národní technická knihovna
National Library of Technology

NUŠL czech national repository of grey literature

When trusted sources don't help us address climate change: A grey dilemma *

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Abstract

This paper delves into the limitations of trusted grey literature in tackling climate change by scrutinizing available information through case studies on recycling, biomass, and ESG investments, and revealing challenges consumers face relative to the messages they receive about climate change. The recycling scenario reveals the illusion of plastic recycling, with a mere 5% effectively recycled in the U.S., prompting a reevaluation of consumer choices. Examining aviation's pursuit of sustainable fuels, the biomass scenario exposes hurdles in reducing greenhouse gas emissions. The ESG investment scenario probes the impact of anti-ESG political rhetoric, highlighting the clash between environmental responsibility and opposing ideologies.

The author emphasizes the messages consumers receive about their pivotal role in greenhouse gas emissions reduction, citing the significant sway of Scope 3 emissions. The author also stresses the necessity for a new consumer-centric narrative adapting to current climate realities, and advocates for a message that encourages investment in innovative, scalable solutions, aligning with the International Monetary Fund's priorities for achieving net-zero by 2050 through global cooperation, incentivizing clean technologies, and supporting vulnerable nations. The paper issues a call to action for a more impactful and inclusive approach to address climate change, transcending traditional literature and academic discourse.

The Peanut Butter Paradox

Peanut butter is not the first thing one would expect to see in a paper on sustainability or climate change or any of the other topics contained in the amorphous concept Environmental, Social and Governance, ESG for short. However, it is a great place to start an examination about what "we" as in we consumers, are up against when we try to make sustainable choices and buy from companies who care about this planet and its inhabitants. Why peanut butter? It is a staple here in the United States and if there is not a jar in the pantry, it is probably on this week's grocery list. From here, things get pretty complicated, pretty fast. Maybe the trip to the grocery store is by mass transportation, an electric car, or maybe it is easier to use an app and have everything delivered to the front door. Plastic bag? Paper bag? Reusable bag? Another decision and they just keep coming. Once at the store, there are brand names, private labels, and organic options; enough to fill at least five or six shelves. The catch, almost every single peanut butter choice is in a plastic jar. Reducing plastic use? Need to go with glass. For those who are aware that harvesting palm oil is resulting in deforestation and destroying orangutan habitats, the ingredients list is the next decision point. Only one brand left, and it is one of the most expensive, a sigh of relief, at least it is organic. Not in the budget, take a deep breath, pick another brand, and put it into the shopping cart. When all is said and done, does it really matter which one?

So much to unpack already and we have not even gotten to the supply chain behind every jar of peanut butter.

Doing "our part" can be overwhelming for all of us including this author, a research librarian who prepared a weekly curated news brief on ESG for 18 months for an audience comprised of attorneys and consultants. This paper offers three additional scenarios illustrating dilemmas faced by consumers who are told they need to do their part to prevent global warming, to save the ocean, to ensure a living wage and safe working conditions for employees, and to pay for sustainable, smart cities that run on clean energy and so much more.

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That introduction is a bit dramatic, but purposeful. The ideas included here are supported by grey literature, but are also based on the author's experience, reading about ESG or climate change every day as well as being an informed consumer and voter living in the United States.

The GL25 pre-conference announcement says, "*grey literature communities worldwide are called upon to direct their attention in responding to climate change for the benefit of our vulnerable planet.*" Reminding us, "*In accordance with FAIR data principles, researchers, authors, librarians, and other information professionals and practitioners are tasked to ensure that research outputs are findable, accessible, interoperable, and render potential reuse in furthering research and education in their respective disciplines and sectors of information*." This purpose is inspired and when it comes to climate change, these efforts are beyond critical. The statement is also insular in that grey literature furthers the aims of scholarship within the academy or other public and private research institutions and government agencies. This paper contends that grey literature does not always clarify issues or lead to a useful course of action, especially for the broader audience we also need to serve, everyday people. Grey literature tells us consumers play an enormously vital role in reducing emissions through direct action and by wielding their influence as customers and voters. Helping them understand what is needed, where investment should be made is just as critical as contributing to the innovative technologies needed to save us. The right message is essential and if the status quo tells us anything at all, it tells us the current narrative is ineffectual.

The Backstory on Emissions

Reducing greenhouse gas emissions is key to reaching global aims including the transition to the net-zero economy or more specifically an agenda like the Paris Climate Accord. Many organizations are working toward providing credible, scientific information about what is happening to the planet and to us. One of the most recognizable is The Intergovernmental Panel on Climate Change. The panel was set up by the World Meteorological Organization and the United Nations to provide an objective source of scientific information. In March 2023, it released the final version of its sixth assessment report, AR6 Synthesis Report: Climate Change 2023 (Climate Change 2023).

In unequivocal terms, Climate Change 2023 says that human beings are responsible for global warming and the chief culprit is greenhouse gas emissions. Page 8 of the 40-page summary (!) for policy makers says, "*Global greenhouse gas emissions have continued to increase, with unequal historical and ongoing contributions arising from unsustainable energy use, land use and land-use change, lifestyles and patterns of consumption and production across regions, between and within countries, and among individuals*." Moving to the next page, the summary goes on to say, "*Widespread and rapid changes in the atmosphere, ocean, cryosphere and biosphere have occurred. Human-caused climate change is already affecting many weather and climate extremes in every region across the globe. This has led to widespread adverse impacts and related losses and damages to nature and people…Vulnerable communities who have historically contributed the least to current climate change are disproportionately affected*."[1]

At a more granular level, there are organizations like the International Sustainability Standards Board (ISSB) who help companies to measure and disclose their greenhouse gas emissions along with their plans to mitigate or off-set these emissions. The ISSB is a private, independent body established in 2021 and is charged with developing and approving IFRS sustainability disclosure standards under the auspices of the IFRS Foundation. On June 30, 2023, the inaugural standards, IFRS S1 and S2 launched.[2]

These are standards that guide companies on what to disclose to investors and regulators about their sustainability and climate risks and how they are mitigating these risks or in more business-friendly terms, taking advantage of new opportunities in the green economy.

[1] (Intergovenmental Panel on Climate Change, 2023)
[2] (Deloitte, 2023)

Regulators themselves, like the US Securities and Exchange Commission (SEC) are also working on standards for business. The commission proposed highly controversial sustainability and climate disclosure rules for publicly traded companies in March 2022. Like the IFRS standards, the rules require companies to disclose prospective risk and material impacts to their business caused by climate change including impacts on the company's strategy and outlook. These rules have been delayed for more than a year.[3]

The SEC rules are for publicly traded companies and this matters. Consider privately held, Minnesota-based Cargill. Established in 1865, the company started out as a grain storage facility. It is now an international producer and distributor of agricultural products such as sugar, refined oil, chocolate, and turkey. It also provides risk management, commodities trading, and transportation services. Employing 155,000 people, Cargill's 2022 revenue is reported to be $165B.[4]

For private companies it is up to the executive team or board of directors to govern the company's actions around sustainability. Fortunately, Cargill, like many companies, has voluntarily taken a positive stance on ESG. "*Our Executive Team is dedicated to building a company that nourishes the world in a safe, responsible and sustainable way…Together, they are working to make Cargill the most trusted partner in food, agriculture and nutrition*."[5] How successful Cargill and other companies will be with their ESG efforts requires attention to greenhouse gas emissions.

The Greenhouse Gas Protocol, another voluntary sustainability standards organization, provides the following greenhouse gas (GHG) emissions definitions and classifications usually called scopes.

- Emissions
  - Direct GHG emissions are emissions from sources that are owned or controlled by the reporting entity.
  - Indirect GHG emissions are emissions that are a consequence of the activities of the reporting entity but occur at sources owned or controlled by another entity.
- Scopes
  - Scope 1: All direct GHG emissions.
  - Scope 2: Indirect GHG emissions from consumption of purchased electricity, heat, or steam.
  - Scope 3: Other indirect emissions, such as the extraction and production of purchased materials and fuels, transport-related activities in vehicles not owned or controlled by the reporting entity, electricity-related activities (e.g., T&D losses) not covered in Scope 2, outsourced activities, waste disposal, etc. (Greenhouse Gas Protocol, 2023)[6]

Scope 3 emissions also include 'use of products sold' which refers to the scope 1 and scope 2 emissions of end users. End users include both consumers and business customers that use a company's final products. Direct-use emissions by end users includes:
Products like automobiles, aircraft, engines, motors, power plants, buildings, appliances, electronics, lighting, data centers, and web-based software.

Fuel and feedstocks like petroleum products, natural gas, coal, biofuels, and crude oil.

Greenhouse gases and products that contain or form greenhouse gases emitted during use include CO2, CH4, N2 O, HFCs, PFCs, SF6, refrigeration and air-conditioning equipment, industrial gases, fire extinguishers, and fertilizers.

[3] (PricewaterhouseCoopers, 2023)
[4] (Forbes, 2023)
[5] (Cargill, 2023)
[6] (Greenhouse Gas Protocol, 2023)

Including indirect-use-phase emissions by end users is optional when reporting out on scope 3 emissions under the Greenhouse Gas Protocol. These emissions include products that indirectly consume energy (fuels or electricity) during use. Examples:

- Apparel (requires washing and drying)
- Food (requires cooking and refrigeration)
- Pots and pans (require heating), and
- Soaps and detergents (require heated water)[7]

Scope 3 emissions may account for as much as 70% of a company's emissions or more. This is exceptionally problematic because Scope 3 emissions are beyond the individual company's control. In terms of the supply chain, purchasing decisions and product designs by individual suppliers have greater influence over reducing emissions than the company for whom they supply products or materials. Companies have the option of switching suppliers, turning to those whose practices align with the company's net-zero or other sustainability targets, but this strategy is limited at best and extraordinarily difficult for companies that manufacture products. Manufacturers must contend with emissions stemming from extraction and manufacture of raw goods. Companies have even less control over direct-use emissions by the end-user which brings us to back to the consumer.[8]

Scope 3 emissions are the foundation of the compelling argument on the large and critical role consumers play in achieving the net-zero economy. However, these now decades old messages, laced with moral imperatives, are not working. The following case studies, or scenarios, provide plausible reasons as to why.

The Scenarios

The **Recycling Scenario** considers the ease at which consumers in the United States can recycle materials relative to how successful these efforts are at keeping materials especially plastics out of landfills here and abroad.

People in the United States are happy to recycle, hauling out their overflowing, ubiquitous blue bins to the curb on the designated day of the week, confident that the contents will be recycled and that they are doing the right thing. A tangible sign that the mythology that plastic is being recycled into something new persists. As of 2021, only about 5% of US plastic waste was recycled while the rest wound up in a landfill, the bulk to be exported with other municipal waste to developing countries where the most likely outcome for plastic is either open dumping or incineration.[9]

How did we get here?

The United States is one of the world's largest consumers of plastics, a habit that has grown consistently since the 1980s. By 2019 on a per capita basis, the US created five times as much plastic waste as their global counterparts. Given the mythology plastic can be recycled, it is easy to see why US consumers keep buying plastic. We only need to look at the bottom of container to find the familiar recycling symbol. Created in the 1970s by Gary Anderson, a senior at Southern California University, who submitted his logo to a competition sponsored by the Container Corporation of America. An uncomplicated design of three arrows chasing each other round and round in a closed loop. The first arrow represents materials collected, the second represents the manufacture of new products from those materials, and the third the purchase of those products by the consumer.[10] This works well for things that can be readily recycled like paper and glass, but for plastics and other consumer goods like textiles or clothing, reduce and reuse are the only options. Sheer volume shows the impracticality of reuse and returning to our

[7] (Greenhouse Gas Protocol, 2022)
[8] (Deloitte, 2023)
[9] (Statista, 2023)
[10] (The Origin of the Recycling Symbol, 2023)

peanut butter example, reducing plastic consumption is difficult at best especially for anyone on a budget.

There is sufficient and readily accessible literature that explains why plastic recycling is not a scalable solution. It comes down to plastic itself. There are all kinds of different plastics. Plastics with different additives and colorants that cannot be recycled together, and separating plastics is prohibitively expensive. Plastics may also contain or absorb toxic chemicals. All of which means that mechanical recycling–the grinding and melting down of plastic–is limited and investment in plastic recycling innovation is needed.[11]

From a sustainability perspective, until plastic recycling is practicable, plastic production needs to be drastically curtailed, but this is not going to happen any time soon. Per Statista, *"The plastics market is projected to grow in the coming years to reach a value of more than 810 billion U.S. dollars by 2030, registering a CAGR of 3.7 percent during the forecast period of 2022 to 2030."*[12]

Encouraging consumers to take companies to task on reducing plastic use and efforts to pass legislation to inhibit manufacture of certain plastics might make us feel better but are no more likely to succeed in solving the problem with plastic now than they were before. Plastic products are all too frequently the only economically feasible or available option and that is why people keep buying them. The recycling message keeps us wheeling brightly colored bins full of rubbish to the street, but so far, it is not getting us to net-zero and nothing indicates it ever will.

The ***biomass scenario*** examines alternatives to fossil fuel starting with aviation as an example. While aviation's contribution to greenhouse gas emissions is minor compared to other travel and transportation, it is an industry that is growing at a fast pace, and it is difficult to decarbonize. If it is going to meet 2050 net-zero goals, aviation needs to find lower-emissions fuels and increase aircraft efficiency. This may not be enough, which means there is also a need for demand constraint solutions. Bringing the focus even tighter, sustainable aviation fuel (SAF) is coming to the fore; however, based on planned production only a fraction of jet fuel demand in 2027 will be met by sustainable fuel. What is more, according to the US Department of Energy, SAF must be blended with Jet A fuel prior to use in aircraft.[13] Just like biofuels blended with gasoline for automobiles, SAF causes less pollution, but is still dependent on the fossil fuel industry. Despite the dependence, SAF investment is expected to be worthwhile. The U.S. Department of Energy, the U.S. Department of Transportation, and the U.S. Department of Agriculture are invested in research, development, and analysis of SAF. The widespread adoption of SAF seems likely. If it goes the way of blended biofuels for cars and trucks, the average customer does not have any control over what is in their 747 if they are thinking about it all.

Sustainable fuel is not just about moving people and things around the planet. There are also economical and moral quandaries associated with sustainable long-term use of land for fuel and food. Finding a balance is another "must" because "feeding a growing and increasingly affluent population is clashing with efforts to conserve habitat and natural resources."[14]

Recently, there was a natural experiment around what it would take to reduce greenhouse gas emissions at scale–the COVID-19 pandemic. Diminished leisure and business travel led to well publicized reductions in pollution. Post-pandemic, this simply is not how people live their lives. Previously remote workers have been required to return to the office three days a week or more. The devastated travel and leisure industry is putting out all the stops to encourage people to visit family or take that special vacation. Not to mention celebrities like Taylor Swift taking to the skies in her own private jet to meet the fans who missed live music during lock down. Not

[11] (Enck, 2022)
[12] (Stastita, 2023)
[13] (IEA, 2023)
[14] (Sustainable Intensification of Agriculture, 2023)

"hating on" Taylor here, the point is, it took a global pandemic to reduce greenhouse gas emissions at a scale sufficient to meet net-zero goals. No clever consumer campaign, no narrative, no carpool incentive, has ever come close to what is needed.

The ***ESG investment scenario*** ostensibly asks whether climate change risk should inform investment decisions and it does. No bait and switch here, but if we move this case study out into the real world, it brings us full circle, ultimately testing our collective ability to provide a trustworthy narrative about climate change, sustainability and other ESG topics as a counter to other messages like the Anti-ESG political rhetoric heard throughout the United States. An executive from the investment giant Morningstar succinctly explains this rhetoric, "Anti-ESG [is] a proxy for opposition to the spread of 'liberal values' in civil society."[15]

Pragmatically, investment in sustainability from novel research work to companies bringing innovative technological solutions to the market is the only path to saving the planet because consumers can only choose sustainable options if they are available. When it comes to ESG investment "our part" should lean toward understanding and taking action about where the money goes. However, in recent years, many Republican leaders have turned sustainability into a "liberal agenda" and actively campaigned against ESG. Those who were elected are leading efforts to eliminate consideration of ESG in investment decisions on Capitol Hill and in state houses across the country.

Calling for a specific narrative against a political agenda may feel like a slippery slope, but as film maker Michael Moore is quoted as saying "*Librarians see themselves as the guardians of the First Amendment. You got a thousand Mother Joneses at the barricades*!" Moore is a little more colorful than your average librarian might be, but he is correct that providing information necessary to addressing actions by the government is an ethical obligation and part of the field's overall advocacy and commitment to intellectual freedom or "the rights of library users to read, seek information, and speak freely as guaranteed by the First Amendment. Intellectual freedom is a core value of the library profession, and a basic right in our democratic society."[16]

Coming from this perspective, we should provide trustworthy information. Gaining an understanding what ESG investment is, what its critics say and what anti-ESG investment laws could mean to the future is the dilemma this scenario presents.

First an incredibly brief history lesson from Harvard Business Review, "*The idea of screening investments on environmental and social issues goes back decades. But in recent years, a critical mass of investors clearly decided that global mega-challenges like climate change create economic and business risk that they should understand and include in decision-making*." [17]

The ESG agenda has taken its fair share of criticism with commentators reminding everyone at large that the purpose of business is to make as much money as possible while still conforming to basic social norms. Concerns about how companies and their investors could tie ESG to the bottom line is also warranted given how difficult it is to accurately measure, let alone mitigate greenhouse gas emissions as discussed elsewhere in this paper. Another critique involves companies using ESG for marketing and public relations to enhance their reputations or to satisfy customer preferences. Unsurprisingly, this gives rise to accusations of greenwashing, which is a false impression of what or how well a company is doing around its sustainability efforts.

Despite the criticism, ESG is a driving force. According to McKinsey & Company, 90% of companies on the S&P 500 are providing some type of ESG reporting as of December 2022. McKinsey's consideration does not stop here. Their analysts go on to explain that "*true ESG is consistent with a judicious, well-considered strategy that advances a company's purpose and business model*." Moreover, while it may be correct that businesses are in the business of making

[15] (Winston, 2023)
[16] (Support for Intellectual Freedom, 2023)
[17] (Winston, 2023)

money, strategy has evolved into companies looking toward long-term value for shareholders. With this comes the need to "*manage and address, massive, paradigm-shifting externalities*" including climate change.[18]

As mentioned previously, there is an insistent group of political leaders in the United States who are adamant that investors and the companies in which they invest should not be permitted to consider ESG when it comes to making decisions. By the 2023 legislative cycle, ESG investment was highly politicized to put it mildly with Republicans making good on promises to move forward an anti-ESG agenda. This has played out in 37 states with 165 pieces of proposed legislation including 9 resolutions. The overarching goal, to restrict ESG-related risk considerations in decision-making, often using pension fund and government contract regulation as the means to an end.

Pleiades Strategy is tracking these 165 bills, as of June 2023:

- 83 bills are dead, across 23 states:
  - In 17 states where legislation was introduced, no laws passed. 10 of these states are controlled by Republicans.
- 3 bills were vetoed by the governor in Arizona.
- 42 bills that did not pass will carry over into the 2024 legislative session.
- 22 bills and 6 resolutions were approved by state governments:
  - 19 laws and 6 resolutions have passed in 14 states this year.
  - 3 enrolled bills await governor action in 3 states.
- 12 active bills are pending. 6 have not had committee hearings.

According to Pleiades, there are real world costs to this legislation including higher costs to municipalities and lower pension returns coupled with increased administrative costs. As to government contracts, there was a surge of proposed legislation that if enacted would block states and local governments from contracting with financial institutions that limit engagement with certain industries by categorizing this refusal as a "boycott" or "discrimination." These industries include fossil fuels, mining, agribusiness, timber, and firearms with all but the last inextricably linked to climate change.[19]

The New Narrative

Consumers have been asked to do their part for decades. Ordinary people have been told in many different ways, they can save the planet by recycling, by driving less, by voting for the right people. Yet here we are. The planet is getting too hot. It does not take a meteorologist to recognize extreme weather events are having devastating effects on our lives. Though there is plenty of optimism, we are not moving towards net zero fast enough and the case studies here make it clear, calling for individual action is not adding up as promised.

Fight me on this, as popular memes argue, and I will, armed with nothing more than a plastic straw. Well, more like 127 school buses filled with them every day. The anti-straw movement began more than a decade ago. Started by a nine-year-old, the idea caught fire and it became virtuous to say no thank you to the individually wrapped straw that accompanied your soda. The message was clear, straws do not recycle, they wind up in the ocean, and you do not really need one to drink your soda. To be fair, EU countries and a few others have banned plastic straws and other single use plastic items. Kudos on an amazing grassroots campaign, but yet here we are.

In November 2022, confronted with the reality that the world is not on track to meet net-zero goals by 2050, the International Monetary Fund suggested three priorities, "*steadfast policies to reach net zero by 2050, strong measures to adapt to the global warming that's already locked in, and staunch financial support to help vulnerable countries pay for these efforts*." They go on to say that these priorities "*will require a mix of incentives to push firms and households to*

[18] (Perez, 2022)
[19] (Pleiades Strategy, 2023)

prioritize clean goods and technologies across all their decisions." While the IMF mentions households, these priorities and recommended actions do not mention individual actions or call for everyone to do their part:

- An international carbon price floor agreement
- Private investment in low carbon technologies
- Public investment in green infrastructure
- Broader investment in resiliency–infrastructure, social safety nets, early warning systems, and climate-smart agriculture and the like
- Climate financing--including unlocking capital from pension funds, insurance companies and other long-term investors that collectively manage over $100 trillion of assets.[20]

The need for a new consumer narrative, one that focuses on adapting to current climate realities and encourages investment in innovative, scalable solutions, is evident.

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Information, Public Decision-Making, and Climate Change: The Many Roles of Grey Literature*

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Abstract

The far-reaching effects of climate change are among the leading global concerns today. The impacts of changing climate manifest in rising global temperatures (on land and in the ocean), escalating destructive extreme weather events, increasing biodiversity loss, shifting biomes, growing food insecurity, greater health risks (physical and mental), and involuntary migration of people, among other interconnected factors. The complexity of these problems individually and collectively is receiving extensive consideration in research and public arenas. Concerns about the influences of climate change have been increasing since the 1950s and through the last half of the twentieth century scientific understanding reached a consensus of the causes and numerous negative outcomes. The impacts have become clear in the first decades of the twenty-first century. Researchers in many disciplines are cautioning that the world is rapidly reaching a tipping point in the overall health of the planet, after which recovery will be very difficult. In addition, decision makers are grappling with how to evaluate multiple and sometimes competing calls for action and to decide how to address the issues best.

In both research and decision-making settings, grey literature has been a prominent information genre about the multifaceted aspects of climate. Large quantities of grey literature on climate and climate change subjects have been produced. Academic institutions, governmental and intergovernmental bodies, non-governmental organizations, professional associations, think tanks, and news media have turned out grey literature ranging from brochures to hefty technical reports. These materials have been generated in print and digital formats to fulfil a suite of roles: 1) to report research findings, 2) to compile and synthesize literature on research and professional practice, 3) to inform policymakers and the public, 4) to advocate for policy development, 5) to implement policy, 6) to promote change in professional and individual practice, 7) to educate; 8) to broker information and promote networking, and 9) to counter misinformation. In this paper we draw on research about decision making in public policy and management practice about coastal and marine environments to illustrate how grey literature on climate subjects has been deployed in delivering on these roles. Grey literature is widely used in many decision-making contexts. Recognizing its numerous roles can inform citizens, managers, planners, and policy- and decision-makers in addressing the climate challenges facing society today.

The far-reaching effects of climate change are among the leading global concerns today. In 2023, for example, devastating storms, droughts, floods, and record heatwaves and wildfires occurred in many locations around the world (European Environment Agency, 2023; Osaka, 2023; Owens, 2023; Ripple et al., 2023; Voosen, 2024; World Meteorological Organization, 2024; You, 2024). The costs of the destruction stemming from these weather extremes, which are becoming more frequent, are massive (Bowman & Sharples, 2023; Ness, 2023; Newman & Noy, 2023). In 2022, for instance, 18 separate disastrous events in the United States caused damages totalling US $165 billion (Rott, 2023; Smith, A. B., 2023). The World Meteorological Organization estimated that economic losses due to “extreme weather, climate and water-related events” between 1970 and 2021 totalled US $4.3 trillion globally (World Meteorological Organization, 2023).

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Coupled with over two million human deaths in this period, due to these extreme events, and escalating major distresses on wider biodiversity (Díaz & Malhi, 2022; Isbell, et al., 2023), the implications of climate change for human and environmental health of the planet are without any question serious (Pörtner & Roberts, 2022),

Abundance of Information on Climate Change

Literature in all research areas, particularly scientific domains, has increased markedly over the past century. In 2018, the STM: International Association of Scientific, Technical, and Medical Publishers reported that that more than three million scientific papers were being published each year rising at a rate of 4% annually (Johnson et al., 2018). Over the next two years that rate increased to between 5% and 6.5% (STM global brief 2021, 2022). UNESCO reported in 2021 that between 2015 and 2019 scientific publications increased by 21% (Schneergans et al., 2021; see also Castillo et al., 2023). Notably, these publication statistics do not include grey literature.

The quantity of information on climate and climate change subjects (both primary peer-reviewed journal articles and grey literature) has also rapidly spiralled upward since the early decades of the twentieth century following the discovery that rising global temperatures were primarily caused by carbon dioxide emissions (Dessler, 2022; UKRI, n.d.). It is difficult to estimate the total number of publications related to climate subjects. One quite rough measure of the extent is determined by a simple Google search of the term "climate change," which returns results exceeding 1.2 billion (e.g., a Google search returned 1,260,000,000 hits on 12 January 2024). Many different aspects of climate change are found in this substantial output and it is likely that grey literature constitutes a sizeable portion (possibly the largest).

Grey literature has been defined as "that which is produced on all levels of government, academics, business and industry in print and electronic formats, but which is not controlled by commercial publishers, i.e., where publishing is not the primary activity of the producing body" (Schöpfel & Farace, 2010, p. 2029). While this definition is widely accepted, in practice other organizations, in addition to the types explicitly listed in the definition, produce grey literature. For example, large numbers of non-governmental organizations, many of which focus on environmental issues, annually turn out grey literature publications by the score.

Decision-Making Processes

To gain an appreciation of this vast body of grey literature, understanding the contexts in which the information is produced and used is essential. In an earlier iteration of this series of conferences on grey literature, we described the importance of grey literature in public policy development processes (MacDonald et al., 2015). Most policy decision-making processes are notoriously complex, as Sir Peter Gluckman, then Chief Science Advisor to the New Zealand Prime Minister, illustrated in a policy cycle diagram that he presented at a conference of the International Network for Government Science Advice in Brussels in 2016 (reproduced and expanded in Gluckman, 2018). That diagram vividly highlights the "messiness" of public policy development processes (Castán Broto, 2020; Lewis et al., 2023). The public arena of policy decision making at all levels of government is populated with many different actors and actions where information of many types and formats supports decision-making processes (SAPEA, 2019). It is important to recognize that this environment is where much of the climate-related grey literature functions.

Evidence (information) can be and is introduced at many different entry points in decision processes, e.g., in public hearings and consultations, in legislative committees, etc., by distinctly separate actors, e.g., researchers, policy analysts, journalists, citizens, etc. (MacDonald et al., 2016). The context surrounding each access point often dictates the type and format of information that is used. For the evidence to be effective it must be relevant and be presented in a usable form at each location (Cairney & Kwiatkowski, 2017; Mitchell et al., 2006; Sarkki et al., 2014). Once introduced, the format of the information may evolve as it moves along the various pathways in the decision processes. For example, information may enter as a briefing

note prepared by a researcher, which is presented to a policy analyst or a resource management committee, then transmitted through a variety of pathways in the hierarchical structures of government and concludes the course of its travel as a reference in a policy document. Most information transmission routes, however, are less straightforward and are drawn-out and convoluted with potentially numerous hurdles or blockage points. Typically, grey literature figures in every one of the pathways (Bogenschneider & Corbett, 2021; Cairney, 2016).

Types of Grey Literature dealing with Climate Change

As is well known by grey literature researchers, the types of grey literature are varied and extensive (see Table 1). This diversity is largely related to how and where information is used in decision-making processes, as noted above. Some types are widely used in organizational settings, e.g., briefing notes, often specifically designed and formatted to meet the contextual requirements. While some types are very common at both operational and political branches of governmental bodies, they may not be publicly accessible by default. Grey literature used within government ministerial cabinets in Westminster styles of government, for example, is considered confidential unless explicitly made publicly accessible (Campagnolo, 2018). In other organizational contexts, e.g., private think tanks or companies, grey literature used in decision processes can also be labelled confidential and not made available publicly.

Table 1. Types of Grey Literature about Climate Change

- Blog Posts
- Briefing (Policy) Notes
- Conference & Workshop Papers
- Databases and Data Sets
- Fact Sheets
- Government Publications (many types)
- Industry / Consultant Reports (many types)
- Infographics
- Literary and Artistic Works
- Maps
- Media Releases
- Meeting Records
- Newsletters
- News Media Reports (several types)
- NGO Publications (many types)
- Patents
- Photographs and Graphic Images
- Reports (many types)
- Social Media Posts
- Standards
- Theses / Dissertations
- Think Tank Publications (many types)
- Video & Audio Posts
- Websites – a*nd more* …

The types listed in Table 1 also illustrate a range of producers of grey literature: individual authors, governmental and non-governmental organizations, intergovernmental bodies, news organizations, private companies, etc. The diversity of types and producers points to numerous roles that this literature fulfills.

Roles of Grey Literature in Climate Change Decision Processes

In this section we describe a suite of roles that grey literature performs in decision processes (see Table 2). As Petzold et al. (2023) point out, grey literature can be the main type of information facilitating consideration of options to address the implications of climate change:

> Many on-the-ground responses to climate-related hazards may not be included in peer-reviewed literature but documented in other forms of literature (that is, grey literature), for example, reports by the private sector or civil society actors. (p. 1528)

Table 2. Roles of Grey Literature in Climate Change Decision Processes

To Report Research Results
To Synthesize Information (e.g., Research and Professional Literature)
To Inform Policy Makers and the Public
To Advocate for Policy Change
To Implement Policy
To Promote Change in Professional and Individual Practice
To Educate
To Broker Information and Promote Networking
To Counter Misinformation

To illustrate each role, we present examples of grey literature published by a variety of different organizations: governments at different levels, NGOs, and policy institutes.

To Report Research Results

Figure 1. Examples of Research Reports

From a research perspective, initial reports of results may be published as grey literature (Figure 1). Technical reports, for example, have been produced by governments and other organizations in very large numbers and in various formats for many decades. This type of grey literature has received extensive attention by grey literature experts, librarians, and authors alike (e.g., Bielskas et al., 2022). Technical reports are often the first documentation of research results and usually contain more details than is included in journal articles arising from the research. Sometimes, the resources required to produce technical reports can be substantial.

To Synthesize Information (e.g., Research and Professional Literature)

Figure 2. Examples of Syntheses

As noted above, research and professional literature about climate change is extensive and growing rapidly. This large volume of literature is scattered among many publications, which has prompted the production of syntheses that vary in scope and comprehensiveness (Callaghan et al., 2020; Smith, L. C. 2023) (Figure 2). Governments and intergovernmental agencies produce syntheses, and probably the best known are the major periodic reports of the Intergovernmental Panel on Climate Change. Xuemei Bai recently emphasized that IPCC "reports primarily synthesize existing literature, and as such, …[are] largely influenced by the existing body of knowledge" (Bai, 2023). As these syntheses are very large, global, and comprehensive, the IPCC also produces Summaries for Policy Makers to facilitate mobilization of research into policy.

To Inform Policymakers and the Public

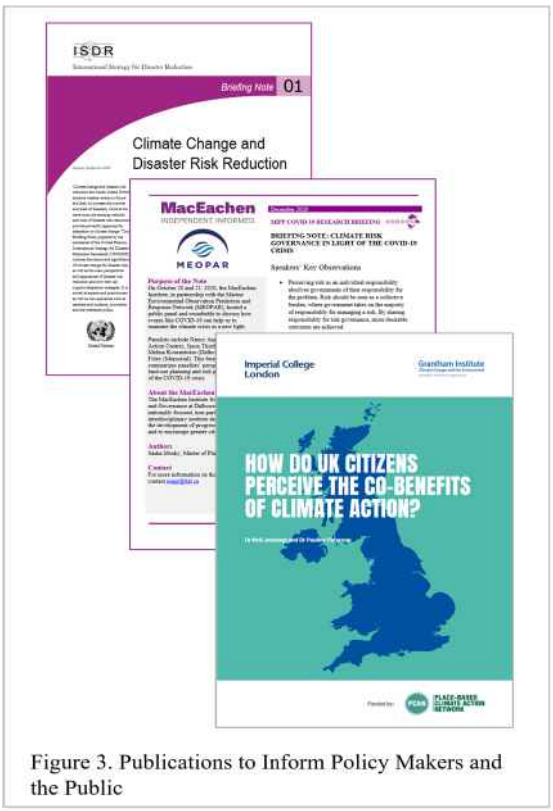

Figure 3. Publications to Inform Policy Makers and the Public

The prominence of grey literature is evident in the significant role of informing both policymakers and the public (Figure 3). Briefing notes are widely deployed to serve in this capacity. Such publications are frequently used to convey information to politicians and decision makers in many, if not most, governmental organizations. While briefing notes are common, due to confidentiality and the typically short life span of the documents, they may not be readily accessible. Briefing notes are used both within and outside governments primarily because the format (short documents, often two pages) fits the important role of informing. In addition, readability in an accessible manner is a key characteristic of these publications.

To Advocate for Policy Change

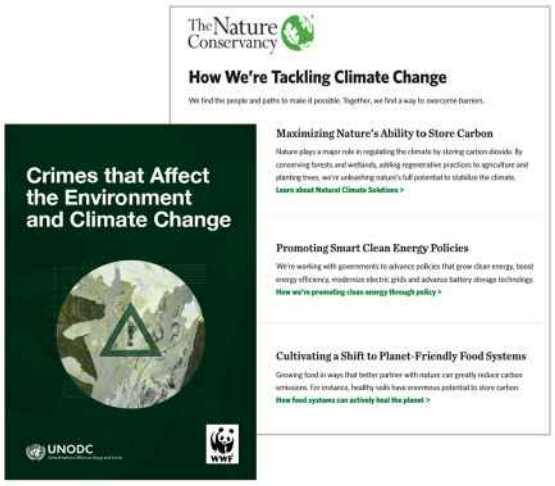

Figure 4. Publications to Advocate for Policy Change

Grey literature fills a fourth role by serving as tools for advocacy (Figure 4). Non-governmental organizations, such as WWF [Worldwide Fund for Nature], Nature Conservancy, and many others, pursue advocacy agendas as a matter of their mandates. They carry out their objectives by directing information specifically to governments and/or to wider publics. Frequently, these organizations maximize use of digital resources in this work. Grey literature in the form of multifunctional websites and active social media platforms, for example, are commonly used.

To Implement Policy

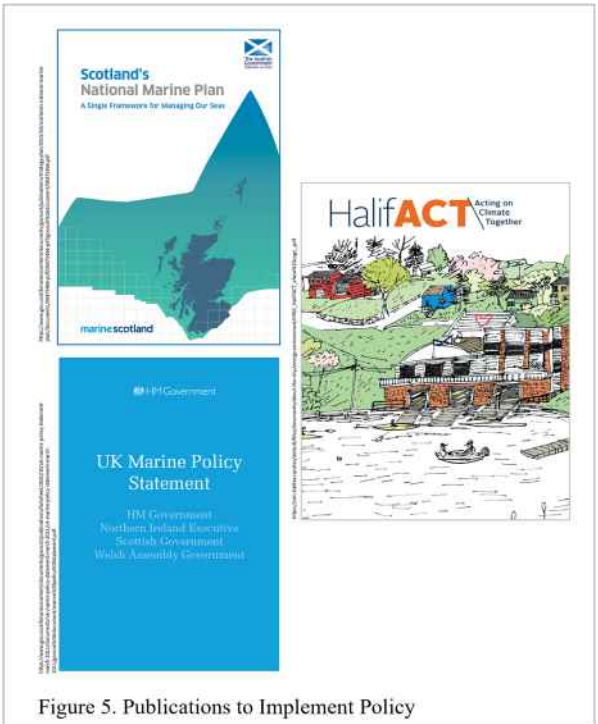

Figure 5. Publications to Implement Policy

Once policies have been approved, implementation follows and grey literature fills yet another role, namely, to support the implementation of policies in diverse sectors (Figure 5). Planning documents are a prime example of this role. Plans are designed for local to international levels. The policy itself is set out in an approved plan and further grey literature is used to specify the steps and actions to implement the plan. The examples of planning documents included in Figure 5 range from an urban municipal climate action plan for the city of Halifax, Nova Scotia to a country level marine spatial plan for Scotland.

To Promote Change in Professional and Individual Practice

Figure 6. Publications to Change Professional and Individual Practice

Grey literature also serves to promote change in professional and individual practice (Figure 6). To mitigate and combat the increasing risks caused by climate change, academic institutions and professional organizations are examining their practices and implementing changes in their operations to achieve positive outcomes.

Many governmental and non-governmental organizations disseminate grey literature to deliver prominent messages, often with engaging graphic images, about the urgency of the issues and to encourage changes in individual habits and practices.

To Educate

Figure 7. Publications for Education

Complementing initiatives to promote change in professional and individual practices, non-governmental organizations have been set up explicitly to fill educational roles (Figure 7). Invariably, these organizations develop and distribute educational materials in the form of grey literature. A full toolkit of educational strategies may be used in designing such grey literature in order to be effective at different educational levels from grade school to adults. To promote awareness of and raise understanding about climate change and efforts to build resilience, governments also use grey literature for educational purposes.

To Broker Information and Promote Networking

Figure 8. Publications to Broker Information and Promote Networking

The next role for grey literature may not be as obvious as the preceding examples. Some organizations, either intentionally or unintentionally, take on the responsibility of information brokers among groups, e.g., between stakeholders and governments (Willems & Giezen, 2022; Willems et al., 2023) (Figure 8). They may also serve as information brokers between levels of governments when particular departments or agencies are not on "speaking terms" with their counterparts in other levels of government. Grey literature generated by brokering organizations can serve as boundary objects between levels of government since the organizations and the grey literature are viewed as "neutral" and not directly tainted by negative characterizations of government units (Cadman et al., 2020).

In addition, non-governmental organizations may be trusted and carry greater credibility than governmental bodies in the eyes of some stakeholders. In such situations, the NGOs can use grey literature in their brokering and networking role.

To Couxnter Misinformation

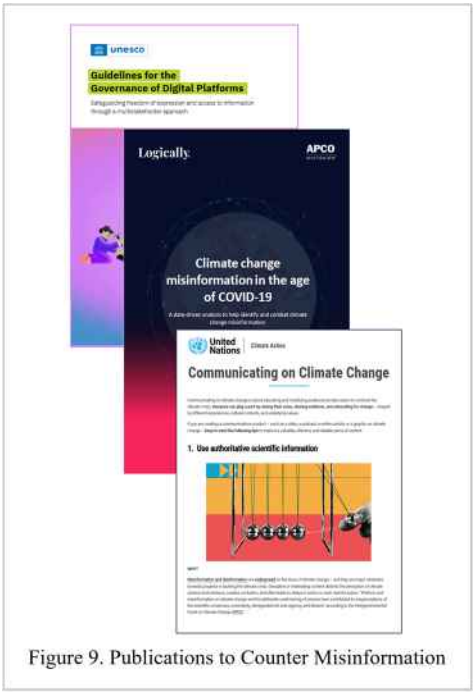

Figure 9. Publications to Counter Misinformation

The nineth role we have identified in our assessment of climate change grey literature has become increasingly important over the past decade as digital communication technologies have evolved and become widely used. Misinformation is a growing concern in dealing with the implications of climate change and more and more initiatives are being implemented to mitigate the effects of this problem (Henley, 2023) (Figure 9).

Many governmental, intergovernmental, and non-governmental organizations have focused greater attention on this issue and are producing reports and other types of grey literature designed to understand and counter the effects of misinformation.

Conclusion

Our survey of grey literature related to climate change has identified a suite of significant roles that this literature fulfills globally in all levels of society. This wide range is available to inform and support policy- and decision-making processes. Due to the complexity and messiness of these processes and almost countless contexts, grey literature is produced for different purposes, in different formats, and for different audiences. Many actors, both individuals and organizations, are involved in producing and using grey literature on climate and climate change topics. In a recent paper about developing resilience to climate disasters, the relevance of grey literature was described as "where perspectives of community based organizations and marginalized citizens are more likely to appear on their experiences of local governance participation" (McNaught, 2024, p. 13; see also Piggott-McKellar, 2019). Similarly, Brubacher et al. (2024) state that the "community voices" included in grey literature can extend understanding about health and well-being in the midst of climate change and biodiversity loss (p. 7).

The roles that grey literature fulfil are typically connected to specific stages or actions in the many interconnected information pathways in policy- and decision-making processes that we outlined above. These roles play out at many levels of decision making. Thalheimer et al. contend, for example, that grey literature is important because it "contextualises adverse impacts of climate change" on various industry and societal sectors (2021, p. 8). Moreover, as Galappaththi et al. point out, giving attention to grey literature is "essential…because much of the evidence on climate change adaptation is documented there" (2022, p. 6).

Due to its different roles, grey literature products can consist of a diversity of components and may fulfil different roles simultaneously. For example, a multipart website can serve to inform, to advocate, and to educate. This flexibility ensures that grey literature can reach various audiences with different education levels and understanding more easily and likely more effectively than peer-reviewed research literature. Although the latter may be accessible, it is read and understood in much narrower circles (see, for example, Sampson et al., 2024).

Finally, due to its ubiquity and accessibility, many people (probably all people) encounter grey literature in their daily lives. Consequently, given its roles in informing and educating, this genre may have far greater societal influence than other types of information. People of all levels of society need accurate and accessible information to make decisions necessary to avert climate disaster. Thus, recognizing the numerous roles that grey literature fulfills can inform citizens, managers, planners, and policy- and decision-makers in addressing the climate challenges facing society today.

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A Review of French PhD Theses on Sustainable Development *

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Abstract
The purpose of our study is to assess the French PhD theses on sustainable development, with two objectives: to give a scientometric overview on the French PhD landscape in the field of sustainable development; and to show how PhD theses (as a major part of grey literature) and related tools can be helpful for the scientometric study of science. The review is based on data from the French national portal theses.fr. The results of our study provide a detailed review of the French PhD research on sustainable development, including the main French research universities in the field of sustainable development and the most eminent academic scholars, the disciplinary distribution of the research on sustainable development, and the accessibility of the PhD theses on sustainable development (open science).

Keywords Sustainable development, PhD theses, grey literature, scientometrics, open science, France

Introduction

For more than 30 years, sustainable development has become a major challenge for mankind. Sustainable development refers to a concept that emphasizes meeting the needs of the present without compromising the ability of future generations to meet their own needs. It involves balancing economic, social, and environmental considerations to ensure that development occurs in a way that is equitable, responsible, and respectful of the planet's natural resources and ecosystems. The concept of sustainable development gained significant attention after the publication of the Brundtland Report in 1987 by the World Commission on Environment and Development (WCED). The report defined sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland, 1987).

Sustainable development is often pursued through policies, practices, and strategies that promote renewable energy, responsible consumption and production, biodiversity conservation, social inclusivity, poverty alleviation, and climate action. The United Nations' 2030 Agenda for Sustainable Development, with its 17 Sustainable Development Goals (SDGs), provides a comprehensive framework to guide global efforts toward achieving sustainable development in various areas. Key principles of sustainable development include economic prosperity, social equity, environmental protection, inter-generational equity, participation, and collaboration, in a long-term perspective.

In particular, the UN 2030 Agenda calls for enhanced scientific research capacity to achieve the targets of the SDGs. Scientific research and development are required to produce solutions for problems like climate change and global warming, air and water pollution, land degradation, loss of biodiversity or limited resources. Grey literature is part of the solution, insofar it is a vector of fast and rich communication of research results through communications, working papers, reports, posters, theses and so on (Schöpfel & Farace, 2018). Moreover, grey literature is also a reliable and relevant way to learn more about the topics, institutions, and actors in the field of research on sustainable development.

For this last purpose, PhD theses are of particular interest because they offer a representative perspective on the current academic research at universities worldwide[1] and because many theses are freely available in open repositories[2]. PhD theses are generally the result of 3-4 years of research and the first valuable document in the career of a researcher; at the same time, they

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[1] See the thesis resources of the Networked Digital Library of Theses and Dissertations https://ndltd.org/thesis-resources/find-etds/
[2] See the statistics of the global Directory of Open Access Repositories OpenDOAR https://v2.sherpa.ac.uk/opendoar/

are administrative documents necessary to obtain the doctoral degree. Sometimes, they are considered as the result of teamwork; in any case, they contain information about supervisors and institutions delivering the diploma (Stock & Paillassard, 2010).

Up to day, there are several hundreds of systematic reviews on sustainable development and related topics. They generally focus on journal articles and neglect (if not exclude) what they call "unpublished and not peer reviewed literature", i.e., grey literature (Schöpfel & Prost, 2021). By way of illustration, here are some recent highly cited reviews, retrieved with the Web of Science Core collection. From eight reviews published between 2019 and 2023, only one includes grey literature, such as PhD and Master theses, reports and conference presentations (Mensah, 2019). The other reviews exclusively analyze journal articles and (less often) academic books (Findler et al., 2029; Hallinger & Chatpinyakoop, 2019; Corona et al., 2019; Di Vaio et al.,2020; Rasoolimanesh et al., 2020; Ranjbari et al., 2021; Ruggerio, 2021). Another systematic bias is the focus on English, excluding other languages like Chinese, Spanish, German or French.

What we want to show is that, especially in the field of sustainable development, a complementary review of grey literature can produce reliable and valid results. The following study will provide a scientometric analysis of French PhD theses on sustainable development, based on a public dataset from the French Bibliographic Agency for Higher Education[3]. The objective is twofold: to give a scientometric overview on the doctoral research in France in the field of sustainable development; and to show how PhD theses, as a major part of grey literature, can be useful for the scientometric study of science.

Methodology

The review is based on data from the French national portal theses.fr[4]. This portal gives access to 446,579 PhD theses defended in French universities since 1971, together with 78,109 theses under preparation (accessed August 23, 2023). For our study, we downloaded the dataset "Thèses soutenues en France depuis 1985" which contains the metadata of French doctoral theses defended since 1985 and which is available on the French public open data platform data.gouv.fr[5]. The dataset has been produced by the French Bibliographic Agency of Higher Education (ABES)[6] and was last updated on January 20, 2023. It is published under an Open Licence (Licence Ouverte) version 2.0.

The ABES data file was downloaded in csv format on August 16, 2023. It contains metadata of 431,997 theses. The metadata includes information about the author, the jury (supervisor, other members), the institution (university, graduate school), the content (title, abstract, discipline, subject), the year and the accessibility (embargo, open access).

The csv dataset was processed with the business intelligence and data analytics software Omniscope (Visokio). We built up the sample in two stages:

1. The search for "sustainable development" or "développement durable" in all metadata, including title, abstract, subject indexing, and graduate school produced 2,326 theses.
2. Additional search for entry terms and related concepts of the preferred term "sustainable development" of the UNESCO thesaurus[7] produced 1,141 other theses (see Appendix).

The final sample consists of 3,467 theses which represent 0.8% of the total number of theses in the ABES file.

[3] ABES https://abes.fr/
[4] Theses.fr https://theses.fr/fr/
[5] *Thèses soutenues en France depuis 1985* https://www.data.gouv.fr/fr/datasets/theses-soutenues-en-france-depuis-1985/
[6] Agence bibliographique de l'enseignement supérieur (ABES) https://abes.fr/
[7] UNESCO Thesaurus https://vocabularies.unesco.org/browser/thesaurus/en/

Results

Evolution

We identified 3,467 French doctoral theses defended since 1985 on sustainable development and/or related concepts. The annual number steadily increased from 8 in 1985 to a ceiling of 180 to 200 theses from 2011 on (figure 1).

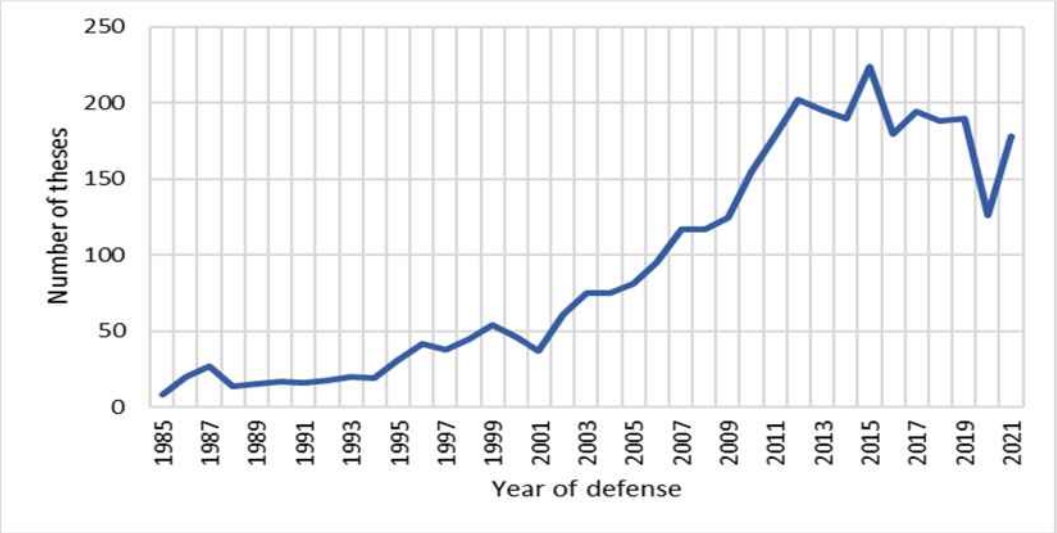

Figure 1. Evolution of defended theses on sustainable development (1985-2021)

The decline in 2020 is attributable to the COVID-19 pandemic; the figures for 2022 (53 theses) and 2023 (1 thesis) are not complete and have been excluded.

Until 2001, the theses on sustainable development represented 0.1 to 0.5% of all defended theses. This percentage increased steadily over the years, reflecting a growing interest for this topic. The actual percentage is 1.4 to 1.6%.

85% are written in French, 13% in English, 2% in other languages.

Institutions

The doctoral theses in the field of sustainable development have been defended in 166 universities and other Higher Education Institutions (HEIs). Their distribution is similar to a long tail; while 20% of the institutions represent 52% of all theses, 80% of theses have been defended in 42% institutions (figure 2).

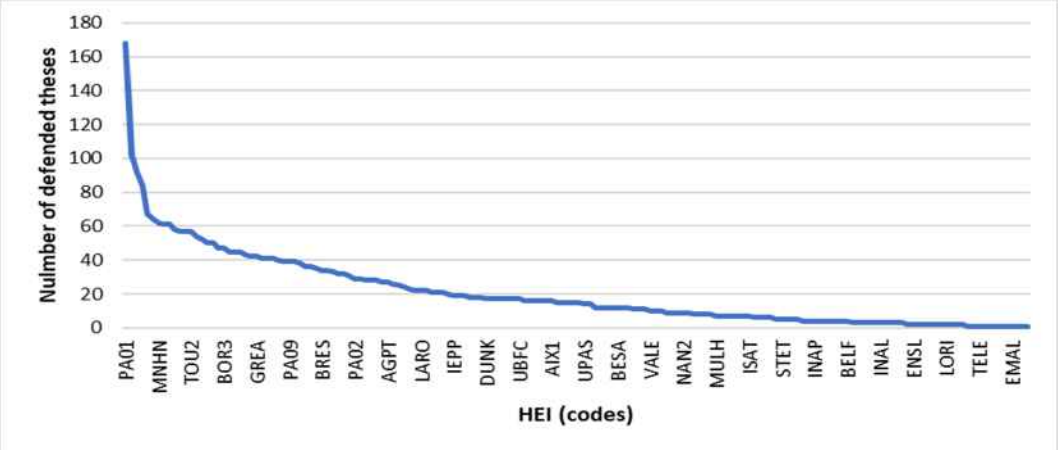

Figure 2. Number of theses per HEI (N=166 institutions)

In other words, we can identify some important universities with doctoral research in the field of sustainable development, i.e., a couple of universities with more defended theses than others (table 1). These ten institutions together represent 819 theses on sustainable development (23.6%). However, we cannot speak of a kind of excellence cluster of some highly significant institutions because doctoral research related to sustainable development has been conducted in roughly 80% of all French HEIs.

Universities	**Number of theses**	**In %**
Paris 1	168	4,8
Compiègne	102	2,9
Nice	92	2,7
Paris 10	84	2,4
Aix-Marseille	67	1,9
Montpellier	64	1,8
Muséum d'Histoire Naturelle	62	1,8
Strasbourg	61	1,8
Reims	61	1,8
Lyon	58	1,7

Table 1. The ten most important institutions (N=166 institutions)

Six institutions of table 1 are members (or part of members) of the Udice union of ten leading French universities working for excellence in research, performance in higher education and the development of attractive innovation ecosystems[8]. Paris 10 (Nanterre) is a large university with a focus on social sciences and humanities, with more than 1,500 PhD students; while the University of Montpellier puts forward environmental issues and social responsibility, hosts the technical support unit coordinating an assessment supported by the United Nations' Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), and defines its scientific attractiveness through its recent Montpellier Advanced Knowledge Institute on Transitions (MAK'IT) aiming to stimulate the contribution of scientific communities to the analysis, support and acceleration of the transitions necessary to achieve the Sustainable Development Goals (SDGs) in the fields of agriculture and food, environment and health. The University of Technology of Compiègne is ranked among the leading French engineering schools and pursues forms of technological research that answer societal questions generated by environmental issues; and the University of Reims Champagne-Ardenne is a multidisciplinary training and research university positioned and recognised nationally and internationally in the bioeconomy field, with an excellence cluster focused on agriscience, the environment, biotechnology, and the bioeconomy.

The institutional long tail distribution is confirmed by the analysis of the graduate schools (*écoles doctorales*)[9]. The dataset contains information about graduate schools for 2,066 theses (60%). The PhD students have been registered with 280 graduate schools. Their distribution is like a long tail, as 20% of the graduate schools (56) represent 57% of the defended theses (1,174) (figure 3).

[8] Udice https://www.udice.org/?lang=en
[9] See the national registry of graduate schools https://doctorat.campusfrance.org/phd/dschools

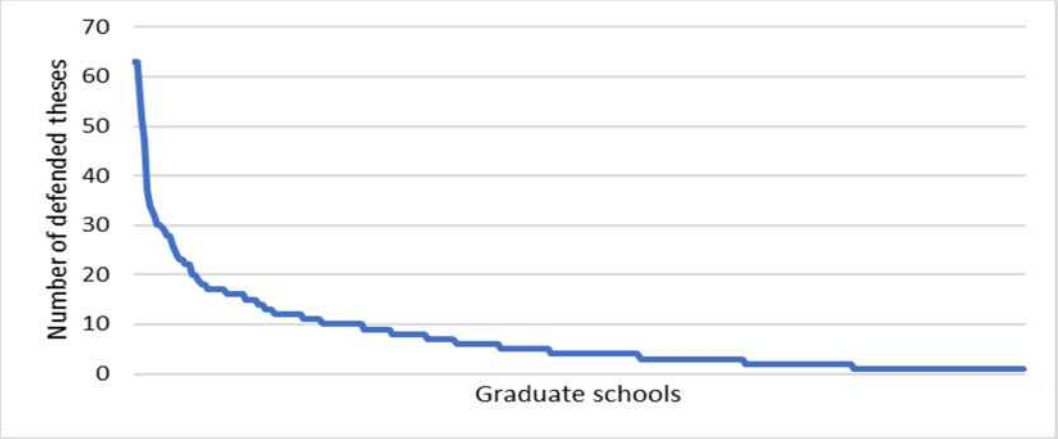

Figure 3. Number of theses per graduate school (N=280 graduate schools, with 2,066 theses)

Table 2 shows the ten most important graduate schools, in terms of number of defended theses. Each of these graduate schools represents between 30 and 60 theses related to sustainable development, in agricultural and environmental sciences, civil engineering, social sciences and humanities, and chemistry.

Graduate school	**Domain**	**Town**	**Number of theses**	**In %**
Sciences de la nature et de l'Homme - Évolution et écologie	Agricultural and environmental sciences	Paris	63	3,0%
Sciences pour l'ingénieur	Civil engineering	Compiègne	63	3,0%
Sciences pour l'Ingénieur	Civil engineering	Troyes	52	2,5%
Sciences de l'homme et de la société	Social sciences and humanities	Reims	47	2,3%
GAIA	Agricultural and environmental sciences	Montpellier	37	1,8%
Sciences de la matière, du rayonnement et de l'environnement	Chemistry	Villeneuve d'Ascq (Lille)	34	1,6%
Chimie	Chemistry	Lyon	32	1,5%
Géographie	Humanities	Paris	30	1,5%
Temps, Espaces, Sociétés, Cultures	Humanities	Toulouse	30	1,5%
Sciences sociales	Social sciences	Lyon	29	1,4%

Table 2. The ten most important graduate schools (N=280 graduate schools)

But again, this is just the top of the chart; actually, the official registry contains 287 graduate schools, which means that nearly all graduate schools are involved in the organization and follow-up of doctoral research in the field of (and/or related to) sustainable development.

People and partners

The dataset allows the identification of 6,819 members of a thesis jury. This membership means that they can be considered to a certain extent scientific experts in sustainable development and/or related topics. However, this involvement appears for most of them occasional, not very important, as 88% has been members of only one or two juries. Their distribution follows more a Pareto than a long tail curve, as 20% of the expert members (1,367) have been involved in the juries of 70% theses.

Only 36 experts have been involved in 10-20 theses, most often as thesis supervisor, representing together 446 theses (7%).

Additionally, we identified 2,457 academic supervisors of theses in the field of sustainable development or related topics. Here, the distribution is clearly a long tail distribution: 20% of the supervisors (491) have directed 41% theses (1,422), while 80% theses (2,764) have been directed by 72% supervisors (1,766) (figure 4).

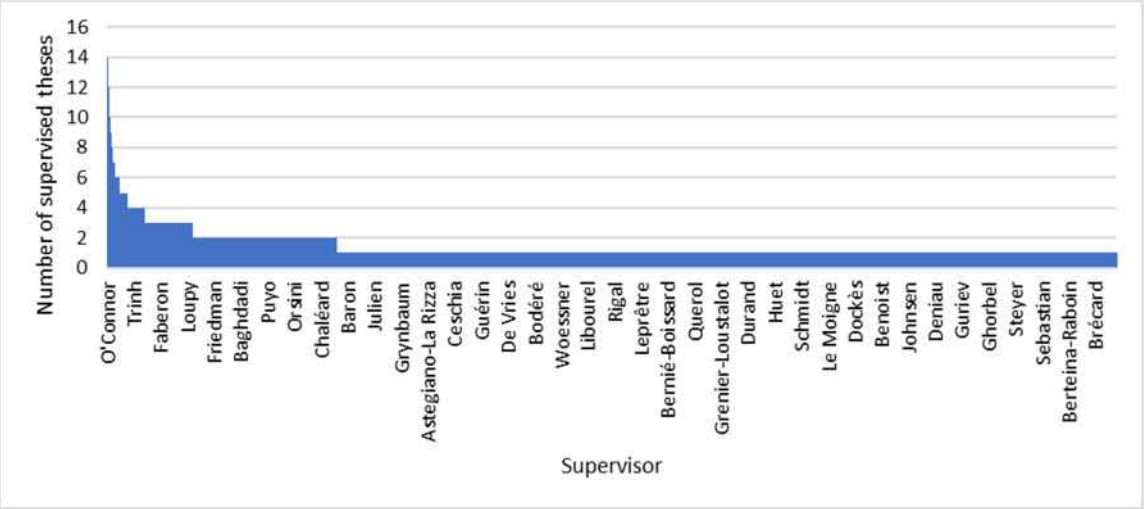

Figure 4. Number of theses per supervisor (N=2,457 supervisors)

Also, figure 4 shows the name of some supervisors, selected at random. More interesting, table 3 contains the names of the ten most important supervisors.

First name	Last name	Institution	Discipline	# of supervised theses
Martin	O'Connor	University of Paris Saclay	Economics, sustainable development	15
Alain	Piquemal	University of Nizza	International law	14
Eugène	Vorobiev	University of Compiègne	Process Engineering	12
Sylvie	Faucheux	Conservatoire national des arts et métiers (CNAM)	Economics, environment	12

Christophe	Len	University of Compiègne, Chimie ParisTech	Chemistry	11
Michel	Prieur	University of Limoges	International law, environment	11
Raphaël	Romi	University of Nantes	Public law, environment	10
Nathalie	Machon	Muséum National d'Histoire Naturelle	Biodiversity	9
Christian	Brodhag	Ecole des Mines Saint Etienne	Civil engineering, corporate social responsibility, sustainable development	9
René	Passet	University of Sorbonne	Economics, development	9

Table 3. The ten most important supervisors

Likewise, table 3 gives an idea of the diversity of the doctoral research but also, of the supervisors' status and expertise. Some examples.

- Martin O'Connor is professor of economics at the University of Paris-Saclay. With research degrees in natural sciences, humanities and economics, and former director of the REEDS laboratory (Research in Ecological economics, Eco-innovation and Tool Development for Sustainability), he works at the interface society-nature, ecological economics, political economy, and social epistemology.
- Alain Piquemal is state councilor and permanent representative of the Principality of Monaco to the United Nations Environment Program (UNEP). He is emeritus professor of international law at the University of Nice Sophia Antipolis (France), former vice-president of this university, in charge of environment and sustainable development and former dean of the faculty of international and european law (IDPD).
- Sylvie Faucheux is a French academic specializing in environmental economics and sustainable development. She is the founder of the Fondaterra partnership foundation (European Institute for Sustainable Development) and chaired the European Association for Ecological Economics, before becoming a board member of the International Society for Ecological Economics. She was a member of the European Consultative Forum on the Environment and Sustainable Development for the European Presidency, and she took charge of the working group on climate change.
- Michel Prieur is a French associate professor specializing in environmental law and honorary dean of the faculty of law at the University of Limoges. He is active in a number of international organizations, including the International Union for Conservation of Nature (IUCN), where he was vice-chairman of the environmental law commission. He is president of the International Centre of Comparative Environmental Law (CIDCE), an international NGO accredited to the Rio (1992), Johannesburg (2002) and Rio+20 (2012) Conferences. He represents France on the European Council of Environmental Law.
- Christian Brodhag is a French politician, environmentalist and academic, professor emeritus at the École nationale supérieure des mines de Saint-Étienne. He has been national spokesman for the Greens, chairman of the French Sustainable Development Commission and interministerial delegate for sustainable development, and he is chairman of the French AFNOR Commission on Sustainable and Intelligent Cities and Territories.
- René Passet is a French economist and development specialist. Professor emeritus at the Sorbonne, he was the first chairman of ATTAC's scientific council. He is considered one of the leading specialists in the new complex or transdisciplinary approaches.

Despite the diversity of their research fields, they share two common points: a personal and outstanding concern for the future of society and environment in the long term, and a civic, public and/or political commitment to sustainable development. We cannot speak of a cluster of excellence, of course; there is no clearly identified group of scientists working together in the same field; but the analysis of the defended theses reveals a "pool of expertise" capable of meeting the challenges of our time, through research, academic work, and education of future scientists.

The dataset contains also information about scientific partnerships for 1,921 theses (55%), including 588 (17%) with several partners. Most partners are public research laboratories, research institutes and specialized HEI; less than 20 theses have been prepared with an industrial partner.

Disciplines

Nearly all theses' disciplines have been indexed with the Dewey Decimal Classification system (ddc), with three whole numbers making up the main classes and subclasses. The complete dataset (all theses) contains 98 different ddc codes while the sustainable development sample has been indexed with 70 ddc codes (71%).

All domains are covered; however, the most important scientific domains covered by our sample are social sciences (ddc:300), pure science, i.e., natural sciences and mathematics (ddc:500), technology (applied sciences) (ddc:600), and history and geography (ddc:900). Together, these four domains represent 90% of all theses related to sustainable development (figure 5).

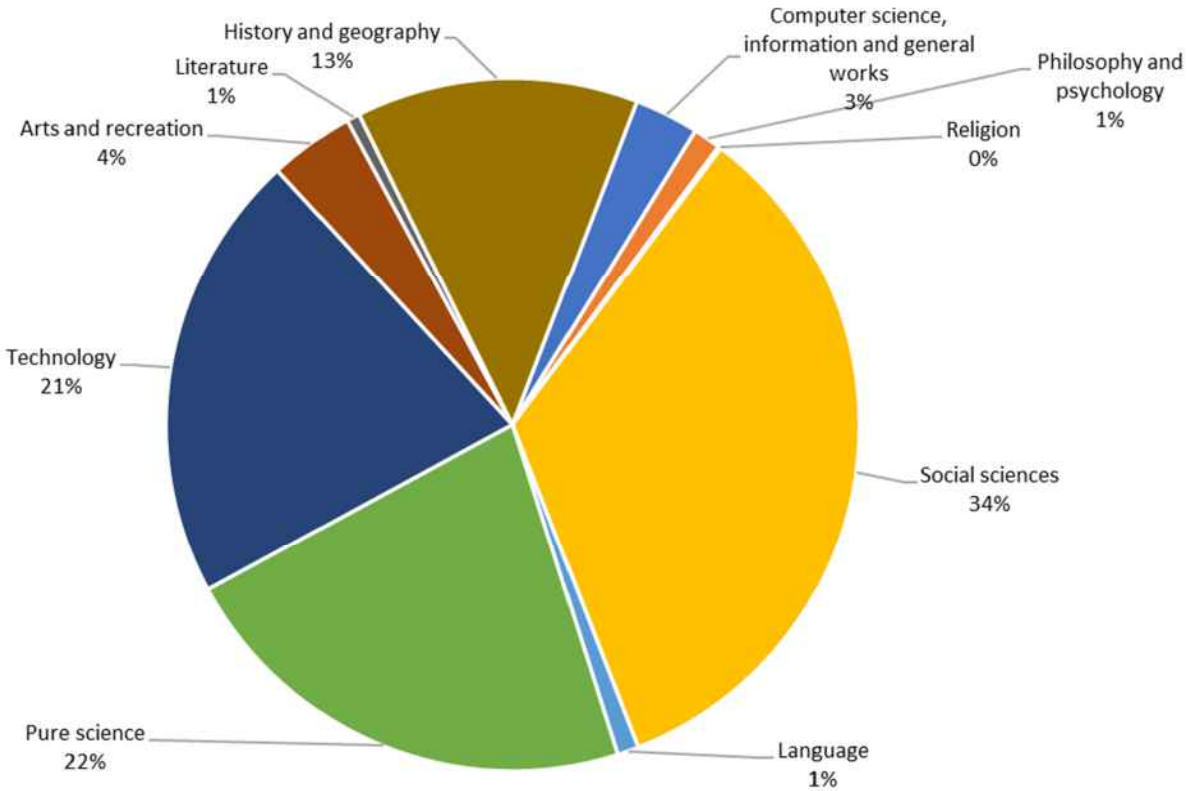

Figure 5. Scientific domains (ddc classes) (N=3810 theses)

A look on the ddc subclasses provides more detailed results of the academic disciplines (table 4). The most important disciplines are economics (15% of the sample), geography (10%), law (10%), chemistry (9%), engineering (8%), biology (7%) and management (7%). Together, the theses defended in these disciplines represent two-third of all theses in the field of sustainable development.

ddc class	Domain	ddc subclass	Discipline	# of theses
300	Social sciences	330	Economics	554
		340	Law	370
		300	Social sciences, sociology, anthropology	140
500	Pure science	540	Chemistry, mineralogy, crystallography	338
		570	Life sciences, biology, biochemistry	282
600	Technology	620	Engineering	319
		650	Management and office management	261
700	Arts and recreation	710	Urban planning	113
900	History and geography	910	Geography and travel	376
		900	Geography and history	91

Table 4. Scientific disciplines (ddc subclasses) (N=3,810 theses)

When compared to all defended theses, theses on (or related to) sustainable development represent a relatively more important part in some disciplines. While our sample represents 0.8% of the total number of theses in the ABES file (see above), this percentage is significantly higher in the following five disciplines:

- Urban planning (8.8%)
- Geography (6.6%)
- Social problems and services (5.4%)
- Buildings (4.9%)
- Economics (4.4%)

Figure 6 shows the evolution of the number of defended theses for each of the ten most important disciplines (ddc subclasses, see table 4).

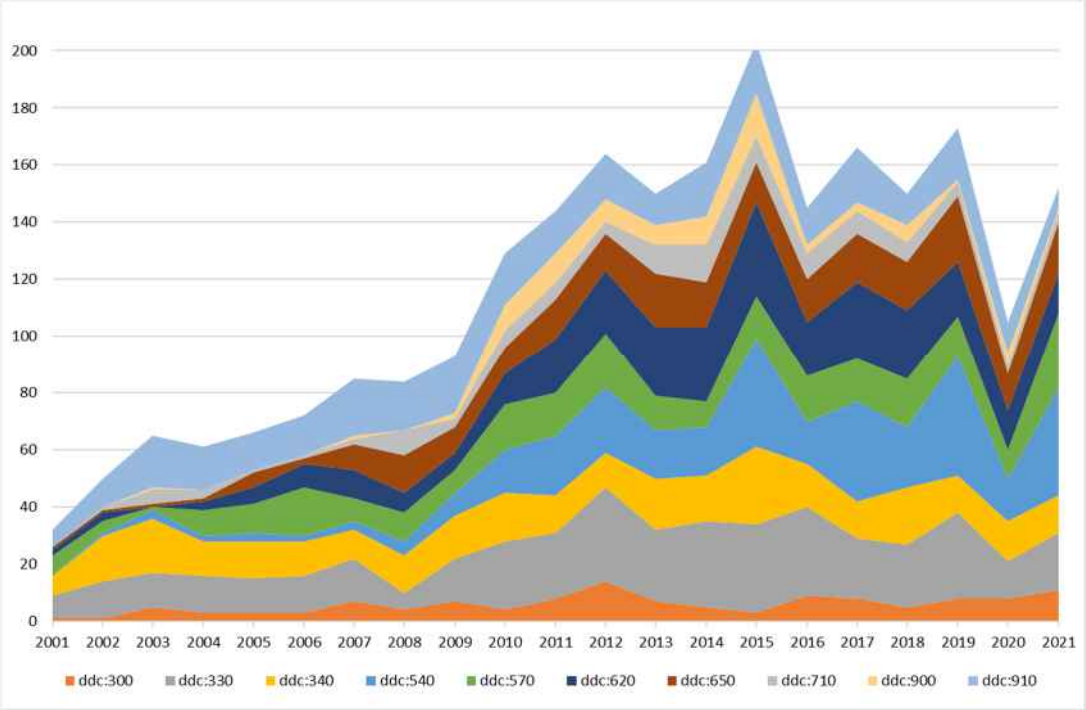

Figure 6. Evolution of the number of defended theses per discipline (ddc subclasses) (2001-2021)

The differences between the ddc subclasses are significant on a p=0.005 level (Chi-square test). The main conclusions can be resumed as follows:

- The importance of natural sciences, in particular chemistry and biology, is increasing over the years. Less but still on a significant level, the number of theses in management and social sciences is also increasing.
- On the other side, the importance of economics and law and (less) geography is decreasing, with less defended theses than expected.
- Third, we can't observe a significant increase or decrease of theses in the field of urban planning and engineering.

Subjects

Beyond disciplines, other metadata enable a more detailed analysis of the themes studied, e.g., title, abstract, and key words. One part of the key words is based on RAMEAU, a French subject indexing language, a derivative of the Library of Congress Subject Headings LCSH), and which is used in France by the Bibliothèque nationale de France, university libraries, numerous public reading and research libraries, and several private organizations[10].

Except for 143 (4%), all theses of our sample have been indexed with one or more RAMEAU subject headings. The complete list is made up of 2,536 headings. Most of them (93%) describe only one or two theses, and only 2% (= 49 headings) are used for the indexing of 10 or more theses. In other words, this list of headings reflects a large diversity of subjects studied, rather than a homogeneous corpus of research. Figure 7 illustrates the 100 most important subject headings.

Figure 7. The 100 most important RAMEAU subject headings (N=3,324 theses)

The research subjects are extremely wide-ranging, covering economic and legal topics as well as management, politics, engineering, technology and even ethics. We didn't match each thesis against the United Nations' 2030 Agenda for Sustainable Development, but we were able to identify for each of its 17 SDGs (including, for instance, Gender equality, Sustainable cities and communities, Responsible consumption and production, and Life below water) one or more subject headings. In other words, the doctoral research of our sample covers the whole range of the international agenda for sustainable development.

[10] RAMEAU https://rameau.bnf.fr/

Table 5 shows the 15 most important subject headings, the French RAMEAU terminology along with an English translation.

Subject headings (fre)	Subject headings (eng)	# of theses
Développement durable	Sustainable development	288
Responsabilité sociétale	Social responsibility	54
Biodiversité -- Conservation des	Biodiversity -- Resource	36
Écologie chimique	Chemical ecology	36
Chimie verte	Green chemistry	33
Conservation des ressources	Conservation of resources (biology)	33
Biodiversité	Biodiversity	26
Gestion de l'environnement	Environmental management	26
Urbanisme durable	Sustainable urban planning	26
Aménagement du territoire	Regional planning	23
Éducation au développement	Education for sustainable	22
Environnement -- Droit	Environment -- Law	21
Changements climatiques	Climate change	20
Environnement -- Droit	Environment -- International law	20

Table 5. The 15 most important RAMEAU subject headings (N=3,324 theses)

This table illustrates some of the most important doctoral research subjects in France, in particular:

- Political action and management: social responsibility, environmental management, sustainable urban planning and regional planning, education for sustainable development;
- Life sciences: biodiversity, and conservation of resources;
- Chemistry: chemical ecology, and green chemistry;
- Law: environmental and, in particular, international environmental law.

Climate change is another, transversal subject of research.

Accessibility

Nearly half of the defended theses on sustainable development are accessible on the Internet. In figures: 1,644 theses can be accessed online (47%), 1,823 are not disseminated in open access but are available in the academic libraries in print format or on microfiche (53%). The percentage of theses in open access increased steadily, from 4% before 2000 to 71% for theses defended between 2020 and 2023 (figure 8).

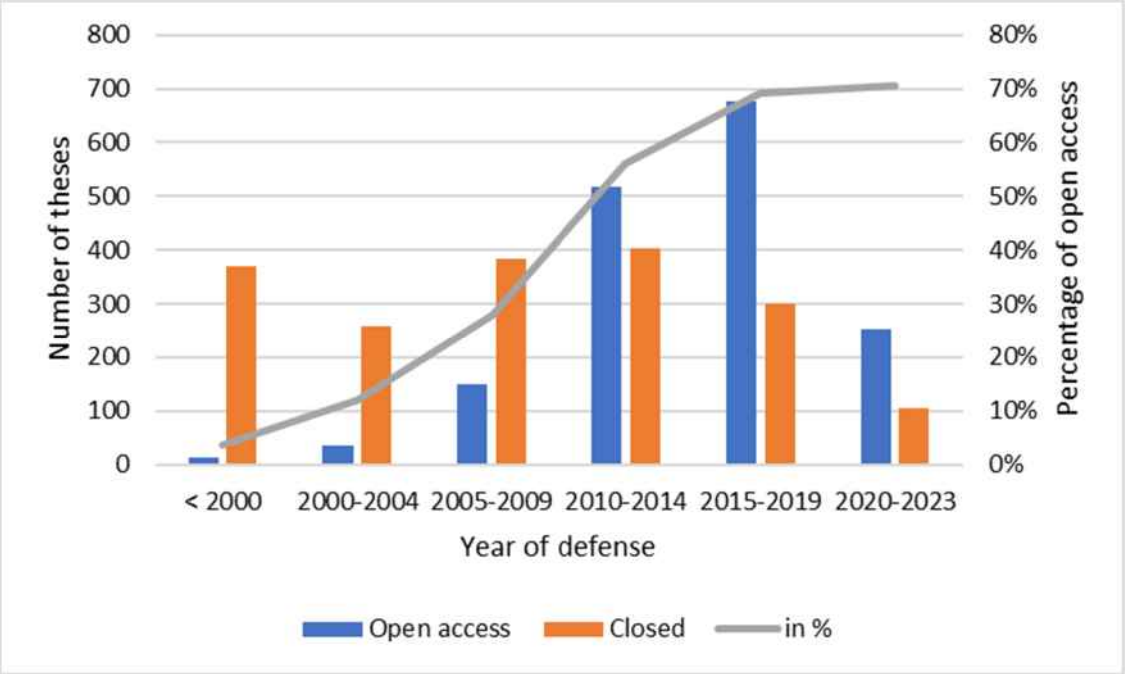

Figure 8. Accessibility of theses on sustainable development (1985-2023)

The open access part of theses in this field is higher than for all French theses over the whole period (31%) but similar for the last four years 2000-2023.

Two complementary observations: For 223 theses (6%), the document which is accessible in open access is not the same as the archived version. 188 theses (5%) have been released under embargo.

Discussion

Our results confirm that a scientometric analysis of grey literature can produce reliable and valid results in a given scientific field, especially regarding disciplines and subjects, institutions, experts, and accessibility. PhD theses are particularly interesting for such a review insofar they are the result of doctoral research projects at most if not all universities. Also, there are two other reasons for their specific interest: one part of the results will not be published elsewhere, in academic journals or books; and, depending on countries and institutions, one part of these results is (only) disseminated in languages other than English. That is to say, PhD theses can provide complementary scientometric information outside of usual systematic review methodology.

However, the scientometric potential of PhD theses and, more generally, of grey literature requires rich metadata, controlled terminology for disciplines and subjects, and standard identifiers for persons and organizations. It requires, too, metadata accessibility and reusability, and a certain degree of representativeness, if not exhaustiveness of the corpus.

From our study with a very rich and complete dataset, we can identify some limitations, on three levels:

- Metadata
    - We identified some errors (probably human errors in cataloging), for instance regarding the institutional identifiers (codes).
    - Some identifiers are missing or not standard, which makes it sometimes difficult to link the data with other information sources, to get complementary information about persons or institutions.
    - The indexing of disciplines and subjects is not based on international standards, or only partly (LCSH).
    - We also identified a language bias, as some metadata is provided in two or more languages, but may be more complete in French than in English, for instance.

- Methodology
  - We retrieved bibliographic records with the term “sustainable development” and other related concepts from the Unesco thesaurus. We hope that this approach has enabled us to identify as many relevant theses as possible but we cannot exclude that we missed some significant theses which do not use this terminology. Some retrieved theses may also be less relevant for the topic, especially those retrieved with related terms.
  - Another limitation of our study is that we did not analyze all relevant metadata. For instance, we did not analyze the thesis’ title, the abstract or the specific role of each member of the thesis jury. We were limited by time and resources, but it is obvious that content analysis of titles and abstracts would have produced a more detailed insight not only into subjects but also into applied methodologies and even into results.
- Context
  - A specific problem with doctoral research is the dynamic academic environment; universities are merging and changing names, graduate schools disappear or are launched, and so on. Static metadata does not reflect such changes which makes, for instance, a longitudinal assessment a little bit complicated.

A last observation: What about the future, what can be said about actual tendencies? The ABES dataset contains only defended theses, not doctoral research in preparation. Some information about theses in preparation can be found on the national Theses.fr portal[11], based on declarative metadata (title, abstract, subject, discipline…) produced by the PhD students themselves. As of September 12, 2023, the portal announces 544 theses in progress; 14 will be defended before March 2024. It is not certain whether all other projects will be finalized. However, based on available data, we can make two observations.

The most important universities with doctoral research in progress are Paris-Saclay (= the highest ranked French university appears in the world’s top 20 universities according to the Academic Ranking of World Universities 2022), Reims, Bordeaux (another Udice member, see above), Lorraine and Montpellier. Created in 2019 in direct competition with the MIT and other high-level international HEIs, Paris-Saclay is a newcomer, with 9,000 scientists and 4,800 PhD students, 230 research laboratories and 17 graduate schools. Its scientific output represents 13% of the French public research. So, it is more than likely (and not surprising) that this university will take the lead in doctoral research in the field of sustainable development in the coming years.

Similar to the past years, the most important scientific disciplines (ddc sub-classes) of these projects are Management and office management, Economics, Law, Geography and travel, and Social sciences, sociology, anthropology. However, all disciplines are covered as before, including information and communication sciences with research, e.g., on media and education for sustainable development (at Bordeaux), on the role and skills of local environmental associations in communication for sustainable regional development, or on the role and values in the communication processes of industrial companies faced with the risks of climate change and the challenges of sustainable development (both at Aix-Marseille).

Concluding remarks

The paper highlights the value of grey literature for the research on sustainable development, in addition to usual systematic review methodology. Our approach can be applied to other resources and document types, on condition of access to quality metadata.
Further perspectives are on two levels:

[11] Theses.fr https://theses.fr/en/accueil.jsp

A content analysis of the title and abstract metadata, a mapping of subjects against institutions and graduate schools, and a mapping of experts. In other words, data analytics as a kind of expert system (or research information management system) based on the ABES dataset.

An exploration of other datasets, such as conference presentations, preprints, reports, Master dissertations or working papers, to identify other data sources for similar complementary scientometric studies.

Data availability

The reused initial dataset is available at the following address: *Thèses soutenues en France depuis 1985* https://www.data.gouv.fr/fr/datasets/theses-soutenues-en-france-depuis-1985/
The dataset of our sample is available on the French research data platform recherche.data.gouv https://doi.org/10.57745/M119IV

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Appendix: Search Terminology

The sampling strategy was based on the UNESCO Thesaurus, a "controlled and structured list of terms used in subject analysis and retrieval of documents and publications in the fields of education, culture, natural sciences, social and human sciences, communication and information"[12]. We limited the search to the French UNESCO vocabulary, as all metadata of the ABES file contain French information about the content (title, abstract…).

Preferred term

Développement durable

Entry terms

Développement écologique

Développement soutenable

Développement viable

Durabilité de l'environnement

Durabilité écologique

Écodéveloppement

Viabilité écologique

Related concepts

Autosuffisance

Bien public mondial

Chimie verte

Conservation de l'environnement

Conservation des ressources

Économie bleue

Economie verte

Ecotourisme

Education pour le développement durable

Équilibre écologique

Évaluation de l'impact sur l'environnement

Gestion de l'environnement

Ressources non renouvelables

Source énergétique non renouvelable

[12] UNESCO Thesaurus https://vocabularies.unesco.org/browser/thesaurus/en/

The Green Human Resource Management Framework: Exploring the Implementation Phases for Sustainable Coal Mining Operations

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Abstract
To address the environmental concerns, the coal mining sector must embrace sustainable practices throughout its value chain, including the area of human resource management. This paper aims to develop a green human resource management framework suitable for the coal mining sector, incorporating the principles of environmental sustainability into the human resource management practices. The framework demonstrates the potential in supporting the coal mining sector in achieving sustainability. The study is based on a single case study of Alpha-90 Company, a major open-cut coal mining company in Indonesia. Data was collected through 7 (seven) interviews with the management team, document analysis, and direct observation. The case study confirmed the key components of the green human resource management framework. It also found that Alpha-90 Company was at the awareness stage of the green human resource management practices, acknowledging its importance but not fully implementing them. This study proposes theoretical insights, practical implications, and recommendations for human resource practitioners. Additionally, it contributes to the green human resource management literature by providing a framework specific to the coal mining sector.

Keywords: Coal Mining, Green Human Resource Management, Sustainability

Introduction

Coal mining, a vital industry for energy production, has long been associated with significant environmental impacts across its entire lifecycle, ranging from exploration to extraction, processing, and waste management (Masood *et al*., 2020; Shkolik, 2022). These impacts, varying in intensity due to factors such as mining methods and regulatory measures, demand immediate attention and mitigation to align the industry with sustainable practices.

In recent years, the coal mining sector has faced mounting external pressures driven by global shifts in energy trends, growing environmental concerns, and governmental initiatives aimed at reducing carbon emissions (Shkolik, 2022). These challenges have not only affected the sector's economic viability but have also raised questions about its long-term sustainability (Kalisz *et al*., 2022; Ofori *et al*., 2022; Qian *et al*., 2021).

To address these multifaceted issues, the coal mining sector must extend its commitment to sustainability throughout its entire value chain, including human resource management (HRM) practices (Bagri *et al*., 2022; Baiquni & Heriani, 2021; Ofori *et al*., 2022). Green Human Resource Management (GHRM) has emerged as a proactive response by organizations to environmental concerns that extends beyond mere pollution prevention and reduction (Renwick *et al*., 2013). It entails integrating corporate objectives, environmental goals, and social sustainability to achieve comprehensive environmental performance (Alenzi *et al*., 2022; Omarova & Jo, 2022).

While GHRM has gained traction across various industries, including banking, education, healthcare, and more, there remains a significant research gap regarding its application in the coal mining sector. The potential benefits and challenges of implementing GHRM practices within this industry have received limited academic attention. Addressing this knowledge gap and understanding the implications of GHRM in the coal mining context require further empirical research, offering valuable insights for industry stakeholders and enriching our understanding of GHRM's applicability across diverse sectors.

Research Methodology

Rationale for Methodology

This study employs the case study methodology to investigate the development of GHRM in the coal mining sector. The case study approach allows for an in-depth examination of a specific phenomenon within a particular context, providing context-dependent knowledge and addressing the "how" questions related to complex and evolving research areas like GHRM (Simons, 2014).

Case Selection and Design

The empirical setting for this case study is Alpha-90 Company (pseudonym), a prominent coal mining firm situated in East Kalimantan, Indonesia. Alpha-90 Company operates one of the world's largest open-pit mining sites, spanning an extensive concession area of 61,543 hectares. Since its inception in 1990, the company has consistently produced over 50 million tons of thermal coal annually. Its workforce comprises more than 3,900 direct employees and over 25,000 contractor employees. The selection of Alpha-90 Company was driven by the organization's size, the scale of its operations, and its profound impact on the local community.

Data Collection

To ensure the credibility and comprehensiveness of this research, two primary sources of empirical evidence were utilized. Firstly, a thorough examination of secondary data related to sustainability issues in the Indonesian coal mining sector, with a specific focus on Alpha-90 Company, was conducted. This secondary data encompassed government regulations, news articles, the company's sustainability reports, policies, and other pertinent documents.

Secondly, primary data was acquired through semi-structured interviews with key subject matter experts within Alpha-90 Company. Interviews were conducted between April and May of 2023, totaling seven interviews. Participants included the Chief Operating Officer, General Manager – Human Resources, Manager – Industrial Relations & Recruitment, Manager – Compensation & Benefits, General Manager – Health, Safety, Environment & Security, Manager – Health, Safety, Environment & Security Systems, and Manager – Environmental. Permission was obtained from interviewees, and interviews were documented. Secondary documents were also collected to triangulate interview findings. Semi-structured interview questions:

1. What are the pressing environmental challenges that demand collaborative efforts from various stakeholders at the global, national, and local levels?
2. How does the HR function in the coal mining sector contribute to addressing environmental concerns?
3. To what degree has GHRM been adopted and implemented in organizations, particularly in the company?

Data Analysis and Interpretation

The analysis of data and insights involved a rigorous process of coding and categorization. Using NVivo, a qualitative data analysis software, categories and codes were initially identified based on the fundamental concepts of the proposed conceptual framework. Subsequently, the coding scheme evolved iteratively as data and insights were analyzed, culminating in a final list of codes and categories.

For data interpretation, the analytical technique of 'building explanations,' a form of pattern matching (Hosseini *et al*., 2019), was employed. This involved identifying patterns and interpreting relationships between codes within the context of the proposed conceptual framework. Triangulation of data from multiple sources further ensured the credibility and validity of the research findings.

Ethical Clearance

The authors claim that ethical considerations were taken into account during the creation of the work. The investigation was conducted in accordance with the ethical guidelines permitted by the University's Ethics Committee (SBM.PN-6-03-2021). As a result of the research's adherence to all ethical standards and anonymity, there were no requirements to provide confidential information (name, date of birth, domicile, etc.). Respondents gave their written consent to conduct the research and data processing.

Results and Discussion

Document Analysis

In its unwavering pursuit of enhancing sustainability performance, Alpha-90 Company prioritizes not only the operational aspects of the company but also recognizes the critical need to raise awareness regarding the repercussions of its activities on all stakeholders. As a prominent coal mining enterprise, Alpha-90 Company is deeply committed to continually implementing responsible environmental, social, and governance (ESG) practices, thereby bolstering its sustainability performance, ensuring adherence to pertinent regulations, and advancing the United Nations Sustainable Development Goals (SDGs). As one of the leading coal producers, Alpha-90 Company staunchly adheres to the philosophy of "More than Mining," firmly believing that the long-term well-being of society and the mitigation of adverse impacts on the surrounding community can only be achieved through conscientious coal mining practices that are economically, socially, and environmentally sustainable.

In the face of formidable challenges posed by the Covid-19 pandemic, Alpha-90 Company remains resolute in maintaining its mining operations, thereby ensuring the country's energy needs are met and that its valued customers receive uninterrupted service.

Figure 1 Alpha-90 Company's Sustainability Framework

Since the year 2003, Alpha-90 Company has consistently produced sustainability reports, a testament to its commitment to transparency, accountability, and responsibility to all stakeholders. These reports serve as conduits for disseminating information pertaining to the company's sustainability strategy, future plans, challenges, opportunities, and ongoing performance to its stakeholders. In recognition of its steadfast commitment to sustainability, Alpha-90 Company has earned a host of accolades and awards, including the Subroto Award 2021 from the Indonesian Ministry of Energy and Mineral Resources, the Good Mining Practice (GMP) Award 2021, also bestowed by the Indonesian Ministry of Energy and Mineral Resources, the Indonesian Sustainable Development Goals Award (ISDA) 2021, the prestigious Gold Rating from the Environmental Performance Rating Program for the years 2020-2021 by the Governor of East Kalimantan, and the Green Rating from the Environmental Performance Rating Program 2020, awarded by the Indonesian Ministry of Environment and Forestry.

Alpha-90 Company's steadfast commitment to responsible mining practices is underscored by its adherence to the principles of Good Mining Practice (GMP), which encompass nine measurable and systematic aspects woven into various operational facets of the company. These include employee competence, mine design and planning, selection of appropriate equipment and diligent maintenance, occupational health and safety, considerations of dimension and time frame, cost-effective production, attention to environmental and ecosystem aspects, nurturing of social community aspects, and diligent adherence to legal compliance and procedural protocols.

In support of the Sustainable Development Goals (SDGs), Alpha-90 Company actively engages in corporate social responsibility initiatives, aligning with current international norms, most notably ISO 26000, which has been adopted in Indonesia as SNI ISO 26000:2013.

The coal production chain at Alpha-90 Company traverses three distinct phases: pre-mining, mining, and post-mining. The pre-mining phase encompasses a spectrum of activities, ranging from exploration and surveying of soil composition to the examination of on-site infrastructure construction. This phase extends to securing vegetation seeds, relocating wildlife, clearing land, and recycling topsoil for rehabilitation. The primary objective of this phase is to meticulously prepare the mining site and ensure its readiness for the subsequent phases.

The mining phase represents the core of coal extraction activities, involving processes such as blasting, coal extraction, and stockpiling. From this juncture, the coal proceeds to the processing plant via overland conveyors. At the processing plant, the coal undergoes rigorous cleaning and sorting, contingent upon its quality. The sorted coal is subsequently stockpiled at the port and readied for loading onto ships destined for delivery to customers. Notably, a portion of this coal is allocated for power generation to support company operations.

The final phase, post-mining, pivots towards reclamation and rehabilitation of the mining site. Here, the focus shifts to activities such as land regrading, vegetation planting, and ongoing site monitoring. The overarching objective is the complete restoration of the land to either its original state or a condition suitable for alternative uses, such as agriculture or forestry, in consonance with the needs of the community.

Collectively, Alpha-90 Company's coal production chain represents a complex and meticulously orchestrated process, encompassing strategic planning, precise execution, and vigilant monitoring. The company's unswerving commitment lies in conducting its mining operations with the utmost environmental responsibility, thus ensuring minimal impact on the local ecosystem while endeavoring to return the area to its original condition or even better.

Interview Results

In the period from April to May 2023, a series of interviews were conducted at Alpha-90 Company to delve into various aspects of environmental sustainability in the workplace, assess the level of Green Human Resource Management (GHRM) implementation, and examine existing sustainability practices within the coal mining industry. A total of seven subject matter experts were chosen to participate in these interviews, including the Chief Operating Officer, General Managers, and Managers from the Health, Safety, Environment, and Security (HSES)

Division, as well as the Human Resources (HR) Division. These participants were selected due to their pivotal roles in shaping sustainability initiatives within the company.

The insights and responses garnered from these interviews provided valuable perspectives on the current state of environmental sustainability at Alpha-90 Company, shed light on the understanding and application of GHRM principles, and assessed the maturity level of GHRM implementation within the organization. Notably, the findings from these interviews exhibited alignment with the level of GHRM implementation as reported in the company's annual sustainability reports. By amalgamating the viewpoints of these experts and harmonizing their insights with the company's sustainability objectives, our research study offers a holistic understanding of the present state and implementation status of GHRM within Alpha-90 Company.

GHRM Concepts

Based on research result, GHRM is a holistic approach that integrates environmental sustainability principles into various aspects of human resource practices within an organization. In this context, this study introduces the GHRM framework, which outlines the important layers that can improve environmental outcomes (Table 1). The first layer, which is the outermost layer, is the External Context. It shows how the GHRM framework relates to the SDGs, which cover various global environmental and social priorities such as poverty alleviation, zero hunger, quality education, gender equality and climate action. In addition, existing regulations, standards and commitments, such as the UN Global Compact, the Environmental Impact Analysis, the Indonesian Minister of Energy and Mineral Resources Decree 1824/2018, and other initiatives also play an important role in directing GHRM steps to achieve positive environmental outcomes.

The second layer, which is the middle layer, is Internal Context. On this layer, attention is focused on the internal organizational approach. This is where companies must adopt responsible Economic, Social and Governance (ESG) practices as well as apply Good Mining Practice (GMP). Sustainability strategies and policies, including the Company Sustainability Policy, the Green Procurement Policy, and the Green Human Resources Policy, support an organization's environmental commitment. Sustainability support systems, such as the Green Competency Management System, the Green Performance Management System, and the Green Information Technology, play a role in driving and measuring green efforts. In addition, the presence of the Green Leadership as well as the Green Organizational Design and Development is key to ensuring the integration of environmental responsibility throughout the corporate structure.

The third layer is the GHRM Core Practices. It is on this layer that various programs are implemented to increase the ability, motivation and opportunities of employees to adopt and engage in environmentally friendly practices. Through the Green Training, employee capabilities in the environmental field are enhanced. The Green Performance Management is conducted to provide recognition and rewards for those who achieve green KPIs. In addition, supportive environmental conditions and resources are also provided through the Green Recruitment and Promotion Program.

This GHRM concepts aims to provide comprehensive guidance for companies and organizations in integrating environmentally friendly practices in aspects of human resource management. With the proper adoption of these layers, it is expected that companies can contribute significantly to global sustainability goals and enhance positive environmental outcomes at all levels of operations and employees.

Table 1 Representative Quotations on GHRM Concepts

Themes	Codes	Quotations
External Context	SDGs	*"Alpha-90 Company emphasizes the commitment and concrete actions it has taken to adhere to the SDG 7, 9, 13, and 15 principles in its coal mining operations. Alpha-90 Company actively pursues sustainability by integrating sustainable mining practices with pertinent sustainable development objectives".*

	Governmental Regulations	*"Alpha-90 Company has incorporated environmental concerns into its policies, ensuring that environmental factors play significant roles in every decision."* *"We have taken proactive measures to establish a comprehensive environmental policy that encompasses waste management, energy preservation, responsible resource utilization, and emission reduction."*
	International Sustainability Standards	*"Alpha-90 Company follows the guidelines of the Global Reporting Initiative [GRI] in reporting our sustainability performance and progress. This ensures transparency and accountability in our sustainability reporting".* *"Alpha-90 Company aligns with the International Finance Corporation (IFC) Performance Standards, which cover various aspects of environmental and social risk management in our operations."* *"Alpha-90 Company upholds the United Nations Guiding Principles (UNGP) on Business and Human Rights, respecting human rights throughout our operations and engaging with local communities in a responsible manner."* *"Alpha-90 Company is a member of International Council of Mining and Metals (ICMM), a global industry association that promotes sustainable development in the mining sector. We actively engage in sharing best practices and learning from other industry leaders."*
Internal Context	Economic, Social, and Governance (ESG)	*"We recognize the significance of ESG in ensuring long-term business sustainability and addressing the environmental and social impacts associated with our operations. To align ourselves with ESG principles, we have implemented several key initiatives."*
	Good Mining Practice (GMP)	"*We have made a concerted effort to align ourselves with Good Mining Practice (GMP) principles. We believe in conducting our operations responsibly and with utmost consideration for the environment, local communities, and our employees' well-being. To achieve this, we have implemented a comprehensive Environmental Management System (EMS) that ensures compliance with relevant environmental regulations and industry best practices. Our EMS covers all stages of the mining process, from exploration to reclamation, and emphasizes the preservation of biodiversity, efficient water management, and the reduction of greenhouse gas emissions."*
	Sustainability Strategies & Policies	*"Alpha-90 Company embraces an eco-conscious approach towards waste management, encompassing strategies such as waste reduction, recycling, and the utilization of cutting-edge technologies to minimize adverse environmental effects."* *"Alpha-90 Company has adopted a Green Procurement Policy which aims to support the purchase and use of environmentally friendly products and services."* *"To maintain transparency and accountability, we conduct regular environmental audits and monitoring to ensure strict compliance with established policies and regulations."*
	Green Leadership	*"We believe that leadership focused on sustainability and the environment is at the heart of responsible practice. Green Leadership views that the company's long-term success lies in a balance between economic, social, and environmental aspects".*
	Green Organizational Design & Development	*"Alpha-90 Company has core values which include "Care", "Integrity" and "Excellence".* *"We have engaged the entire management team in training and development regarding sustainability practices and environmental protection".*

		"Alpha-90 Company has launched various Green Organizational Development initiatives, including value talks, environmental talks, green warriors, and green olympics, that aimed at encouraging awareness and active participation in sustainable practices".
Core GHRM Practices	Green Recruitment & Promotion	*"We place special emphasis on the skills and knowledge required to promote sustainable mining practices".* *"In addition, we also identify and assess the candidate's interest and commitment to environmental sustainability through an interview process and qualification assessment".*
	Green Training	*"Creating a culture of sustainability starts with raising awareness and providing education".* *"Through workshops, seminars, and awareness campaigns, we ensure that our workforce understands the importance of sustainable practices and their role in protecting the environment".* *"By cultivating an in-depth comprehension of environmental issues, we enable our employees to make informed decisions and contribute to a greener future."* *"Through mentorship, seasoned sustainability leaders instruct and motivate others to adopt sustainable practices. We provide employees with resources, direction, and platforms for sharing ideas and best practices, nurturing a collaborative and supportive environment."*
	Green Performance Management	*"By establishing SMART (specific, measurable, attainable, pertinent, and time-bound) goals, we provide a framework for evaluating our progress toward sustainability. These objectives guide our actions, allow us to monitor key performance indicators, and ensure that our sustainability efforts are accountable."* *"To monitor our performance and assess the efficacy of our sustainability initiatives, Alpha-90 Company places a premium on the accumulation and analysis of pertinent data. We collect information on energy consumption, greenhouse gas emissions, water consumption, refuse production, and other sustainability metrics. Through rigorous data analysis, we acquire insight into our environmental and social performance, identify trends, and identify improvement opportunities."* *"Transparency is fundamental to Alpha-90 Company's performance monitoring and evaluation procedure. We are committed to providing stakeholders, such as employees, shareholders, and the community, with regular updates on our sustainability performance.* *"Performance monitoring and evaluation serve as catalysts for continuous improvement at Alpha-90 Company. Through regular assessments, we identify areas where we can enhance our sustainability practices and take corrective actions. We embrace a proactive approach to address challenges and seize opportunities for innovation."*
	Green Recognition & Reward	*"We have implemented performance-based bonus programs that incentivize employees to actively engage in sustainable practices. By linking financial incentives to sustainability goals, we create a culture of accountability and motivation, encouraging employees to go the extra mile in implementing eco-friendly initiatives."* *"Alpha-90 Company has established recognition programs that highlight and celebrate employees who demonstrate outstanding commitment to sustainability."*

GHRM Maturity Level

During the interviews, the following themes were explored, shedding light on the strategies and practices employed in the coal mining sector to incorporate sustainability principles into the HR functions (Table 2).

Table 2 Representative Quotations on GHRM Maturity Level

Themes	Codes	Quotations
Awareness	Assessing and educating on sustainability	"*At the awareness level, employees are introduced to the concept of GHRM. This stage serves as an opportunity to assess and educate them on the principles and practices of GHRM. By raising awareness and providing education on GHRM, we empower our employees with the knowledge and understanding needed to embrace sustainable HR practices and contribute to our environmental goals*." "*Creating awareness about GHRM is the first step towards building a sustainable workforce. By introducing employees to the concept and its significance, we lay the foundation for a culture of environmental responsibility within our organization. Through assessments and education, we empower our employees to understand the impact of their HR practices on the environment and inspire them to make conscious choices that promote sustainability*."
Adoption	Planning, engaging, implementing	"*In the journey of GHRM adoption, it is crucial to plan, engage, and implement sustainable practices. By carefully planning and strategizing our approach, actively engaging employees in the process, and effectively implementing green initiatives, we can ensure the successful adoption of GHRM principles throughout the organization*." "*Adoption is not just about embracing a concept; it is about putting it into action. In the context of GHRM, it involves planning and designing sustainable HR policies and practices, engaging employees in sustainability initiatives, and implementing them effectively. Through this adoption process, we can create a culture of environmental responsibility and drive positive change*."
Institutionalization	Monitoring and embedding	"*At the institutionalization stage of GHRM, sustainability practices have moved beyond initial implementation and have become ingrained in the organization's culture and operations. They are now actively monitored and embedded in various HR processes and policies, ensuring their long-term integration and effectiveness."* "*As GHRM reaches the institutionalization stage, it becomes a part of the organizational DNA. Sustainability principles are seamlessly woven into our values, mission, and strategic goals. We monitor our progress, assess the impact of our actions, and embed sustainable practices in every aspect of our HR function*."
Integration	Expanding, engaging, improving	"*In the process of integration, GHRM becomes ingrained in the fabric of the organization, permeating all levels and functions. It involves expanding sustainability practices, engaging employees in meaningful ways, and constantly seeking opportunities for improvement. Through integration, we can enhance our environmental performance and create a positive impact on the wider community*."

Application of GHRM Maturity Level

- *"Alpha-90 Company has realized the significance of integrating sustainability considerations into HR policies and practices. They recognize the importance of integrating environmental and social considerations into their human resource management.*
- *"Alpha-90 Company has begun to implement some GHRM practices. They have defined key areas in which these practices could be implemented and are initiating their implementation. Reducing a company's carbon footprint, increasing employee environmental awareness through training and communication, developing policies that support sustainability, and encouraging employee participation in sustainable initiatives are examples of GHRM practices that have been adopted.*
- *"However, despite having taken initial steps in adopting GHRM, Alpha-90 Company has not yet attained a more mature level of GHRM implementation. This demonstrates that there is still area for improvement in implementing more comprehensive and integrated GHRM practices."*

Insights from the Case of Alpha-90 Company • *GHRM to Support Sustainable Coal Mining*

The research findings on sustainable coal mining, coupled with the case study of Alpha-90 Company, offer valuable insights into the current state of coal mining practices and their potential for sustainability. Extensive literature highlights the multifaceted impacts of coal mining, including environmental, economic, and social consequences such as land use alterations, water contamination, waste generation, greenhouse gas emissions, and adverse effects on human health, safety, social dynamics, and quality of life (Jason et al., 2019; Liu & Kozan, 2011).

Alpha-90 Company, in acknowledgment of these challenges, underscores its unwavering commitment to institute responsible environmental, social, and governance practices, aligning with the insights derived from relevant literature. The company recognizes that achieving sustainability goes beyond operational changes; it necessitates raising awareness among stakeholders regarding the impact of its activities. This commitment mirrors the definition of sustainable development by the UN World Commission on Environment and Development (WCED), emphasizing the fulfillment of current needs without compromising the ability of future generations to meet their own requirements (Turner, 2017).

Alpha-90 Company's dedication to transparency, accountability, and stakeholder engagement is evidenced by its annual sustainability reports, a practice initiated in 2003. These reports provide comprehensive information about the company's sustainability strategy, objectives, challenges, opportunities, and performance. Furthermore, Alpha-90 Company has garnered recognition and awards for its sustainable business practices, including the Subroto Award, GMP Award, ISDG Award, and commendable environmental performance ratings (Jarosławska-Sobór, 2021).

To address sustainability issues identified in the literature, Alpha-90 Company adheres to the principles of Good Mining Practice (GMP). These principles encompass various facets of operational activities, such as employee competence, mine design and planning, equipment selection and maintenance, occupational health and safety, cost-effective production, environmental and ecosystem considerations, social community aspects, and legal compliance. By integrating these elements into its operations, Alpha-90 Company aims to minimize its environmental impact, prioritize the well-being and safety of its workforce and surrounding communities, and maintain legal compliance.

Additionally, Alpha-90 Company's commitment to sustainable development is underscored by its adoption of ISO 26000, a social responsibility standard, and its persistent efforts to assess and enhance the ecological and economic dimensions of its strategic management framework. The company strives to strike a balance between economic, social, and environmental considerations, infusing the concept of sustainability into its decision-making processes.

Despite the challenges posed by the Covid-19 pandemic, Alpha-90 Company remains steadfast in its commitment to sustaining mining operations, ensuring energy security for the

nation, and concurrently mitigating the negative impacts on the community. This underscores the importance of achieving a harmonious equilibrium between energy security and sustainability, as Alpha-90 Company actively contributes to the attainment of the United Nations Sustainable Development Goals (SDGs).

GHRM as a Pillar of Sustainable Business

Green Human Resource Management (GHRM) stands as a pivotal subject in the realms of both business and sustainability, exerting a significant influence on financial and market-related facets. Within green-oriented organizations, GHRM plays a substantial role in shaping a culture of sustainability that permeates every facet of the organization (Gupta, 2018; Saifudin *et al*., 2021). By aligning human resource practices with green values and objectives, GHRM profoundly impacts decision-making within the organization and shapes stakeholders' perspectives.

Contemporary research places heightened emphasis on the nexus between GHRM and organizational sustainability. GHRM emerges as an essential instrument in crafting, cultivating, and executing sustainable business strategies within organizations. A comprehensive model delineates the constituent components and ramifications of green people management practices on diverse dimensions of individual and organizational performance.

The GHRM framework outlined in this study encompasses a myriad of internal and external elements. Internal components encompass performance monitoring and evaluation, value chain sustainability, employee well-being, green procurement policies, sustainability-driven incentives, employee training and support, and the integration of sustainable mining practices (Agyabeng-Mensah *et al*., 2020). When efficiently integrated into HR practices, these internal components enhance sustainability performance within organizations.

Furthermore, external elements like stakeholder engagement and community involvement serve to cultivate constructive relationships and foster sustainable practices that extend beyond organizational boundaries. By methodically implementing and harmonizing these elements, organizations can elevate their sustainability performance, contribute to environmental preservation, and establish favorable relationships with stakeholders (see Figure 2).

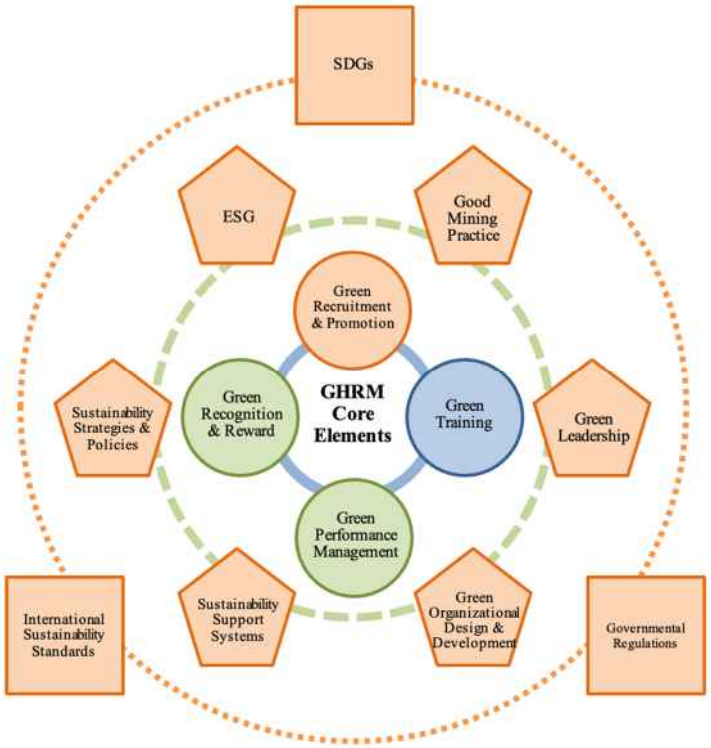

Figure 2 Proposed GHRM Framework Framework

GHRM Maturity Level

The implementation of GHRM can be classified into 4 (four) levels: awareness, adoption, institutionalization, and integration (Figure 3).

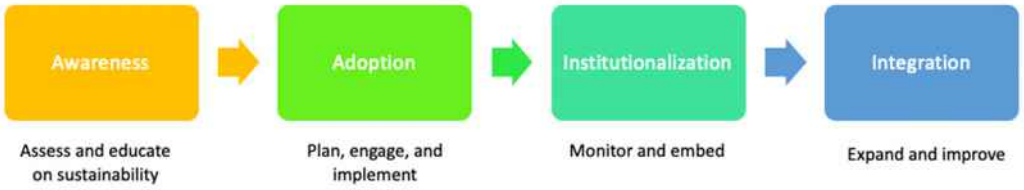

Figure 3 GHRM Maturity Level

Based on the results of interviews, Alpha-90 Company is known to be at the awareness stage of implementing Green Human Resource Management (GHRM). The company is still in the early stages of implementing GHRM and has yet to fully adopt specific practices. The level of institutionalization, where GHRM practices become embedded in organizational culture with formalized policies and structures, has not yet been reached. Likewise, the level of integration, where GHRM seamlessly permeates all aspects of the organization, is still in its infancy for Alpha-90 Company. Being at the awareness level, further effort is required to advance to the next level. To advance implementation, Alpha-90 Company can develop specific GHRM initiatives, formalize policies, and integrate sustainability objectives into HR practices.

Based on previous result, there are a number of barriers to GHRM implementation, including a lack of awareness, resources, top management support, and employee engagement (Bombiak, 2020; Kodua *et al*., 2022). Education level can also affect employees' attitudes and beliefs about GHRM practices. Companies must address these challenges to effectively implement GHRM practices and drive sustainability within their organizations (Omarova and Jo, 2022a; Saifudin *et al*., 2021).

While there is currently no GHRM policy specific to the coal mining industry in Indonesia, Alpha-90 Company and similar companies should consider developing internal policies covering aspects such as work-life balance, environmental training, sustainable supply chain management, and performance-based incentives for sustainability. Experience and policies from other countries, such as Australia, where GHRM practices have been implemented in the mining sector, can provide Alpha-90 Company with valuable guidance in developing sustainable GHRM practices.

Future Strategies and Adaptation

Human resource management (HRM) and corporate sustainability (CS) are gaining in popularity. Therefore, adopting GHRM has become more than a necessity (Goel *et al*., 2022; Marrucci *et al*., 2023; Shukla and Bankar, 2022). To overcome the current obstacles and preserve the prospect of conserving natural resources, all aspects of the discipline must be considered, including human resource management. In this context, the practice of GHRM, which includes continuous recruitment, continuous training, and continuous performance evaluation, among others, becomes crucial (Al-Minhas *et al*., 2020; Anjum *et al*., 2022; He *et al*., 2023). These practices seek to guarantee the active participation of employees in environmentally friendly activities and to motivate them to be environmentally conscious and use company resources sustainably.

According to a study by Algarni *et al*. (2023), organizations with ecological innovation tend to be more globally competitive and prosperous than their competitors. This study demonstrates that the disclosure of environmental information has a significant and positive impact on the financial performance of businesses, and that this impact is moderated by social and ethical practices (Ansari *et al*., 2022). This enables policymakers to design better environmental, social, and economic regulations to assist entrepreneurs in achieving the national agenda through collaboration with diverse stakeholders, thereby contributing to the development of

innovation, the satisfaction of consumer needs, and the creation of value in environmental, social, and economic dimensions (Alenzi *et al*., 2023).

As a first stage, the incorporation of environmental concerns into the company's strategy creates opportunities for sustainable competitive advantage growth. By incorporating sustainable practices into their business and operational models, businesses are able to recognize new opportunities, reduce risks associated with environmental impacts, and increase operational efficiencies. In this context, GHRM plays a crucial role in securing human capital with environmental consciousness and sustainable skills.

"Integration of environmental issues in corporate strategy can increase competitive advantage and support sustainable development"

"Environmentally friendly practices must be an integral part of business strategy, with a focus on increasing competitiveness and management effectiveness. This emphasizes the need for companies to adapt to changing market conditions and a dynamic business environment."

"*The strategic implementation of environmental management is an important key for companies to respond to external changes, increase consumer demand for company products or services, and strengthen their competitive position*"

In the context of GHRM, the incorporation of environmental issues into corporate strategy affords businesses the opportunity to cultivate an environmentally conscious organizational culture. Companies with such a culture are able to recruit and retain employees who share their commitment to sustainability, as well as encourage their participation in sustainable initiatives.

Environmental performance programs implemented on a regular basis within organizations stem from individual initiatives undertaken autonomously (He *et al*., 2023; Saifudin *et al*., 2021; Shoaib *et al*., 2021). GHRM encompasses more than just the execution of sustainable policies and practices by company leadership; it equally emphasizes the engaged involvement of all stakeholders within the organization, including its workforce. At the core of the successful execution of environmental performance programs lies the proactive commitment of individuals to embrace sustainable behaviors. Employees who exhibit environmental consciousness and dedication will respond by engaging in actions aligned with the company's ethos of sustainability. This might encompass proposing inventive strategies to curtail pollution or conserve resources, or even championing the adoption of eco-friendly workplace norms.

"*Investments in promoting GHRM not only have a direct impact on the environment, but also through the mediating variables that underlie the concept of Human Resource Management. Environmental performance programs implemented in organizations are regularly triggered by individual initiatives taken independently*.

"*The success of environmental programs and activities depends on voluntary support from employees and employers who have a pro-environmental commitment in the workplace, as well as the implementation of supportive policies.*"

In conclusion, GHRM is not limited to the adoption of sustainable practices in the workplace; it is also a means of altering the organizational culture as a whole. By integrating environmental issues into company strategy and practice, GHRM can shape companies that are more competitive, innovative, and actively contribute to positive environmental, social, and economic impacts.

Conclusions

In this study, we delved into the realm of sustainable coal mining, using Alpha-90 Company as a prominent case study. The findings unveiled critical insights into the prevailing state of coal mining practices and the promising potential for sustainability within this industry. Alpha-90 Company's dedicated commitment to sustainability was evident through a spectrum of initiatives and practices. These included the consistent publication of comprehensive annual sustainability reports, unwavering adherence to the principles of Good Mining Practice (GMP), the embrace of ISO 26000 for social responsibility, and earnest efforts to weave sustainability considerations into the fabric of its decision-making processes. Moreover, Alpha-90 Company's steadfast commitment to these principles has garnered it numerous accolades and awards,

symbolizing not only its dedication to its stakeholders but also its resolute pursuit of sustainability goals.

Furthermore, our research delved into the level of implementation of the Green Human Resource Management (GHRM) framework within Alpha-90 Company. Our findings revealed that the company currently operates at the "awareness" stage of GHRM implementation. While Alpha-90 Company possesses a keen understanding of the principles and relevance of GHRM, it is evident that further concerted efforts will be requisite to advance to subsequent stages, encompassing adoption, institutionalization, and full integration of GHRM principles into its operational core.

In conclusion, this research underscores the pivotal role of sustainable coal mining practices and the imperative need for their adoption within the industry. Alpha-90 Company's case exemplifies a commendable commitment to sustainable practices, yet it also highlights the journey ahead in fully integrating GHRM into its organizational DNA. The lessons drawn from this study resonate beyond Alpha-90 Company, offering valuable insights for coal mining enterprises and other industries aspiring to balance economic prosperity with environmental responsibility. Through continued dedication to sustainability principles, strategic integration of GHRM, and the pursuit of global sustainability goals, coal mining can evolve into an industry that not only meets the energy needs of nations but also safeguards the environment and fosters a sustainable future for all.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancy have been completely observed by the authors.

Ethical Statement

The authors state that the research was conducted according to ethical standards.

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Sustainable Performance Management Development: A Bibliometric Analysis from 2000-2023

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Abstract
Sustainable performance management stands as a critical aspect for businesses grappling with the multifaceted challenges of social, economic, and environmental concerns. Its importance has surged as companies endeavor to harmonize their operational strategies with sustainable development goals. However, it is notable that the current body of research overlooks the intricacies at the micro-level and the dynamic roles played by individual employees. Furthermore, there remains a notable gap in exploring the intricacies of causality and the mechanisms driving the relationships between sustainable practices and performance outcomes. This study conducted a bibliometric study dissecting the existing corpus of literature on sustainable performance management, to unveil prevalent trends, key contributors, influential journals, and emerging research themes. Through this rigorous exploration, seven distinct thematic clusters have emerged which reflect the interrelationships between various aspects of sustainable performance management, encompassing economic, environmental, social, and technological dimensions. Finally, this study offers valuable suggestions for future research endeavors aimed at enhancing the holistic comprehension of sustainable business practices, shaping organizational performance, and advancing global goals of sustainability.

Keywords Sustainable performance management; Social, economic, and environmental concerns; Operational strategies; Sustainable development goals

Introduction

Sustainable performance management (SPM) has gained significant attention as companies strive to balance their operational strategies with sustainable development goals encompassing social equity, economic efficiency, and environmental performance. The integration of methodologies to derive indicators for measuring sustainability performance is crucial for operational activities. Du et al. (2023) proposed an operational sustainability framework that encompasses four levels, offering a foundation for assessing sustainability performance across economic, social, and environmental dimensions. However, the framework's focus primarily remains at the corporate and business levels, lacking elaboration on performance strategies at functional and individual levels.

Sustainable performance management represents a critical nexus between organizational objectives and societal well-being. Maley (2014) emphasize its significance in multinational corporations (MNCs), where adopting a sustainable HR approach to performance management can yield competitive advantages. This approach not only aligns financial goals but also fosters positive human and social outcomes. Similarly, Riguelle and Van Caillie (2017) examine consumer behavior's intricate interplay with sustainability in luxury brands and plastic clothing, revealing intriguing paradoxes that challenge conventional understanding.

Within this landscape, studies explore the broader implications of sustainable management practices. Martins et al. (2021) analyze public organizations, discovering a correlation between sustainable management and sustainability performance. Kumar et al. (2017) delve into sustainable supply chain practices, showcasing their role in mitigating barriers to collaboration. Moreover, Blackman et al. (2017) spotlight the natural emergence of sustainable practices when performance management becomes ingrained in core business operations.

Further insight is provided by investigations into specific sustainable management dimensions. Al-Minhas et al. (2020) reveal how green human resource management and

green supply chain practices directly impact sustainable performance, with the latter mediating the effect of the former. Zhu et al. (2017) offer a manufacturing-oriented perspective, introducing a sustainable manufacturing framework and performance measurement system. These endeavors underscore how sustainable practices can be systematically incorporated across operational aspects.

Additionally, research underscores the far-reaching implications of sustainable performance. Aras et al. (2010) highlight the mediating role of social and environmental performance in connecting corporate CSR practices with economic performance. Shayegan et al. (2023) recognize the link between employee performance and broader sustainable development objectives. Furthermore, Córdova-Aguirre and Ramón-Jerónimo (2021) explore the role of environmental management control systems in nurturing ecological sustainability.

However, while these studies collectively enrich our understanding, several research gaps remain. Firstly, the reviewed literature predominantly emphasizes the macro-level impacts of sustainable performance management on organizations, neglecting the micro-level intricacies and individual employee dynamics. Additionally, the majority of studies explore the correlation between sustainable practices and performance outcomes, leaving room for investigations into causality and the mechanisms driving these relationships.

To address these gaps and guide future research endeavors, a bibliometric analysis is warranted. A bibliometric study would systematically analyze the existing body of literature on sustainable performance management, offering insights into prevalent trends, key contributors, influential journals, and emerging research themes. This approach would not only provide a comprehensive overview of the field's evolution but also identify underexplored dimensions, facilitating more targeted and impactful research initiatives. Therefore, a bibliometric analysis serves as an essential step towards advancing our understanding of sustainable performance management's intricate dynamics and contributing to its strategic implementation across diverse organizational contexts.

Research Method

Bibliometric methods constitute a valuable tool for systematically evaluating the scholarly contributions and impact of publications within a specific research domain. This approach finds relevance in analyzing the evolving concept of sustainable performance. Similar to its application in the sustainable performance management, bibliometric analysis can shed light on the trends and knowledge structure within the development of sustainable performance. The process of conducting bibliometric analysis involves accessing databases in Scopus and employing mathematical and statistical techniques such as co-citation, co-word, and co-authorship analysis. Just as Li et al. (2019) and Taticchi et al. (2015) utilized these techniques to uncover the intellectual and conceptual evolution in their respective fields, such approaches can illuminate the progression of sustainable performance research.

The research design, as illustrated in Figure 1, encompasses keyword selection and inclusion criteria. In the context of sustainable performance, relevant keywords may include "sustainable and “performance management” The search would span a defined timeframe between 2013-2023 and specific research domains aligned with business management subject. The subsequent co-word analysis, facilitated by tools like VOS viewer, would be employed to identify co-occurring keywords within selected publications. This analysis enables the identification of clusters of frequently appearing keywords, unveiling prominent research themes and their interconnections. This method can unveil how the sustainable performance concept has evolved over time, the key focal areas, and the relationships between various subdomains. In summary, the application of bibliometric methods to the study of sustainable performance offers a structured and data-driven approach to understanding the scholarly landscape. By investigating the evolution of research themes, identifying influential authors and publications, and revealing emerging

trends, bibliometric analysis provides valuable insights into the intricate and multidimensional concept of sustainable performance.

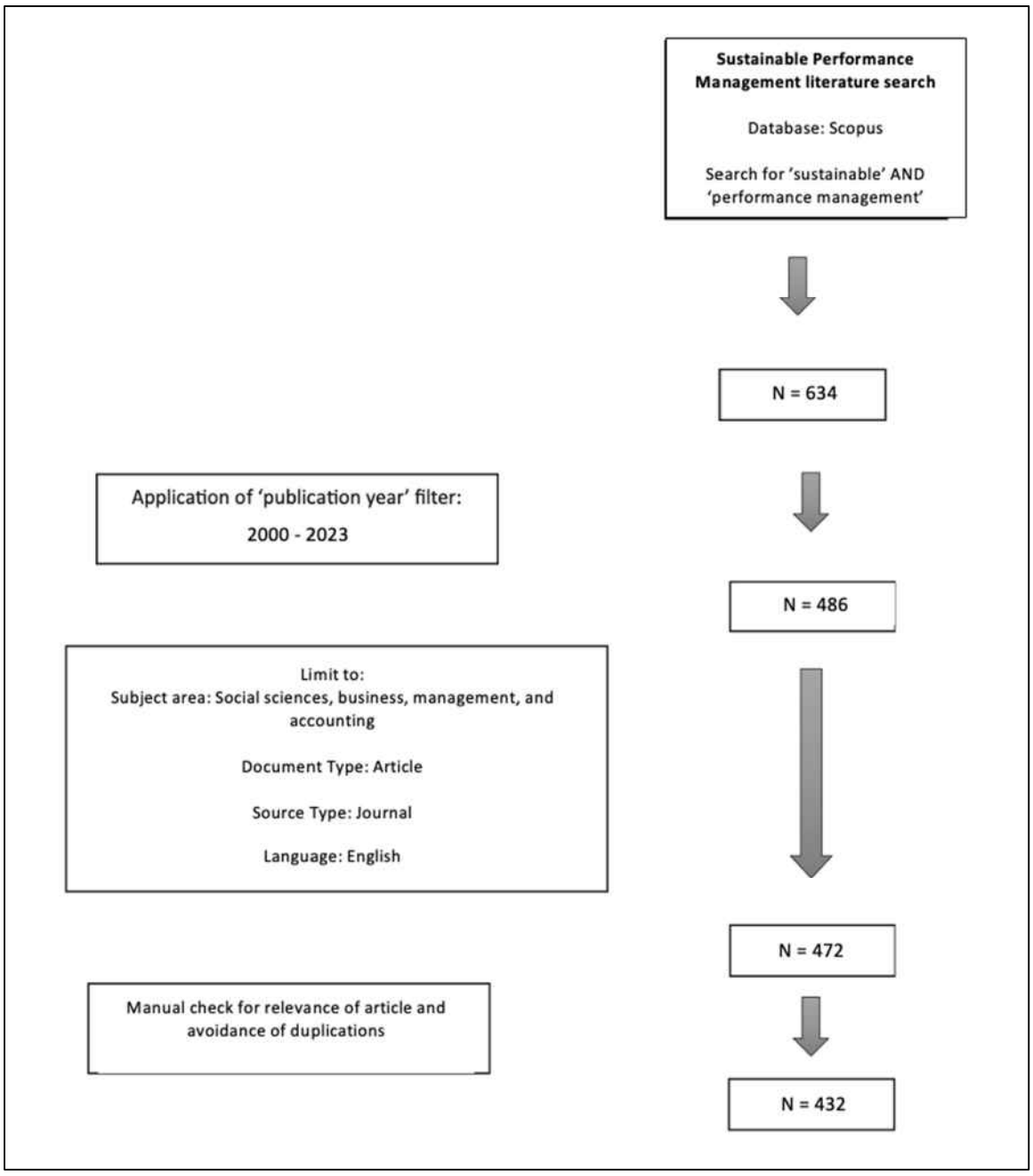

Figure 1. Research Design

Analysis and Discussion of the Findings

Country

Table 1 displays the article count categorized by country context, while Figure 2 presents a map-based distribution for enhanced visualization.

Table 1. Number of Articles by Country

Country	Number of Papers
China	60
United States	53
United Kingdom	50
Italy	39
India	33
Malaysia	22
Australia	22
Germany	18
South Africa	16
Indonesia	15
Brazil	15
Czech Republic	14
Romania	13
Iran	13
Portugal	12

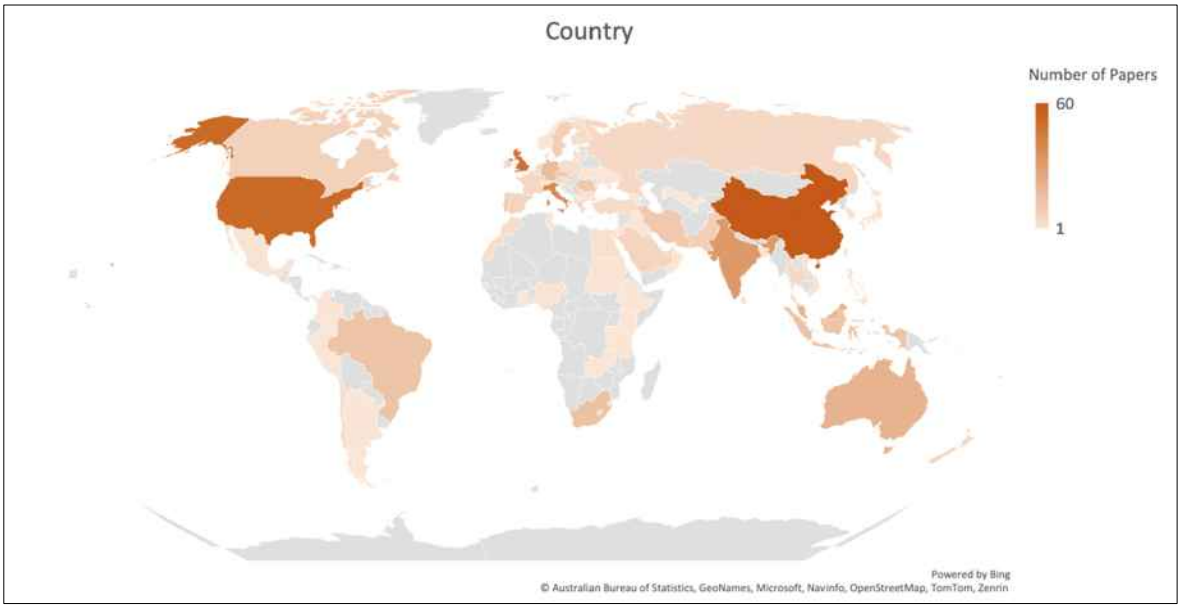

Figure 2. Article map-based distribution

China has made a significant contribution with more than 60 studies related to sustainable performance management. In the context of China's pursuit of carbon neutrality and sustainable development, this research provides important insights into the integral role of managing sustainable performance in various sectors. One important aspect highlighted was the integration of Environmental-Social-Governance (ESG) performance metrics in the compensation structure of high-emission companies. Optimization model based on Genetic Algorithm-Back Propagation neural networks by Jiang (2023) shows how important this role is in achieving sustainable goals. Technological support also plays a key role in this effort, as demonstrated by the systematic evaluation framework for public-private partnership transport projects proposed by Du et al. (2023) uses structural equation modeling and system dynamics to improve project performance. China's focus on a low-carbon economy is also reflected in finance practices, where Jiang (2023) emphasizes the need for low-carbon

principles in finance department budgets for more energy-efficient and environmentally responsible outcomes.

In the United States, 53 studies have been conducted that provide valuable insights into sustainable performance management and its impact on organizational results. This research covers a wide range of sectors and topics including the sports industry, renewable energy, business strategy, application of advanced technology, and management of operations within tourist attractions. For example, research by Scelles and Khanmoradi (2023) reveals a link between market value, roster size, arrivals, and departures and the performance of men's soccer teams in Iran. Santos et al. (2023) highlighted the importance of prioritizing environmental indicators in sustainability reports on wind farms in Southern Brazil. On the other hand, Hristov et al. (2022) proposed a framework for integrating key performance indicators (KPIs) in business strategies to enhance sustainable performance in Italian manufacturing companies. Additionally, Olan et al. (2022) discusses how artificial intelligence (AI) adoption and knowledge sharing impacts organizational performance, and Robinson (2022) highlights the challenges of managing operations in tourist attractions. These studies together provide an in-depth understanding of various aspects of sustainable performance management and their potential positive impact in the United States.

In the UK, 50 studies have been conducted which provide valuable insights into sustainable performance management and its impact on organizational results. This research covers a wide range of topics, from teacher professional development to the use of technology in education. Apart from that, several other countries have also made significant contributions to research related to sustainable performance management. In Italy, 39 studies have been carried out which provide important insights regarding the integration of sustainable key drivers in business strategy, performance measurement systems related to the environment, and the role of stakeholders in improving company performance. In India, a total of 33 studies have been carried out that provide insight into innovation in sustainable performance measurement, integration of the concept of Global Sustainable Development (SDGs) in business strategy, and application of advanced technology to optimize organizational performance. In Malaysia, 22 studies have been carried out discussing sustainable practices in the energy and environmental industries, corporate strategies in achieving the SDGs, and the integration of the environmental dimension in business decision making. Likewise, Australia, Germany, South Africa and Indonesia have provided valuable insights that complement global understanding of sustainable performance management and its impact on various sectors and aspects of life.

Documents by Year

Figure 3 illustrates the number of articles published annually since 2004. In recent years, there has been a significant increasing trend in the number of studies focusing on aspects of sustainability. This trend reflects increasing awareness of the importance of addressing environmental and social challenges and driving sustainable economic growth. In 2004, there were 2 studies highlighting sustainability, which then increased in 2006 with 4 studies. This trend increasingly showed its impact in 2008 with 8 studies, showing the growth of global interest in sustainability issues.

Since 2010, there has been a more consistent increase in the number of studies. In that year, there were 12 studies related to sustainability. In the following years, this trend continued with the number of studies conducted in 2011 reaching 9 studies, and in 2012 with 12 studies. This reflects a paradigm shift in various sectors to integrate sustainability principles in business policies and practices.

In the period 2013 to 2017, the number of studies tended to fluctuate with a range of between 15 and 25 studies per year. However, in 2018, there was a marked decline with only 11 studies. This can be caused by certain factors, such as changes in research trends or changes in the focus of global issues at that time.

However, a significant upward trend emerged again after 2018. Since 2019, the number of studies focusing on sustainability has increased again, and this trend will continue until

2023. In 2019 and 2020, there were 23 and 22 studies conducted respectively . This figure continues to increase in 2021 with 30 studies, and continues in 2022 with 30 studies. In 2023, the number of studies reached 21, indicating that global interest in sustainability continues.

Overall, the trend in increasing the amount of research focusing on sustainability reflects a global shift towards a deeper understanding of environmental, social and governance issues. Sustainability is becoming increasingly integrated across sectors and initiatives, and this research plays an important role in driving positive steps towards a more sustainable future.

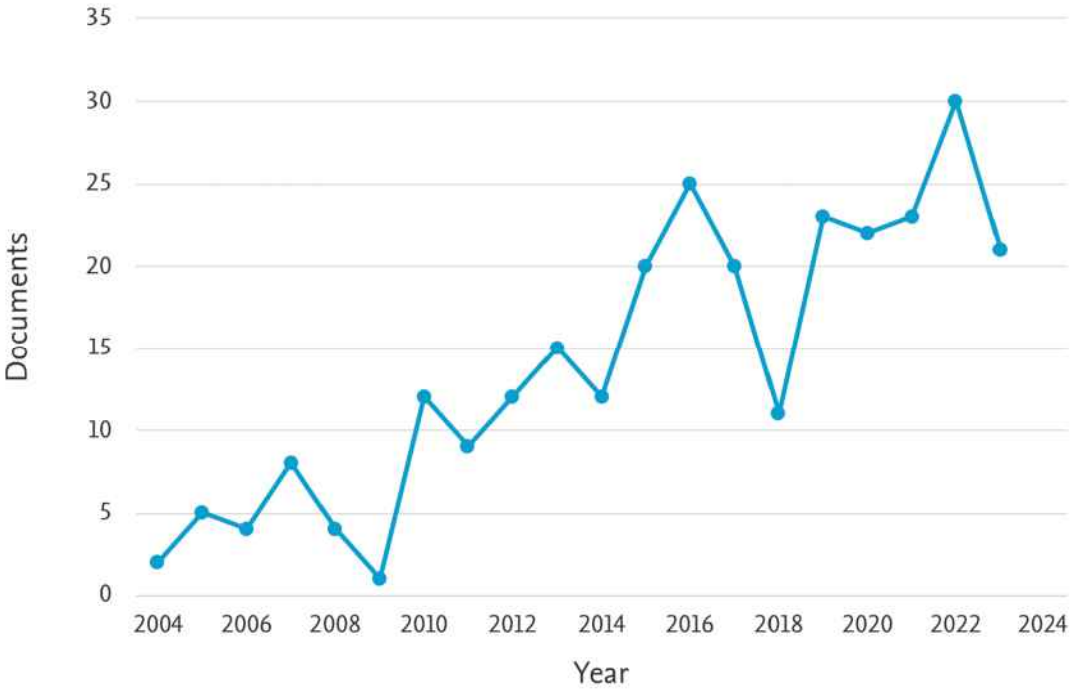

Figure 3. Number of articles by year

Keywords

Table 2 shows the article count categorized by the keywords. Analysis of the frequency of keywords that appear in research on sustainable performance management illustrates a number of central themes and issues that are the focus of this literature. First, there is significant attention to management aspects in a sustainable context, which is indicated by the keyword "Management Practice" with a frequency of 15 times. This shows that researchers recognize the importance of developing management practices that support sustainable development goals and organizational efficiency. In addition, the keywords "Performance Measurements" and "Project Management" with a frequency of 14 times indicate that this research also focuses on overall performance measurement and management, including sustainable project management.

Second, environmental aspects also receive serious attention in this study. The keyword "Environmental Performance" appears 14 times, indicating that understanding environmental performance and the organization's impact on the environment is an integral part of sustainable performance management. The keywords "Environmental Sustainability" and "Environmental Protection" appeared 10 and 9 times respectively, underlining the importance of environmental stewardship in the context of business and sustainable management.

Overall, this analysis reflects that sustainable performance management is a multidimensional and complex subject. Apart from aspects of management and performance measurement, environmental issues, corporate social responsibility, and efficiency are also main concerns in this literature. This reflects awareness of the sustainable challenges faced by the organization and efforts to integrate sustainable principles in all operational and strategic aspects.

There are several advantages and challenges for halal destinations in Malaysia. The advantages of destination tourism in Malaysia are its image as a Muslim country, world recognition and Islamic attraction or Muslim-friendly facilities. The challenges for Malaysia as a halal destination are to increase halal tourism in the next few years of Post Pandemic.

Table 2. Number of Articles by Keywords

Keywords	Frequency
Management Practice	15
Competition	15
Humans	14
Performance Measurements	14
Project Management	14
Environmental Performance	14
Corporate Social Responsibility	13
Supply Chains	13
Balanced Scorecards	12
Sustainable Performance	12
Managers	12
Quality Control	11
Resource Allocation	11
Leadership	11
Life Cycle	11
Human Resource	11
Efficiency	10
Environmental Sustainability	10
Environmental Protection	9
Regional Planning	9
Investments	9
Performance Appraisal	9
Performance Indicators	9

Most Cited Documents

An analysis of the most frequently cited documents in this study, as shown in Table 3, reveals factors that may account for their popularity and high relevance in the field of sustainable performance management. A trend that can be seen is the focus on the integration of the concept of sustainability in management practice, which is in line with the global shift towards sustainable development. Several factors that may explain the particular popularity of these documents are their unique contribution in addressing research questions relevant to contemporary challenges in utilizing sustainable performance as a tool to achieve sustainable goals.

Table 3. Analysis of the Most Frequently Cited Documents

Author (Year)	Number of Citations	Research Question	Findings/ Key Contribution
Snee (2010)	210	What is the level of implementation of green human resource management practices in Palestinian healthcare organizations, and how do they impact sustainable performance?	The study conducted mixed research, including interviews and surveys, to assess the implementation of green HRM practices in healthcare. The practices were found to be implemented at a moderate level, with "green hiring" and "green training and involvement" being the most influential. The study demonstrated a positive influence of green HRM practices on sustainable performance, with environmental sustainability having the highest impact.
Darvazeh et al. (2022)	386	How does Green HRM impact environmentally sustainable business?	The paper introduces Green HRM as a tool to promote environmentally sustainable business practices. It presents a taxonomy of literature on the relation between sustainability performance and firm performance, highlighting the need for further research in developing countries.
Seuring (2008)	462	How has Lean Six Sigma evolved over the years, and what are the emerging trends?	The paper reviews the development of Lean Six Sigma, highlighting its integration into organizational improvement efforts. It emphasizes the holistic nature of improvement methodologies and the need for sustained infrastructure and leadership development.
Masri and Jaaron (2017)	232	What is the relationship between corporate social responsibility (CSR) and financial performance?	The study explores the relationship between CSR and financial performance in developing countries. While the relationship between firm size and CSR was identified, no significant relationship was found between CSR and financial performance.
Goyal et al. (2013)	191	How can sustainability performance be integrated into business?	The paper presents a systematic literature review and a conceptual framework for integrating sustainability performance into business. The framework comprises principles for corporate sustainability, core sustainable business elements, and contextual factors.
Seuring and Gold (2013)	267	How do Green HRM practices impact	The study identifies and validates Green HRM practices in manufacturing organizations. It

		environmental performance in manufacturing organizations?	demonstrates a positive impact of these practices on environmental performance, suggesting strategic links between HR functions and environmental performance.
Aras et al. (2010)	238	What is the relationship between sustainability performance and firm performance?	The study reviews literature on the association between sustainability performance and firm performance. It identifies a lack of universally accepted direction in the relationship, with differing results across cultural and economic contexts.
Schaltegger and Burritt (2014)	233	How has Lean Six Sigma advanced over the years, and what are the future trends?	The paper reviews the development of Lean Six Sigma and discusses its potential for creating sustainable improvements. It emphasizes the importance of holistic improvement methodologies and the need for an organizational improvement process.
Mousa and Othman (2020)	270	What are the developments and research opportunities in sustainable supply chain management?	The study focuses on the expansion of sustainable supply chain management research. It highlights the importance of stakeholder integration, performance measures, and opportunities for future research in low-income countries.
Morioka and de Carvalho (2016)	214	How can sustainability be effectively integrated into supply chain management?	The paper presents a taxonomy of literature on sustainability in supply chains. It discusses the need for holistic approaches, building infrastructures for improvement, and understanding the relationship between sustainability and firm performance.

Documents such as research by Snee (2010) and Darvazeh et al. (2022) introduced and discussed the concept of Green HRM as a strategy to promote environmentally friendly business practices. These two studies provide insight into the implementation of sustainable HRM practices and their impact on sustainable performance. Meanwhile, research by Seuring (2008) regarding the evolution of Lean Six Sigma shows the high interest in developing and improving continuous improvement methods in organizations.

A prominent contribution of this research is the focus on developing frameworks and concepts that can be applied in real business contexts. For example, Goyal et al. (2013) present a framework for integrating sustainable performance in business, while Morioka and de Carvalho (2016) provides a literature taxonomy for the integration of sustainability in supply chain management. These studies provide practical direction and guidance for practitioners and academics in developing sustainable strategies and practices in various sectors.

In addition, the high popularity of some of these documents may also be due to the relevance of their findings and their contribution to business practice and decision-making. For example, research by Masri and Jaaron (2017) on the relationship between corporate

social responsibility (CSR) and financial performance provides findings that can assist companies in planning CSR initiatives and measuring their impact on financial performance. Similarly, research by Mousa and Othman (2020) on sustainable supply chain development identifies new research opportunities and relevance for the development of sustainable business practices.

Overall, the popularity and high impact of these documents can be explained by the relevance of their findings and their contribution to the development of sustainable practices and strategies in various aspects of performance management. The application and adaptation of the concepts described in these documents has the potential to help organizations achieve their sustainable goals and address existing environmental and social challenges.

What Are the Main Research Themes Studied?

Based on the results of the bibliometric analysis in Figure 4, there are several main clusters covering topics that often arise in research related to sustainable performance management.

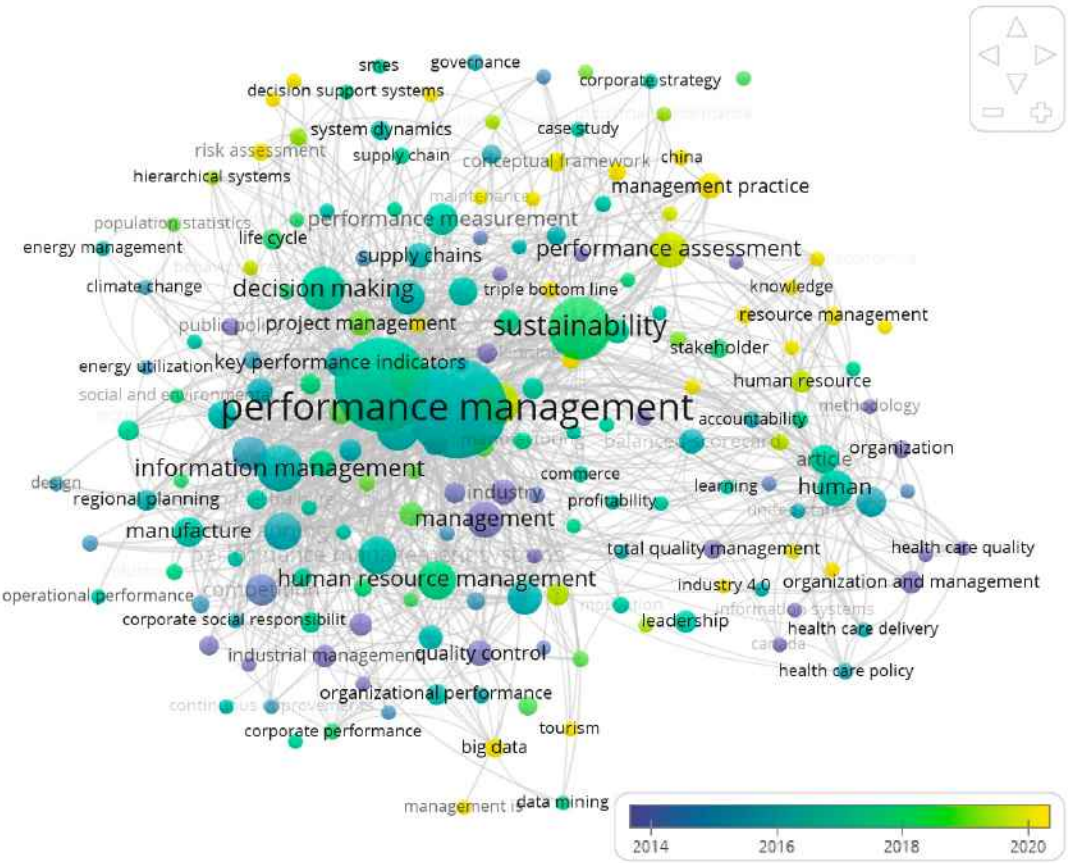

Figure 4. Bibliometric analysis

The following is a summary of each cluster:

Cluster 1: This cluster highlights critical aspects of sustainable performance management, including accountability, digital transformation, environmental economics, environmental protection, organizational innovation, green performance management, and Information and Communication Technology (ICT) applications such as artificial intelligence. The cluster also covers health topics, including health service delivery and health policy, as well as concepts such as Industry 4.0 as they relate to the latest industrial revolution.

Cluster 2: This cluster is related to performance management and performance evaluation through the use of big data, cost management, and performance appraisal and evaluation. In addition, this cluster also covers topics such as quality control, employee performance appraisal, and planning in various contexts such as the tourism industry.

Cluster 3: This cluster highlights behavioral and decision-making aspects in the context of sustainable performance management. Topics such as climate change, competition,

corporate governance, corporate performance and energy management emerge in this cluster, reflecting the interplay between economic, environmental and social aspects in business decision-making.

Cluster 4: This cluster focuses on business aspects and managing sustainable performance, with an emphasis on business performance, corporate social responsibility, continuous innovation and sustainable development. Topics that emerged in this cluster involved risk management, business development, knowledge management, and assessment and development of small and medium businesses.

Cluster 5: This cluster is related to aspects of measuring and managing performance through approaches such as Balanced Scorecards. Topics such as corporate strategy, sustainable supply chain management, as well as case development and studies on the implementation of sustainable practices also appear in this cluster.

Cluster 6 and Cluster 7: These clusters are more focused on aspects of risk management and resource-based management. Cluster 6 deals with business development, process management and customer satisfaction, while Cluster 7 focuses on aspects of safety, evaluation, governance and waste management.

Overall, these clusters reflect the complexity and interrelationships between various aspects of sustainable performance management, including economic, environmental, social and technological aspects. Each cluster covers a wide range of topics that are the focus of research in an effort to develop sustainable practices that have a positive impact on organizational outcomes and broader sustainable development.

Sustainable Management and Practices

This sub-chapter focuses on evaluating and measuring performance in various contexts involving aspects such as company performance management, employee performance measurement, as well as environmental and economic performance measurement. In this research, it was found that company performance evaluation is a concept that continues to develop, including performance management, sustainability, and the "green ports" trend (Rodrigues & Ensslin, 2023). Research discusses the importance of using big data in performance evaluation and measurement to support better decision making (Xavier & Bianchi, 2020). In this context, research also highlights the importance of employee performance measurement and strategies to ensure accurate and effective measurement (Lakshan et al., 2021).

For example, one study presents research exploring ways of managing risks associated with disclosing future-oriented information in integrated reports (Lakshan et al., 2021). This research identifies various strategies used by preparers of integrated reports to manage risks associated with future information disclosure. Some of these strategies include making non-specific predictions, improving prediction accuracy, linking performance management to disclosed targets, and linking disclosed targets to the company's risk management procedures. This study provides valuable insights for managers in deciding how to deal with this kind of risk (Lakshan et al., 2021).

Furthermore, this sub-chapter also discusses the importance of implementing sustainable and dynamic performance management in the context of collaboration and complexity, especially in public policy management (Bianchi, 2021). This research proposes a Dynamic Performance Governance (DPG) approach that combines results-based performance management with collaborative governance. This approach allows stakeholders to review the results of strategies and policies designed to create public value. DPG helps foster effective collaboration, facilitates joint learning, and helps identify early signs of crisis or performance improvement. This study also creates a foundation for the development of a new professional profile that synthesizes the skills of a group learning facilitator and a performance management and governance specialist (Bianchi, 2021).

Performance Evaluation and Measurement

Performance measurement and evaluation is an important component in various fields, including business management, government, and the environment. In the context of business management, Kamensky (2023) observed that the adoption of organizational performance measurement techniques has undergone an evolution in the last few decades. Initially, the focus of performance measurement was more focused on accountability and budgeting, but later shifted to improvement strategies. On the other hand, Gazi et al. (2022) emphasize the importance of continuous performance evaluation in the banking sector, with an emphasis on sustainable performance management to improve organizational efficiency and effectiveness. They highlight the use of measurement tools such as the Balanced Scorecard in performance evaluation.

In the context of government and public policy, French and Mollinger-Sahba (2021) propose a new approach to managing performance in complex and inter-institutional environments. They introduced the concept of "performance attractors" which use outcome and impact indicators to regulate institutional behavior in an inter-institutional environment. In the environmental field, Rodrigues and Ensslin (2023) highlight the importance of evaluating environmental performance in ports and the potential for developing tools such as the Eco-Management and Audit Scheme (EMAS) and the ISO 14001 standard.

Overall, performance measurement and evaluation has a crucial role in achieving goals and sustainability in various sectors. The use of tools such as the Balanced Scorecard, a results-based approach, and innovation in performance management are the main components in realizing better and more sustainable achievements (Ramezankhani et al., 2018; Trisyulianti et al., 2020). With a holistic and dynamic approach, researchers, practitioners and decision makers can optimize the benefits of performance evaluation and measurement to encourage positive change and better achievement of goals (Castelnovo et al., 2016; Zhang et al., 2021).

Environmental and Social Impacts

This sub-chapter discusses in detail the environmental and social impacts that arise from company performance management practices that adopt a sustainability approach. The third and fourth clusters analyzed in this sub-chapter involve a number of aspects that have significant impacts, including climate change, corporate governance, corporate social responsibility, and competitive aspects in the business world. Performance management practices integrated with sustainability emerged in response to stakeholder demands and global changes related to environmental and social issues.

According to Hristov and Chirico (2023), research has shown that many companies adopt strategic approaches that include sustainability issues in their corporate plans, but there are still challenges in effectively integrating aspects of sustainability and corporate strategy. Their study highlights the need to integrate five dimensions of sustainability, namelye nvironmental, social, economic, cultural, and organizational, in performance management systems to realize sustainability strategies.

In research conducted by Que (2023), it is highlighted that companies in the midst of the development of a low-carbon economy with the goal of "carbon neutral" are facing increasingly heavy pressure in terms of energy efficiency and emission reduction. In this context, corporate governance and corporate performance management are key in ensuring corporate carbon compliance. Environmental, social and governance (ESG) performance evaluation is increasingly important, and ESG evaluation systems are becoming a key investment concept at the international level. This research explores the relationship between corporate governance, economic performance and the environment, and provides policy recommendations to support the implementation of the concept of sustainable development.

Additionally, Somwethee et al. (2023) presents research results that link entrepreneurial capability and innovation capability with sustainable organizational performance. They found that entrepreneurial capability and innovation contribute to sustainable organizational

performance, with innovation capability acting as a mediator in the relationship between entrepreneurial capability and organizational performance. These results provide guidance for policy makers in creating an environment that supports the growth of the business community, promotes entrepreneurship and innovation, and contributes to sustainable organizational performance.

Overall, this sub-chapter shows that corporate performance management practices that focus on sustainability have a significant impact on environmental, social and overall organizational performance. The integration of sustainability dimensions in performance management plays an important role in responding to global challenges and ensuring sustainable business continuity (Hristov & Chirico, 2023; Que, 2023; Somwethee et al., 2023).

Strategy and Business Development

This theme reviews strategy and sustainable business development with a focus on the fifth cluster covering various important aspects. This sub-chapter discusses the development of corporate strategies that are integrated with sustainability aspects, such as sustainable supply chain management and implementation of sustainable practices in business development. Risk management, small and medium business development, and process management are also described as integral parts of efforts to achieve sustainable performance (Chang et al., 2017; Hristov et al., 2022).

In addition, this research theme reflects the complexity and diversity of aspects related to sustainable performance management. This theme covers economic, environmental, social, technological and business strategy aspects which overall have a significant impact on business continuity and sustainable development. Through in-depth analysis of each sub-chapter, researchers can highlight a more specific research focus on relevant topics related to the development of sustainable practices and their impact on organizational outcomes and overall sustainable development (Chang et al., 2017; Hristov et al., 2022).

Future Research

The field of sustainable performance management presents an expansive realm for potential research endeavors that can deepen our understanding of the intricate dynamics between sustainability and business performance. One promising direction is the exploration of how organizations effectively integrate sustainability into their core business strategies. Researchers can undertake cross-industry analyses to examine the strategies employed, their sector-specific impacts on performance, and competitive advantage. An in-depth understanding of the mechanisms and challenges associated with embedding sustainability into strategic decision-making can provide valuable insights into fostering long-term sustainability and resilience within organizations (Hristov et al., 2022).

Another compelling arena of research involves investigating the dynamic relationship between environmental performance and economic outcomes. This entails comprehensive scrutiny of how sustainable practices, encompassing energy efficiency, waste reduction, and eco-friendly innovations, contribute to organizational profitability and resilience. Such investigations can illuminate the potential trade-offs and synergies between financial success and sustainable practices, offering strategic guidance to businesses in effectively aligning economic and environmental objectives.

Moreover, the advent of emerging technologies and digitalization provides an enticing frontier for research in sustainable performance management. Delving into how technologies like blockchain, artificial intelligence, and data analytics can enhance transparency within supply chains, optimize resource utilization, and facilitate informed decision-making for sustainability goals is of paramount importance. Research in this direction can yield practical insights into harnessing technology to streamline sustainable practices across diverse industries.

Understanding the challenges and opportunities inherent in implementing sustainable practices within small and medium-sized enterprises (SMEs) constitutes another area ripe for

exploration. Researchers could delve into the unique barriers faced by SMEs in adopting sustainable strategies and the role they play in promoting sustainable development. Insights into how SMEs can overcome constraints and contribute to broader sustainability objectives could inform policies and interventions aimed at fostering sustainability across varying business scales.

In conclusion, the landscape of sustainable performance management beckons researchers to engage with multifaceted dimensions. Future studies have the potential to encompass strategic integration, environmental-economic linkages, technological advancements, and the dynamics within SMEs. By venturing into these diverse avenues, researchers can collectively contribute to a comprehensive understanding of sustainable business practices, shaping organizational performance, and advancing global sustainability aspirations.

Conclusion

This paper has conducted a bibliometric study on the sustainable performance management field. By employing a comprehensive set of search keywords, this study has captured a substantial amount of articles, ultimately narrowing it down to a refined selection of 432 articles.

This study contributed valuable insights into the multifaceted landscape of sustainable performance management research. The findings reveal seven distinct clusters that commonly emerge in studies within this domain. The first are those highlighting critical aspects of sustainable performance management, the second cluster are those related to performance management and performance evaluation through the use of big data, cost management, and performance appraisal and evaluation, the third cluster highlights behavioral and decision-making aspects in the context of sustainable performance management, the fourth cluster focuses on business aspects and managing sustainable performance, the fifth cluster related to aspects of measuring and managing performance through approaches such as Balanced Scorecards, and the sixth and seventh clusters are more focused on aspects of risk management and resource-based management.

Furthermore, this study proposes several promising avenues for future research, such as exploring how organizations effectively integrate sustainability into their core business strategies, delving into the dynamic interplay between environmental performance and economic outcomes, investigating the use of technologies and digitalization in sustainable performance management, and understanding the challenges and opportunities linked to the implementation of sustainable practices within small and medium-sized enterprises (SMEs).

It is important to acknowledge a limitation in this study. While the use of bibliometric methods in this study provides a robust means of systematically evaluating publications within the research domain, there exists the possibility that some pertinent papers may have been overlooked due to the reliance on a single online database, Scopus. Future research endeavors could consider the inclusion of additional databases such as Web of Science and the exploration of alternative sources to ensure a more comprehensive representation of the existing literature.

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International Directory of Organizations in Grey Literature

4th Edition 2024

This revised and expanded edition of the International Directory of Organizations in Grey Literature, IDGL includes a record of each organization's URL (Uniform Resource Locator) and ROR (Research Organization Registry) ID. The ROR-ID record further allows for the inclusion of other linked and persistent identifiers such as the organization's GeoName ID, GRID (Global Research Identifier), ISNI (International Standard Name Identifier), Funder ID, and Wikidata. Organizations are listed under the country in which they reside and appear in alphabetical order. Each organizational entry is assigned one of four sector codes: Academics - ACAD, Government - GOVT, Business - BUSN, or Other - OTHR. If the organization likewise appears in the Registry of Publishers in Grey Literature, a PUBGREY link is also assigned. An organization's entry in the directory indicates that one or more persons within that organization has contact with GreyNet International, that the organization has an assigned ROR ID, and that the organization is currently included on GreyNet's Distribution List. For further information, contact info@greynet.org.

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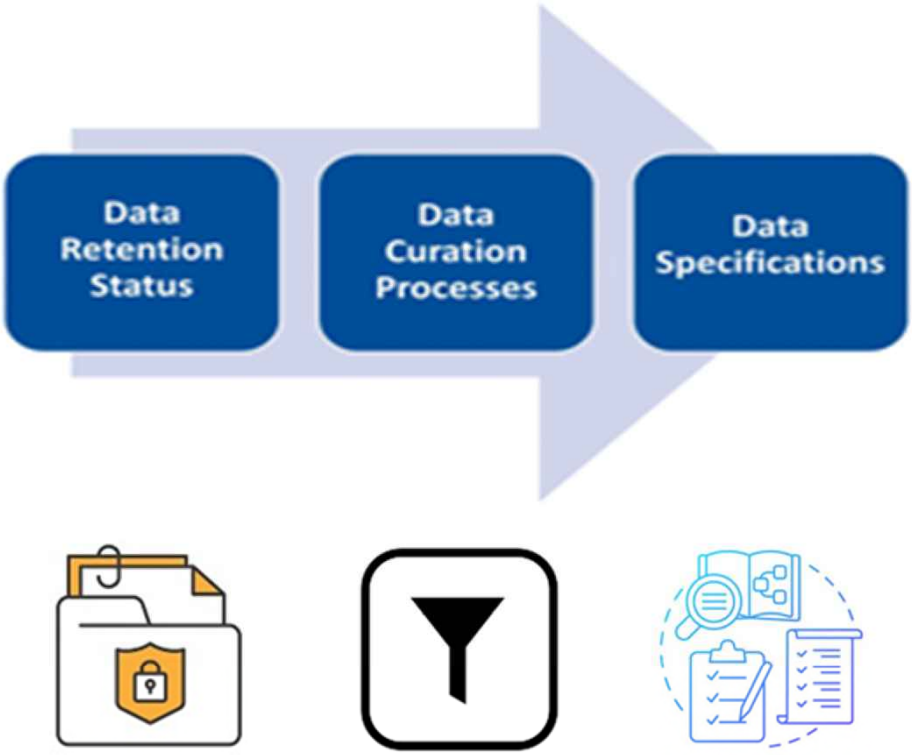

The Korea Institute of Science and Technology Information (KISTI) has invited GreyNet International to collaborate on a research project entitled 'Global Information Repository Research for STI Development'. GreyNet an established community of practice in the field of grey literature for over thirty years has contacts with research organizations in more than 40 countries worldwide. GreyNet seeks to bring to this project its expertise in the promotion and management of scientific and technical information outside the sphere of commercial publishing.

This six-month collaborative research project was launched in the first week of April 2024 and will close the final week of September. GreyNet has made a selection of organizations listed in its 4th edition of the International Directory of Organizations in Grey Literature (IDGL) published in March of this year. This publication will serve in determining the survey population of the study.

If your organization is invited to participate in this research project, please know that your willingness to do so is not only greatly appreciated but will likewise benefit the standing of your organization's work in the field of grey literature.

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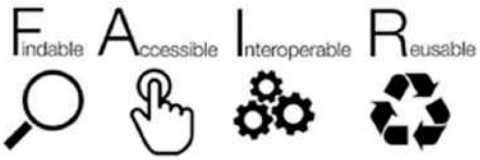
"PIDS benefit the production and publication of grey literature: Supply-side compliance with FAIR Data Principles"

The role of grey literature publishers much like that of commercial publishers is to provide value added information to publications in advance of their dissemination. Today, this involves the inclusion of rich metadata and actionable persistent identifiers. Together they enhance both the generation and transfer of knowledge. Likewise, for grey literature to meet and benefit from compliance with FAIR data principles, publishers must be proactive in the inclusion of PIDS and their associated metadata.

This approach to enhanced publication further demonstrates the value of crosslinking in the publication trail. For example, by incorporating PIDS, **research data** associated with full-text can appear openly accessible in a data archive even prior to the publication of the manuscript. Likewise, **video recordings** of conference presentations can be published in an audio-visual portal prior to their publication as conference papers. Similarly, **conference papers** can appear published and openly accessible in a federated or institutional repository independent of their publication in the conference proceedings.

The more accessible a publication is upon its introduction in the information chain the greater the potential impact it can have. This is of course the significant benefit open access offers grey literature. When the publication further contains actionable persistent identifiers such as the DOI, ORCID, ROR, and Funder ID along with associated rich metadata the researcher and end-user stand to further gain. Today, the inclusion of PIDS is no longer seen as an added benefit but rather becomes a precondition.

Not only are grey literature publishers responsible for the inclusion of PIDS and metadata related to their publications but also the authors and researchers are invited, if not mandated to do so. When they are provided with standardized online templates accompanied by scope notes, this can both enhance the quality of the publication, while decreasing the time in which their work becomes findable, (openly) accessible, interoperable, and (re)useable.



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