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Biodiversity and Extinction Accounting for Sustainable Development: A Systematic Literature Review and Future Research Directions

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Abstract

This paper seeks to present the first systematic literature review (SLR) on biodiversity and species extinction accounting publications. This strand of research is gaining increased attention due to emerging scientific evidence that finds a relationship between the human destruction of biodiversity and the recent Covid-19 crisis, causing profound economic and health impacts. This justifies the need for an SLR of forty articles from 2013-2020. Descriptive results show research contributions peaked in 2018 with the most publications appearing in the Auditing, Accounting & Accountability Journal. Results show legitimacy theory is the most applied theoretical framework with global studies and developed country specific research receiving the greatest attention. In addition, content analysis is identified as the preferred research methodology. Additionally, through synthesising and analysing literature, we provide potential opportunities for future research that is underexplored. This paper will provide a valuable study for academics, policymakers, and practitioners pursuing research in this field.

KEYWORDS: Biodiversity accounting/reporting, extinction accounting/reporting, systematic literature review, species, sustainable development

1. Introduction

One of the greatest threats to the planet is further biodiversity loss and species extinction. Scientific research believes the planet has entered the sixth mass extinction event, with human activity the main driver (Adler *et al.*, 2018; Maroun and Atkins, 2018). Experts estimate up to one million plant and animal species face extinction within decades (IPBES, 2019) if transformational changes are not made. For the last decade, corporate social responsibility (CSR) reporting has been dominant in organisations reporting strategy. Now, within the wider environmental challenges, biodiversity and extinction (hereafter B/E) accounting, is regarded as an extension of CSR reporting. B/E is an emerging stream of literature and in its infancy (Jones and Solomon, 2013; Gaia and Jones, 2017; Haque and Jones, 2020). To date, extant literature provides insights into the complex relationship between global organisations and nature as they have a moral duty to responsibly conserve and protect biodiversity that underpins societal existence (Gaia and Jones, 2019). We contribute to this existing knowledge by providing, what we believe is the first systematic literature review (hereafter SLR) in this emerging stream of B/E literature.

We justify the contribution of this SLR on B/E accounting for several reasons. Firstly, in 2020, The World Economic Forum recognised biodiversity loss as one of the top five global risks to society, which demonstrates the urgency of this research field. Secondly, The United Nations' Sustainability Development Goals (SDG's), specifically SDG-14 *Life below water*, and SDG-15 *Life on land* (hereafter SDG-14 & 15) are the most recent international call for action to address the crisis which interconnects to the wider environmental, societal, and economic sustainability (UN, 2020). These goals are intended to help organisations align with the targets of sustainable development (Mio *et al.*, 2020; Sobkowiak *et al.*, 2020) and prevent resources of natural capital from further decline. In addition, given the current Covid-19 crisis, new cutting-edge research is urgently required to examine organisational responsibility towards B/E (Reade *et al.*, 2015) as experts argue human encroachment with nature originates, and may trigger further global zoonotic pandemics (Ceballos *et al.*, 2020; World Health Organization, 2020). Evidence suggests pandemics are a result of biodiversity loss and habitat destructions (Hassan *et al.*, 2020b; UN, 2020), as proximity contact with humans and wildlife increases zoonotic disease transmission (Johnson *et al.*, 2020). As a result, we expect organisations to, consciously, make tremendous efforts in conserving nature. Furthermore, we expect researchers from interdisciplinary fields to focus on this embryonic stream of literature.

Based on this discussion, we perceive this SLR to be crucial in this research area, thus providing a resourceful foundation for future academics.

Despite the growing interest of accounting academia in environmental research such as climate change (Bryant *et al.*, 2019), carbon accounting (Alsaifi *et al.*, 2019), and wider environmental issues (Elmagrhi *et al.*, 2018) there is little consideration from scholars on exploring organisational responsibility for the B/E crisis (Cuckston, 2013; Jones and Solomon, 2013; Atkins and Maroun, 2018). Early literature provokes researchers to provide contributions (Jones and Solomon, 2013) and raise awareness on how organisations are engaging in ‘stewardship’ of biodiversity. In response, empirical studies emerge, and biodiversity accounting research extends to include the ‘extinction’ element due to the severity of the decline of nature (Atkins and Maroun, 2018). The challenge on how to address the global impact to the natural environment is debated in the literature (Addison *et al.*, 2019; Haque and Jones, 2020) with research contributions of organisational accountability in both corporate (Rimmel and Jonäll, 2013; Adler *et al.*, 2018, Hassan *et al.*, 2020a) and public sectors (Weir, 2018; Gaia and Jones, 2019). Scholars argue B/E accounting is a vital topic with extensive studies focusing on disclosure from annual reports providing a qualitative analysis (Atkins *et al.*, 2018a; Maroun and Atkins, 2018; Weir, 2018), as well as quantitative analysis by examining the relationship of determinant factors and company disclosure (Bhattacharyya and Yang, 2019; Haque and Jones, 2020; Hassan *et al.*, 2020a). Also, further tranches provide calculability mechanisms for biodiversity conservation performance are offered (Cuckston 2013, 2018b; Sobkowiak *et al.*, 2020). A strand of literature argues that the widely adopted Global Reporting Initiative (GRI) standards are inadequate in addressing the decline in nature (Jones and Solomon, 2013; Boiral, 2016; Gray and Milne, 2018; Smith *et al.*, 2019). Scholars also offer a wave of insightful solutions for addressing biodiversity loss and indeed further species extinction in the form of frameworks (Adler *et al.*, 2018; Atkins *et al.*, 2018a, Hassan *et al.*, 2020a).

Based on presenting the above justifications, our main aim and motivation is to synthesise and descriptively analyse current research and identify key areas and opportunities of potential research for academics. Our aim is to provide a systematic in-depth overview of existing literature on B/E accounting. Due to the pressing environmental uncertainties, this substantiates the significance of this SLR and contributes to the current body of literature.

Wider environmental degradation issues, including global warming and climate change are inextricably linked to B/E; therefore, it is imperative researchers must seek to understand the relationship between organisations and nature. In addition, we aim to provide an evaluation of the way research has been conducted in this field, and to identify patterns and trends (Agudelo *et al.*, 2020; Khan *et al.*, 2020), which will enable us to outline potential opportunities for future research.

Essentially, we expect to make several contributions to existing literature. First, we believe to our knowledge, or at least, no evidence exists that there is an SLR offered in this strand, or indeed the wider CSR, or social and environmental reporting (SER) literature, on B/E accounting. Therefore, we present the first SLR on B/E accounting. Secondly, we synthesise and classify publications to analyse by journal, year, country, research methods, and theoretical framework. Thus, enabling us to provide opportunities for future research which are important in establishing a sustainable future. Lastly, as a unique contribution, we provide a table including all relevant research for future researchers with publication specific information, including year, methodology, theoretical framework, and country information (see appendix 1). Thus, our SLR contributes to the current research on B/E accounting by generally mapping out why (theories), how (methodological approaches), and what (empirical evidence) we know in this field. This offers an invaluable starting point for future researchers to progress with research and additionally provides an opportunity to extend as further literature emerges.

This paper is organised as follows. The next section presents the literature review process and selection of publications. The third section presents descriptive results of the review, followed by a critical analysis of limitations, and opportunities for future research. The last section provides the concluding remarks.

2. Methodology

2.1 Selection Approach

The purpose of SLRs is to provide an overview of existing knowledge on the research topic and provide insight into its development (Khlif and Chalmers, 2015; Khan *et al.*, 2020). According to Fink (2005, p.3), the SLR is “a systematic, explicit, comprehensive, and reproducible method for identifying, evaluating, and synthesising the existing body of

completed and recorded work produced by researchers, scholars, and practitioners”. An SLR can be described as an evidence-based selection of the most relevant data (Rafi-UI-Shan *et al.*, 2018) with the aim to provide a summary of knowledge and an understanding of the topic’s development and highlight research gaps (Khan *et al.*, 2020). For the purpose of this research, we include publications that study B/E accounting by organisations. We define organisations by the inclusion of multinational corporate, public sector or, government level studies on B/E accounting. To further understand the research topic, to meet the objectives, only peer reviewed journals have been considered (Rafi-UI-Shan *et al.*, 2018), thus ensuring high-quality search results. We focus on published articles in the English language from 2013 to June 2020. The articles are gathered from the following databases: Science Direct, Elsevier, Emerald, Wiley Online, Taylor and Francis, and Springer Link. Business Source Premier and Google Scholar following previous literature (Ali *et al.*, 2017).

Methods usually involve a keyword search in databases (Khlif & Chalmers, 2015; Khan *et al.*, 2020). The inclusion of the following common and consistent keywords has been searched “biodiversity accounting, reporting or disclosure”, “extinction accounting, reporting or disclosure”, and “threatened species reporting”, were used to search title, abstract, and keywords, a method used by Plockinger *et al.* (2016). Following Khan *et al.* (2020), these words were used consistently and combined using the advanced search function to ensure no article was missed¹. Therefore, for a comprehensive selection of publications, we follow the criteria of Rafi-UI-Shan *et al.*, (2018) for source inclusion or exclusion, which is listed below:

- Peer-reviewed papers and books published from 2013-June 2020
- In the English language only
- Empirical research papers theoretical, qualitative, or quantitative
- Identification of keywords relevant to the subject area
- Ensuring relevance by reading papers entirely

Once studies were identified, a manual search of the references of the lists of the selected articles was conducted, which is supported by academic scholars (Khlif and Chalmers, 2015; Harrison *et al.*, 2016; Bartolacci *et al.*, 2019) to ensure all relevant studies were captured.

¹ Although this review is considered an extensive research approach, it is not exhaustive, which is therefore considered a limitation of this study.

We excluded conference papers, working papers, and thesis (De vita *et al.*, 2014; Khan *et al.*, 2020) as it is argued that grey literature is perceived as unreliable (Harrison *et al.*, 2016).

2.2 Selection of articles

B/E accounting is an emerging strand of literature, and there are a limited number of publications. However, this SLR aims to provide an overview of existing knowledge with the nature of articles selected specifically to organisational behaviour towards B/E. For this SLR, publications searched included contributions out with business related journals as B/E accounting is considered a multidisciplinary research area (Jones and Solomon, 2013). Research depends on shared knowledge from a range of disciplines such as ecology, science, accounting, and other experts to collaborate and develop solutions (Hassan *et al.*, 2020a). As a response from the accounting profession about this vital area, the main source for papers comes from The Accounting, Auditing and Accountability Journal (AAAJ), which has published 19 articles (see Table 1) on B/E. This includes publications from the 2018 special issue “Extinction accounting and accountability”, and the 2013 special issue “Accounting for biodiversity”. The AAAJ is the most influential journal that has led the way in paving interest from scholars in this embryonic research topic. Other journals have published only one or two papers contributing to the literature. In total, 28 journal publications were identified that met the inclusion criteria. The remaining journal distribution is presented in Table 1.

Insert table (1) around here

In addition, four books recently published have been used for this research (see Table 2). The book entitled “Six Capitals, or Can Accountants Save the Planet” (Gleeson-White, 2014) suggests a revolution of accounting to include elements of the natural environment as the most significant accounting scandal of all time is the corporate failure to account for nature. While a book entitled “Chief Value Officer” (King and Atkins, 2016) presents a new approach from the role of a traditional ‘Chief Financial Officer’ to a ‘Chief Value Officer’, thus the idea of companies being led to create value in responsible sustainable governance in saving the planet. Another book entitled “Around the World in 80 Species” (Atkins and Atkins, 2018), which presents an understanding of extinction accounting and the business perspective, providing chapters from guest academic authors exploring B/E accountability studies from around the world. These credible academic scholars have published articles within accounting academia. Although the chapters are short, they provide insightful information on the topic and provide additional analysis to the literature, which is scarce in research papers. These book

chapters present the second largest source of literature for the SLR. These books provided a total of ten chapters which met the inclusion criteria. Overall, our study comprised of 40 journal publications, chapters, and books.

Insert table (2) around here

2.3 Categorisation of publications

For analysis of the SLR, we follow (Khan *et al.*, 2020; Adhikariparajuli and Hassan, 2020) and classify the publications (see Figure 1). This is to identify potential future research. Firstly, the articles are classified by their frequency of publication. This is to examine if the topic is gaining attention in academia. Second, we categorise by geographical spread, firstly by country, and refine into a developed or developing country. Third, as the majority of studies are empirical, we examine research methods. Furthermore, the selected publications are classified into their theoretical focus. Finally, the review analyses the main research limitations within the literature and outline potential future research in this emerging field.

Insert figure (1) around here

3. Results

Descriptive analysis

3.1 Articles published per year

The distribution of articles published by year is shown in Figure 2. Analysis reveals that research peaked in 2018 with seventeen publications. This coincides with the special edition from AAAJ and the book contribution from Atkins and Atkins (2018). The second highest year of publications is 2013 with a further eight contributions which correspond with the AAAJ special edition. The year 2019 provides five research publications and there are three publications in the first half of 2020. It is expected there will be a rise in publications due to experts arguing that human encroachment with nature is linked to the spillover of zoonotic diseases that have led to pandemics such as the recent Covid-19 (Ceballos *et al.*, 2020). Likewise, the ambition of SDG-14 & 15 is to prevent further biodiversity loss and extinction, consequently, it is expected due to the urgency for sustainable solutions, this topic will attract attention from academia and practitioners alike.

Insert figure (2) around here

3.2 Publications by geographic spread

In this section, we analyse research by country, and then further classify them into developing or developed countries. The analysis reveals that literature has focused mainly on global-wide studies for B/E organisational accountability rather than one country specifically. According to Figure 3, eight publications investigate organisations globally for their disclosure on B/E (Bhattacharya and Managi, 2013; Boiral, 2016; Boiral and Heras-Saizarbitoria, 2017; Adler *et al.*, 2018; Addison *et al.*, 2019; Skouloudis *et al.*, 2019; Hassan *et al.*, 2020a). This is followed by six UK specific studies (Freeman and Groom, 2013; Gaia and Jones, 2017, 2019; Weir, 2018, 2019). Research from South Africa warranted three studies (Atkins *et al.*, 2018a; Buchling and Maroun, 2018; Maroun and Atkins, 2018), and two studies each from New Zealand (Tregidga, 2013; Samkin *et al.*, 2014), Australia (Adler *et al.*, 2017; Bhattacharyya and Yang, 2019), Kenya (Cuckston, 2013; Sibanda and Mulama, 2018), and European studies (Rimmel, 2018; Haque and Jones, 2020). Countries such as Denmark (van Liempd and Busch, 2013), Sweden (Rimmel and Jonäll, 2013), Bangladesh (Siddiqui, 2013), China (Zhao and Atkins, 2018), Italy (Martini *et al.*, 2018), the Arctic region (Jonäll and Sabelfeld, 2018), and a combined study of the UK and Germany (Atkins *et al.*, 2014) and the USA and Canada (Solomon and Clappison, 2018) were studied once.

Insert figure (3) around here

Further, we follow prior literature (Ali *et al.*, 2017, Khan *et al.*, 2020) for advanced results and we classify the studies into developed or developing countries following the United Nations country classification. It is found that prior research is conducted more in developed countries (see Figure 4).

Insert figure (4) around here

Extant B/E accounting studies from developed countries include Weir (2018) with the application of extinction accounting within the UK public sector. Analysis indicates that there is limited extinction reporting due to a lack of organisational support and limited knowledge.

Similarly, Rimmel and Jonäll (2013) investigate Swedish companies and unearth lacking continuity in biodiversity reporting with insignificant and general information disclosed. Van Liempd and Busch (2013) support findings of minimal biodiversity disclosure when investigating companies from Denmark, noting disclosure is poor in quality and quantity. Theoretically, these results represent anthropocentric tendencies by failing to account for nature. Adler *et al.* (2017) research's Australian metal and mining companies before and after the UN 'Decade on Biodiversity' announcement in 2010. Results indicate increased biodiversity reporting since the declaration, suggesting that companies understand the biodiversity issue. However, the authors argue that companies are using disclosure as a legitimacy tool and are merely "maintaining licences to operate, not conserving things" (Adler *et al.*, 2017, p.1732). Conclusively, studies observe organisational accountability on B/E is inconsistent, vague, and can be misleading (Rimmel and Jonäll, 2013; van Liempd and Busch, 2013; Atkins *et al.*, 2018a; Gray and Milne, 2018).

Research in developing country (i.e., Kenya), is investigated by Sibanda and Mulama (2018) who note that the black rhinoceros is facing extinction. Their study reports Kenya would benefit from the application of extinction accounting to protect the wildlife heritage and promote an extinction framework provided by Atkins *et al.* (2018a). Zhao and Atkins (2018) test an extinction accounting framework on the giant panda in China. On analysing reports from Chinese listed companies, panda conservation was absent. However, further research into non-government organisations (NGOs) documented more encouraging results with evidence of partnering with listed companies. This progressive collaboration is fundamental in the preservation of species with partnerships of NGOs, charities, government bodies and, the public sector (Zhao and Atkins, 2018).

Global studies on organisations emerge with contribution from Adler *et al.*, (2018) focusing on companies from the Fortune Global list. Consistent with prior literature, few companies are providing substantial reporting. Empirically, results reveal that 91.8% of the sample did not disclose on the loss of biodiversity or species due to its operations. This outcome reflects the real issue companies have in understanding the immense global challenge. The authors seek explanation through legitimacy theory, suggesting companies remain driven by anthropocentric reporting rather than displaying a genuine concern for nature by deep ecology, a theory applied by prior research of Samkin *et al.* (2014) and Atkins *et al.* (2018a). Encouragingly, Addison *et al.* (2019) find almost half of their sample mentions biodiversity in

their reporting which indicates awareness is improving, with some providing clear commitments, indicating organisations realise urgency in conserving nature and its intrinsic value (Atkins *et al.*, 2014). Hassan *et al.* (2020a) provide a longitudinal study of Fortune Global companies and they found that disclosure of B/E increases over the years. However, Hassan *et al.* (2020a) suggest observable B/E disclosure limitations include limited overall B/E disclosure is consistent with prior literature (Rimmel and Jonäll, 2013; Adler *et al.*, 2018; Gaia and Jones, 2019; Skouloudis *et al.*, 2019), and B/E disclosure is found to be minimalistic and vague. Theoretically, the authors support findings that impression management and greenwashing strategies underpin corporate disclosure. An array of literature argues that companies are found to be indulging in impression management by providing symbolic commitments to stakeholders (Solomon *et al.*, 2013; Atkins *et al.*, 2014; Boiral 2016), however, another justification may be companies lack awareness on the issue.

3.3 Publication by Research Method

This section analyses publications by research methods. Figure 5 shows that most prior empirical studies (24) use the content analysis method. Organisations communicate B/E information through websites, and CSR, environmental, sustainability or, integrated reporting formats (Adler *et al.*, 2018; Bhattacharyya and Yang, 2019). The widespread use of such reporting formats explains the favourable content analysis method. These findings support prior CSR literature review studies (Fifka, 2013; Ali *et al.*, 2017, Khan *et al.*, 2020) who evidence extensive use of content analysis. Only a few studies apply mixed methods, combining interviews with content analysis, and semi-structured interviews.

Contributions from authors using content analysis (Atkins *et al.*, 2014; Maroun and Atkins, 2018; Addison *et al.*, 2019; Bhattacharyya and Yang, 2019) search annual reports for disclosure on B/E. Authors use keywords to capture all relevant data as well as manual collections (Adler *et al.*, 2017, 2018; Hassan *et al.*, 2020a). Although content analysis is widely used, there are some limitations to this application. If keywords or specific phrases only are of interest there is a risk of missing more substantial data that may allow you to understand the phenomena (Collis and Hussey, 2014). In the instance of examining organisational published secondary data, there is risk information may be provided for impression management (Atkins *et al.*, 2014). Boiral (2016) mentions that information provided in sustainability reporting can be bias and questions the reliability of the information.

Insert figure (5) around here

The majority of content analysis research is dominated by providing qualitative analysis through the collection of data from documents (and in some cases websites). Methods include the categorisation of information through reporting of GRI disclosure (Boiral and Heras-Saizarbitoria, 2017), identification of themes and patterns through text units (Samkin *et al.*, 2014), and interpretive text analysis (Atkins *et al.*, 2018a). Within these studies, researchers applied deep ecology and stakeholder theoretical perspectives to understand motivations. Practically, the ease of access to organisations reports through websites can explain the frequent use (Khan *et al.*, 2020). As this type of reporting is voluntary, few alternative methods would be practical except for interviews which may be problematic in achieving engagement.

It is observed that fewer studies analyse content analysis quantitatively, which is a limitation in literature. Empirical contributions that provide quantitative analysis focus on examining relationships between disclosure on B/E and several determinant factors. Positive relations emerge in literature through the application of regression analysis with, for example; wildlife partnership engagement (Adler *et al.*, 2018; Hassan *et al.*, 2020a), media attention, board independence, and size, (Bhattacharyya and Yang, 2019), board gender (Haque and Jones, 2020), environmental awards, assurance, and developing countries (Hassan *et al.*, 2020a), and local council specific information (Gaia and Jones, 2019). The relationship between disclosure and industry sector conflicts, with some scholars finding a positive association with high intensive industries (Bhattacharyya and Yang, 2019; Skouloudis *et al.*, 2019; Haque and Jones, 2020; Hassan *et al.*, 2020a), however, a study by Addison *et al.*, (2019) challenges this, suggesting that industry impact on biodiversity is not the sole driver for disclosure. Therefore, this area would benefit from further research. Theoretically, impression management explains high impact sectors provide more information (Atkins *et al.*, 2014, Hassan *et al.*, 2020a) and showcase “good news” and obfuscate negative information (Solomon *et al.*, 2013).

A more robust methodology is presented with a mixed-methods investigation in four publications. In each paper, content analysis is followed by interviews with managers strengthening reliability and validate results combining both primary and secondary data information. For example, Rimmel and Jonäll (2013) find that biodiversity disclosures from Swedish companies are low; however disclosure increases in their longitudinal study. They

validate their findings by conducting interviews, with respondents offering support that due to increased pressure for sustainability reporting, this justifies the increase in disclosure. Likewise, Adler *et al.* (2018) conducts interviews with corporate sustainability managers and unearths a managerial lack of knowledge on how to measure and report on the impact to biodiversity, with companies consequently engage in offsetting activities to compensate. This response is insightful to organisational motivations which would not be detected in content analysis.

Further studies provide literature, theoretical and essay publications. Notable contributions come from Jones and Solomon (2013) who argue that biodiversity reporting and accountability must evolve to address the biodiversity crisis and Atkins and Maroun (2018) who provide the first glimpse of extinction accounting frameworks. King and Atkins (2016) view this framework as a revolutionary reporting format entwined in integrated reporting, and if companies do not comply, they will not be seen as good corporate citizens. Gray and Milne (2018) reflect species extinction is humankind's drive of capitalism, profit, and the pursuit of more. They suggest that the planet is at crisis point, and if humans do not recognise the earth is at a crossroad, human extinction cannot be unthinkable. Bebbington and Unerman (2018) discuss the implementation of the SDGs and they found companies have integrated some SDG's into sustainability reports or GRI index.

3.4 Theoretical focus of prior studies

B/E accounting is mainly analysed through theories commonly utilised in SER literature (Daddi *et al.*, 2018). Legitimacy theory is the most widely applied theory to B/E studies (see Figure 6). This is expected as legitimacy theory is well established in SER research (Cho and Patten, 2007; Chauvey *et al.*, 2015; Bhattacharyya and Yang, 2019). It is widely argued in B/E literature that companies are rife in disclosing information to gain legitimacy (Rimmel and Jonäll, 2013; Adler *et al.*, 2017; Bhattacharyya and Yang, 2019). Legitimacy theory which originates from Suchman (1995) offers support for empirical findings that as all organisations impact nature directly or indirectly, and disclosure is presented to meet societal demands and expectations (Patten, 2002; Cho and Patten, 2007; Cho *et al.*, 2015; Adler *et al.*, 2018). Legitimacy, stakeholder, resource dependency and, institutional theories share a similar ontological view (Chen and Robert, 2010) assuming organisations are influenced by society and vice versa (Gray, 2010; Bhattacharyya, 2014).

Insert Figure (6) around here

Extant literature finds B/E reporting increases due to external pressures on how to manage environmental events (Rimmel and Jonäll, 2013). Legitimacy and impression management are similar in their attempt to increase societal perception, maintain the reputation and, receive greater confidence from stakeholders (Deegan, 2002; Clarkson *et al.*, 2008; Patten, 2015). Goffman's impression management similarly contributes to B/E literature (Solomon *et al.*, 2013; Boiral, 2016; Adler *et al.*, 2018). Prior studies find disclosure is used merely to display good corporate citizenship (Adler *et al.*, 2018), and maintain corporate image (Boiral, 2016). Empirical studies use impression management to explain results and consider companies to be indulging in manipulation by expressing positive performance and omitting negative impacts (Jones and Solomon, 2013; Hassan *et al.*, 2020a). Other SER relevant theories applied in literature are stakeholder (Boiral and Heras-Saizarbitoria, 2017; Gaia and Jones, 2017) and institutional (Gaia and Jones, 2019; Weir, 2019) theories. Although stakeholder theory is applied in empirical studies (Boiral and Heras-Saizarbitoria, 2017; Gaia & Jones, 2019), so far, there is a failure to view species as stakeholders of the wider community. The overwhelming evidence of their fundamental value to business survival explicitly arguably pieces of evidence species are main stakeholders in society. This approach in stakeholder theory would indeed encourage organisations to disclosure accountability on impact and protection to species, ultimately responding to the extinction crisis and provides a theoretical application for future research.

Deep ecology emerges in three studies (Samkin *et al.*, 2014; Maroun and Atkins, 2018; Christian, 2018). To address the ecological challenges facing society and achieve SDG-14 & 15 (Bebbington and Larrinaga, 2014; Sobkowiak *et al.*, 2020), organisations must align with an eco-centric approach to harmonise with nature. Deep ecology philosophy observes all species should be preserved (Naess, 1989; 2008), rejecting anthropocentric shallow ecology, which places humans of hierarchical importance with nature only having value because of what it can contribute to human satisfaction (Thompson and Barton, 1994; Jones, 2004; Jones and Solomon, 2013). Deep ecology theory was established in 1972 by Norwegian philosopher Arne Naess. His approach of environmental defence is to adopt a belief that humans are not the central perspective; human life lies in harmony with nature. This philosophy identifies the fundamental value of biodiversity. Deep ecology philosophy appreciates the intrinsic value of

all beings (Naess, 2008) with the intention of self-awareness to improve ecology rather than self-destruct. The opposite of anthropocentric, deep ecology follows the theory of equalness between species (Jones, 2004; Christian, 2018). Literature applying deep ecological framework (Maroun and Atkins, 2018) discovers genuine concern for species is emerging in organisational disclosure. Samkin *et al.*, (2014) find adopting a deep ecological from an anthropocentric perspective in a business is a long-term commitment and may be difficult but should not put them off. Indeed, pure deep ecology would reject any use of natural capital to satisfy humans (Atkins *et al.*, 2014). However, given the looming disaster faced, embedding a form of deep ecological culture in organisations must now be rooted for a sustainable future. Anthropocentric philosophy rejects this and is based on the belief that humans regard themselves as the central or most important element of existence (Callicott, 1990;1994). It is argued anthropocentrism dominates all organisational behaviour (Atkins *et al.*, 2014) given the mass extinction crisis with a monumental shift in corporate governance required to eradicate the anthropocentric culture and attitude to nature (Maroun and Atkins, 2018).

4. Critical analysis of limitations and opportunities for future research

The researchers critically analysed limitations in prior research to identify opportunities for future research in the B/E accounting discipline. We provide a discussion on the common limitations in extant literature (see Table 3) as they can provide direction for future research (Brutus *et al.*, 2013). We expect a high number of contributions in the coming years, as experts believe pandemics such as Covid-19 are a result of human's destruction of biodiversity and illegal wildlife trafficking (Ceballos *et al.*, 2020). Therefore, this section provides a valuable starting point for academics. We combine limitations reported in publications and book chapters along with limitations identified through a critical analysis of this SLR.

4.1 Sample characteristics

4.1.1 Sample Size

A proportion of studies are identified to have a small sample. For example, contributions from book chapters Martini *et al.* (2018) study only three companies from one industry in Italy, Jonäll and Sabelfeld (2018) investigate only two companies from a high biodiversity intensive industry. Although these short chapters provide insightful snapshots of corporate accountability for B/E this may not reflect the overall practice of country/industry selected (Khan *et al.*, 2020). Similarly, in journal publications, some sample selections are

considered insufficient (Adler *et al.*, 2018; Addison *et al.*, 2019). For example, Atkins *et al.* (2018a) investigated only 41 companies in South Africa. However, the authors recognise this limitation and recommend further research in other jurisdictions to explain the response to extinction. As a result, we would expect future B/E studies to consider larger data samples to improve the validity and robustness of findings which would enhance current literature and challenge or support seminal B/E literature.

4.1.2 Single sector

We note a large proportion of contributions are limited to a specific industry or one governmental, institutional study. For example, higher impact biodiversity industry studies warrant attention (Adler *et al.*, 2017; Boiral and Heras-Saizarbitoria, 2017). Likewise, single government settings provide insights into B/E accounting (Samkin *et al.*, 2014; Weir, 2018). Gaia and Jones (2019) investigate one institutional setting in the UK, self-proclaiming their results can generalise other developed countries; however further research in a developing country institutional setting would provide a more comprehensive contribution. A further research opportunity is to investigate the significance of industry sector and B/E disclosure. Empirical evidence finds organisations in high-risk sectors disclose more B/E information than those in low-risk sectors (Skouloudis *et al.*, 2019; Hassan *et al.*, 2020a). However, other scholars challenge this (Addison *et al.*, 2019), therefore, further investigation is required. Furthermore, researchers argue organisations reporting through the GRI format is insufficient and inadequate in addressing the B/E crisis (Jones and Solomon, 2013; Boiral, 2016; Gray and Milne, 2018). Alternative reporting frameworks emerge in the literature (Adler *et al.*, 2018; Atkins *et al.*, 2018a, Hassan *et al.*, 2020a) that exceeds the GRI framework, incorporating a wide range of B/E and species-specific indicators. Adopting these frameworks provides an excellent opportunity to investigate a wide scope of organisations in industry, country or, institutional setting and is widely encouraged by the authors.

4.1.3 Developed vs. developing countries' limitations

Within limitations of sample characteristics, our previous discussion identifies geographically, single-country studies from developed countries are the focus of research. Thus, providing an opportunity for further research on organisations from developing countries. The research argues as organisations expand globally in developed countries, the focus of developing countries research is slight (Hopper *et al.*, 2017; Khan *et al.*, 2020). We strongly encourage further research in this context as illegal wildlife trade and wet markets of

developing countries could potentially contribute to further pandemics (Vidal, 2020). Further, some developing countries possess some of the world's richest biodiversity; therefore, research to understand how conserving biodiversity and species protection in these countries may provide. As a result, we would expect more research in the near future to investigate organisations from developing countries, or to compare organisations from both developing and developed countries to further enrich B/E literature.

Insert table (3) around here

4.2 Source of data

As discussed earlier, the majority of contributions adopt content analysis in research. Limitations in this method include the dependence of one source of data, e.g. CSR reports and websites. Literature extensively argues that statements provided by organisations can be biased and used for impression management (Solomon *et al.*, 2013; Boiral and Heras-Saizarbitoria, 2017). In essence, companies provide rhetoric on what stakeholders would like to hear, rather than transparent, sincere reporting. For example, Jonall and Sablefeld (2018) find companies are using linguistic strategies to disclose their impact on polar bears. Organisations provide optimistic language and dramatise positive engagement which is a smokescreen, rather than a transparent account of actual impact (Boiral, 2016). Researchers identify the use of one data point may indeed limit the data they collect, for example, Gaia and Jones (2019) acknowledge further information may be available on additional organisational documents such as letters and emails not investigated. Likewise, when investigating websites for content analysis, it is uncertain when information is updated (Adler *et al.*, 2018). Opportunities for future research include a more robust approach by a collection of data from multiple sources such as websites, stand-alone reports, social media, and other documents should be studied as several sources may present a more comprehensive picture of organisations' efforts in B/E accounting, thus, increasing reliability (Piekkari *et al.*, 2009; Fifka, 2013). New technology can advance and support conservation efforts with the help of drones or satellite tracking in assessing inaccessible areas (Palmer, 2018). Investigating if organisations implement technology to inform decision-makers is a new dimension that researchers may want to explore.

4.3 Methodology limitations

The main limitation in current research is the dependency and reliability of secondary data. In our methodology analysis, we identified only three publications that provide interviews

and only four publications provide mixed (content analysis and interviews) research methods. In this vein, we recognise the vital need for primary data analysis. We believe that this offers opportunities for future research to provide evidence that content analysis cannot capture (Ali *et al.*, 2017) and explain organisations motivations, views, and beliefs towards the B/E crisis (Atkins *et al.*, 2018b). Conducting interviews encourages discussion, raises awareness, and reveals information not publically reported (Khan *et al.*, 2020). Additionally, interviews with board members, executives and shareholders (Haque and Jones, 2020) provides an opportunity to examine if organisations are aligning with SDG-14 & 15 and if their future strategy includes protecting and conserving species, which may identify pockets of excellent practice which can be used for benchmarking against other organisations. Cultural insights are imperative to understand organisations rationale on developing solutions which have implications for academia, practitioners, and policymakers.

4.4 Theoretical framework

A rigorous theoretical framework is lacking in realigning the human relationship with nature with a requirement to go beyond the usual CSR mainstream theoretical frameworks (Cuckston, 2018a). We identify many studies lack a clear theoretical contribution. Such theoretical diversion from recognised CSR theories supports the literature that a multidisciplinary approach to B/E is required by collaboration between accountants and other discipline experts to increase knowledge (Jones and Solomon, 2013; Weir, 2018). Therefore, future studies may shift from traditional CSR theoretical frameworks and borrow theoretical framing from wider academic social science disciplines. In addition, an application of a triangulation of theories to support research is required and is supported by Gaia and Jones (2019) who argue a single theoretical application is inadequate for explanations. There are opportunities for researchers to apply theoretical frameworks that can explain human behaviour towards nature, which may help to develop solutions and enrich B/E literature.

Based on our discussion above, the main gaps in the literature are identified through the analysis of this SLR. We observe that due to the embryonic nature of this strand of research, any contribution for understanding further the complicated relationship between global organisations and the biodiversity and species extinction crisis would extend knowledge in the field and help develop solutions. Qualitative contributions in the form of interviews are distinctly lacking. In addition to the above discussion, empirical quantitative studies measuring determinant factors such as board and ownership characteristics, country governance

characteristics are underexplored. In addition, further research is required to establish if companies only provide disclosure on attractive, well-known species, which would suggest they are indulging in impression management, or if they are displaying concern by reporting on a variety of species. For example, a limitation in prior research is the study of single species such as the rhinoceros, a species of intrinsic worth for South African tourism (Atkins *et al.*, 2018a), or the iconic panda in China (Zhao and Atkins; 2018). Adler *et al.* (2018) provides a list of species disclosed by companies but fails to analyse. Weir (2018) finds higher profile species justifies more conservation efforts than others, which indicates a superficial bias approach to protecting nature. Therefore, a thorough investigation of species could explain motivations in conservation efforts. There is undoubtedly, fruitful potential for researchers to explore and contribute to this crucial research area.

5. Conclusion

The objective of this paper is to provide a rigorous SLR on organisational B/E accounting in response to the global challenge of biodiversity loss and species extinction. We synthesise 40 research publications and book chapters, providing descriptive results and critically analyse limitations in current research, identifying opportunities for future research. We acknowledge there are a limited amount of publications in this stream of literature; however, the publications presented offer an excellent insight into this crucial research area. We expect a high number of contributions in the coming years, from multidisciplinary fields as experts believe pandemics such as Covid-19 are a result of humanity's invasion of biodiversity (Ceballos *et al.*, 2020). Therefore, we contribute to the extant B/E literature by providing what we believe to be, the first SLR in B/E accounting. Furthermore, we provide a table including all relevant articles which offer a starting point for future researchers and additionally provide an opportunity to extend as further literature emerges.

Descriptive results indicate the Accounting, Auditing and Accountability Journal has led the way in advancing research on B/E with overall publications peaking in 2018. Furthermore, we critically analyse publications by country, methodology, and theoretical framework which enables us to further contribute by providing opportunities for future research as we believe innovative research is urgently required to examine organisational responsibility towards B/E (Reade *et al.*, 2015). Our critical analysis reveals there are many potential avenues and expect this embryonic strand of literature to gain momentum due to the global environmental

challenges, and the SDGs, specifically SDG-14 & 15 to transform the planet to a sustainable society by 2030. From our analysis of limitations, we identify contributions to the literature have mainly focused on examining organisations from developed countries and global organisational research. This unearths the potential for investigations into organisations from developing countries. Research on organisations from developing countries may provide fruitful insights in explaining how these countries are addressing the B/E crisis, from which pandemics arguable originate (Vidal, 2020). In addition, there remain abundant exploratory opportunities for larger samples of industry or country-specific studies to explain, challenge or, contribute to empirical evidence. Theoretically, an opportunity exists to challenge traditional CSR and SER theoretical frameworks to explain relationships (Cuckston, 2018a) and amplify knowledge. Furthermore, we identify there is a distinct lack of primary data, specifically interviews, to advance insights of organisational motivations which is desired to enrich literature (Atkins and Maroun, 2018; Skouloudis *et al.*, 2019). Further empirical quantitative studies are essential to explore relationships between B/E disclosure and determinant factors such as country governance characteristics and ownership characteristics. In addition, investigating species-specific information could explain the rationale and motivations for conservation efforts.

Future research is imperative in this field as further biodiversity decline and species extinctions will cause profound economic and health impacts (Hassan *et al.*, 2020b, Roberts, *et al.*, 2020). To understand the complex relationship between organisations and nature, business schools must endeavour to promote B/E accounting within the wider SER and CSR discipline. Research opportunities, regardless of location, through conference, special issues or, collaborations between academics and multidisciplinary experts (Jones and Solomon, 2013, Weir, 2018) would provide a more balanced discussion and vitally increase knowledge to the field (Khan *et al.*, 2020). Organisations are at the heart of achieving SDG-14 &-15, biodiversity and species are the lifeblood of all businesses. Academics can raise awareness and promote positive change through research to prevent further biodiversity loss and species extinction.

This review emphasises the practical implication of corporate ethics and business culture must soften from the sole pursuit of profit and capitalist objectives. Hopefully, corporate ethics will change towards a more deep-ecological perspective from anthropocentric legitimising strategies. Stakeholders and policymakers will benefit from this research, educating them on the consequential economic loss if strategic operational changes are not changed. Developed

countries show they have been willing participants in addressing B/E loss, but they may lack financial ability and understanding to address. Therefore, it would be beneficial for developed countries to provide technical and financial assistance to mitigate. This study evidences the evolution of B/E accounting, and there is little evidence to suggest accountants cannot be the drivers to reverse the planet from the brink of collapse. Accounting is a mechanism and tool for change, and accountants have the knowledge, capacity, and communication skills to lead in corporate accountability.

Our study has several limitations. Firstly, we recognise there are a limited number of publications. However, we justify the need for this SLR due to the urgency in resolving the B/E crisis. Secondly, we select only peer-reviewed publications and book chapters, potentially eliminating some insightful knowledge on B/E. Thirdly, although results are classified by year, it should be noted two main contributors in 2018 account for almost all publications in the year. In addition, some academics provide multiple contributions, and this may provide a bias in methodologies, theoretical frameworks, or recommendations. Likewise, geographic results are an indication of only some of the overall literature sources. Prior literature on B/E accounting is exceptionally scarce. However, given the dramatic need for global action to tackle the devastating impact on nature, it is expected that research will increase. Although research is slight, the publications presented offer an excellent insight into corporate accountability and the impending need for change.

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APPENDIX 1

<i>Year</i>	<i>Author</i>	<i>Title</i>	<i>Journal</i>	<i>Theory</i>	<i>Country</i>	<i>Research Methods</i>
2020	Sobkowiak, M., Cuckston, T. & Thompson, I.	Framing sustainable development challenges: Accounting for SDG-15 in the UK	AAAJ		UK	Interviews
2020	Haque, F. & Jones, M.	European firms' corporate biodiversity disclosures and board gender diversity from 2002 to 2016	BAR	Institutional, Resource Dependency	Europe	Content analysis
2020	Hassan, A., Roberts, L. and Atkins, J.	Exploring factors relating to extinction disclosures: what motivates companies to report on biodiversity and species protection	BSE	Greenwashing, Impression Management	Global	Content analysis
2019	Addison, P., Bull, J. and Milner-Gulland, E.	Using conservation science to advance corporate biodiversity accountability	CB		Global	Content analysis
2019	Bhattacharyya, A. and Yang, H	Biodiversity disclosure in Australia: effect of GRI and institutional factors	AJEM	Legitimacy	Australia	Content analysis
2019	Gaia, S. and Jones, M	Biodiversity reporting for governmental organisations. Evidence from English local councils	AAAJ	Agency, Stakeholder, Legitimacy, Institutional	UK	Content analysis
2019	Skouloudis, A., Malesios, C. and Dimitrakopoulos, P.	Corporate biodiversity accounting and reporting in mega-diverse countries: An examination of indicators disclosed in sustainability reports	EI		Global	Content analysis
2019	Weir, K.	The logistics of biodiversity accounting in the UK public sector	AF	Institutional	UK	Interviews
2018	Adler, R., Mansi, M. and Pandey, R.	Biodiversity and threatened species reporting by the top Fortune Global companies	AAAJ	Legitimacy	Global	Mixed method (Content analysis and Interviews)
2018	Atkins, J. and Maroun, W.	Integrated extinction accounting and accountability: building an ark	AAAJ			Literature
2018	Cuckston, T.	Making extinction calculable	AAAJ	Social studies of finance	Not specified	Literature

2018	Gray, R. and Milne, M.	Perhaps the Dodo should have accounted for human beings? Accounts of humanity and (its) extinction	AAAJ			Essay paper
2018	Weir, K.	The purposes, promises and compromises of extinction accounting in the UK public sector	AAAJ		UK	Interviews
2018	Cuckston, T.	Making Accounting for Biodiversity Research a Force for Conservation	SEA			Essay paper
2018	Maroun, W. and Atkins, J.	The emancipatory potential of extinction accounting: Exploring current practice in integrated reports	AF	Anthropocentric Deep ecology	South Africa	Content analysis
2018	Atkins, J., Maroun, W., Atkins, B. and Barone, E.	From the Big Five to the Big Four? Exploring extinction accounting for the rhinoceros	AAAJ	Philanthropic and impression management	South Africa	Content analysis
2018	Buchling, M. and Maroun, W.	Extinction accounting by the public sector - South African National Parks	Edited book		South Africa	Content analysis
2018	Rimmel, G.	Extinction accounting in European zoos	Edited book		Europe	Content analysis
2018	Martini, S., Doni, F. and Corvino, A.	Deforestation risk and the tissue industry in Italy	Edited book		Italy	Content analysis
2018	Sibanda, M. and Mulama, M.	Business contributions to extinction risk mitigation for black rhinos in Laikipia, Kenya	Edited book		Kenya	Literature
2018	Christian, J.	A deep ecology perspective on extinction	Edited book	Deep ecology		Literature

2018	Herron, A.	Extraction and Extinction - The role of investors in ensuring the marine health of the planet	Edited book		Global	Literature
2018	Jonäll, K. and Sabelfeld, S.	Accounting for survival of polar bears	Edited book		Arctic region	Content analysis
2018	Solomon, A. and Clappison, M.	Accounting for captive belugas	Edited book		USA/Canada	Content analysis
2018	Zhao, L. and Atkins, J.	Panda accounting and accountability - Preventing giant panda extinction in China	Edited book		China	Content analysis
2017	Adler, R., Mansi, M., Pandey, R. and Stringer, C.	United Nations Decade on Biodiversity: A study of practices of the Australian mining industry	AAAJ	Legitimacy	Australia	Mixed method (Content analysis and interviews)
2017	Boiral, O. and Heras-Saizarbitoria, I.	Managing Biodiversity Through Stakeholder Involvement: Why, Who and for What Initiatives	JBE	Stakeholder	Global	Content analysis
2017	Cuckston, T.	Ecology-centred accounting for biodiversity in the production of a blanket blog	AAAJ	Geography (TSNP)		Content analysis
2017	Gaia, S. and Jones, M.	UK local councils reporting biodiversity values: a stakeholder perspective	AAAJ	Stakeholder	UK	Content analysis
2016	Boiral, O.	Accounting for the Unaccountable: Biodiversity Reporting and Impression Management	JBE	Impression management	Global	Content analysis
2014	Atkins, J., Grabsch, C. and Jones, M.	Corporate biodiversity reporting: Exploring its anthropocentric nature	Edited book	Anthropocentric	UK and Germany	Content analysis
2014	Samkin, G, Schneider, A. and Tappin, D.	Developing a reporting and evaluation framework for biodiversity	AAAJ	Deep ecology	New Zealand	Content analysis
2013	Bhattacharya, T. and Managi, S.	Contributions of the private sector to global biodiversity protection: case study of the Fortune Global 500 companies	IJBSEM		Global	Content analysis

2013	Cuckston, T.	Bringing tropical forest biodiversity conservation into financial accounting calculation	AAAJ		Kenya	Content analysis
2013	Freeman, M. and Groom, B.	Biodiversity valuation and the discount rate problem	AAAJ		UK	Literature
2013	Jones, M. and Solomon, J.	Problematising accounting for biodiversity	AAAJ			Literature
2013	Rimmel, G. and Jonäll, K.	Biodiversity reporting in Sweden: corporate disclosure and preparers' views	AAAJ	Legitimacy	Sweden	Mixed method (Content analysis and interviews)
2013	Siddiqui, J.	Mainstreaming biodiversity accounting: potential implications for a developing economy	AAAJ	Environmental stewardship	Bangladesh	Content analysis
2013	Tregidga, H.	Biodiversity offsetting: problematisation of an emerging governance regime	AAAJ		New Zealand	Mixed method (Content analysis and interviews)
2013	van Liempd, D. and Busch, J.	Biodiversity reporting in Denmark	AAAJ		Denmark	Content analysis

*Acronym for journals: AAAJ is Accounting, Auditing and Accountability Journal. AF is Accounting Forum. AJEM is Australasian Journal of Environmental Management. BSE is Business Strategy and the Environment. CB is Conservation Biology. EI is Ecological Indicators. IJBSEM is International Journal of Biodiversity Science, Ecosystem Services and Management. JBE is Journal of Business Ethics. SEA is Social and Environmental Accountability Journal. BAR is British Accounting Review.

Table 1. Journals and books with the highest number of publications

Acronym	Journal	Articles Published
AAAJ	Accounting, Auditing and Accountability Journal	19
JBE	Journal of Business Ethics	2
SEA	Social and Environmental Accountability Journal	1
AF	Accounting Forum	1
CB	Conservation Biology	1
AJEM	Australasian Journal of Environmental Management	1
BSE	Business, Strategy, and the Environment	1
EI	Ecological Indicators	1
IJBSEM	International Journal of Biodiversity Science, Ecosystem Services and Management	1

Table 2. Books consulted in the review

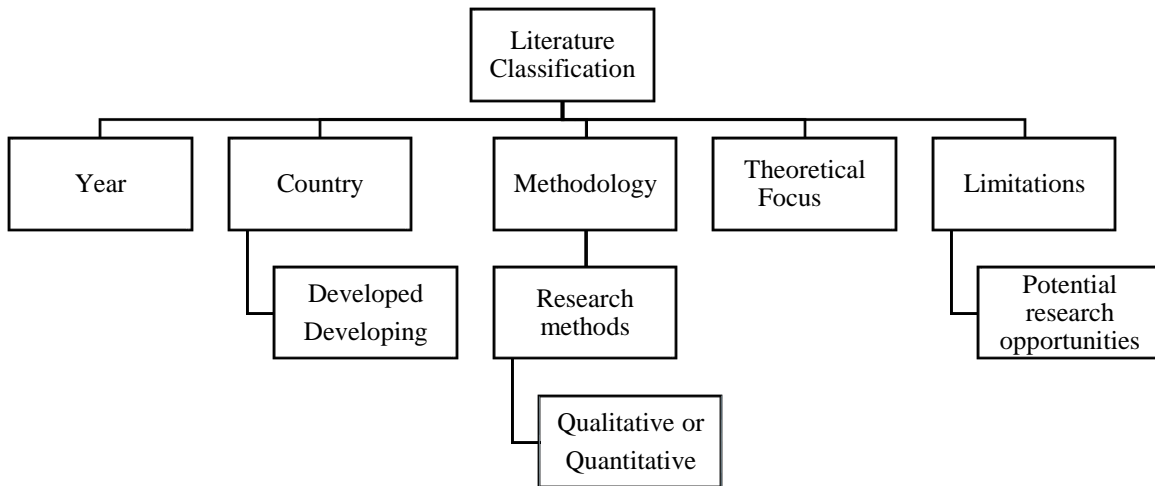
Book

1. Around the world in 80 species (Chapters)	9
2. Accounting for Biodiversity (Chapter)	1
2. Chief value officer	1
3. Six Capitals, or can accountants save the planet?	1

Table 3. Limitations reported in publications

No	Limitation Reported	Number	%
1	Sample Characteristic		
	Small sample selected, e.g. small number of companies	15	37%
	Single industry or governmental organisation	16	40%
	Specific to one country of study	20	50%
2.	Source of data		
	Investigated using one source of data e.g. annual reports, websites	10	25%
3.	Methodological limitation		
	Need for primary data in the form of interviews	14	35%
4.	Theoretical Framework		
	Application of the varied theoretical framework	15	37%

Figures



Figures 1. Analysis of articles

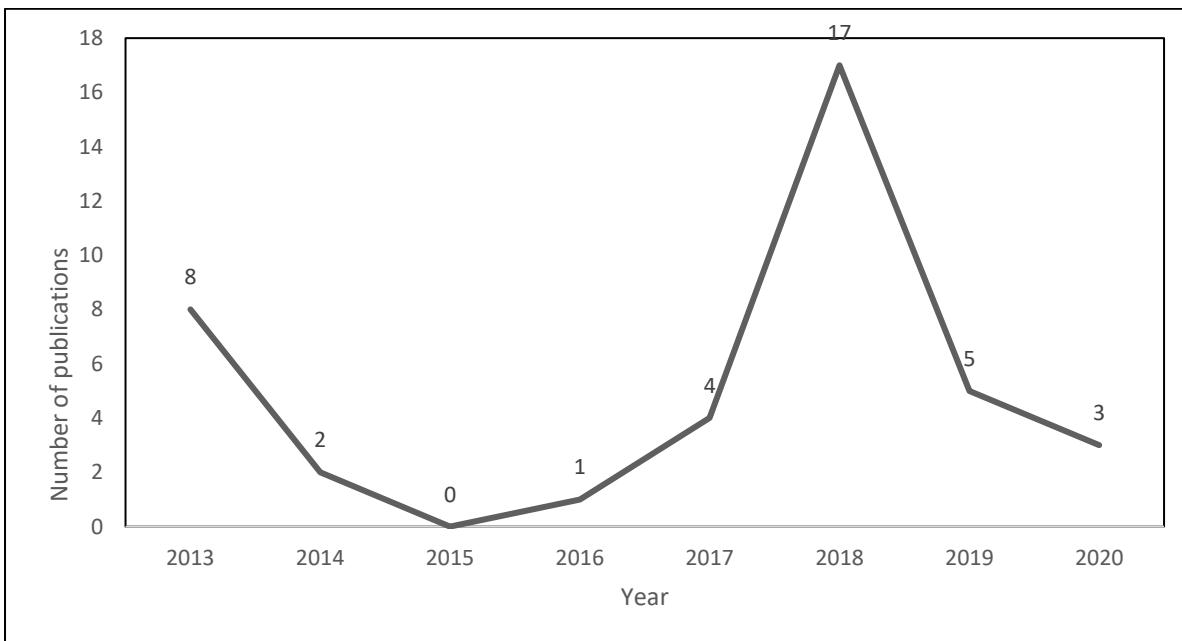


Figure (2) Number of articles per year

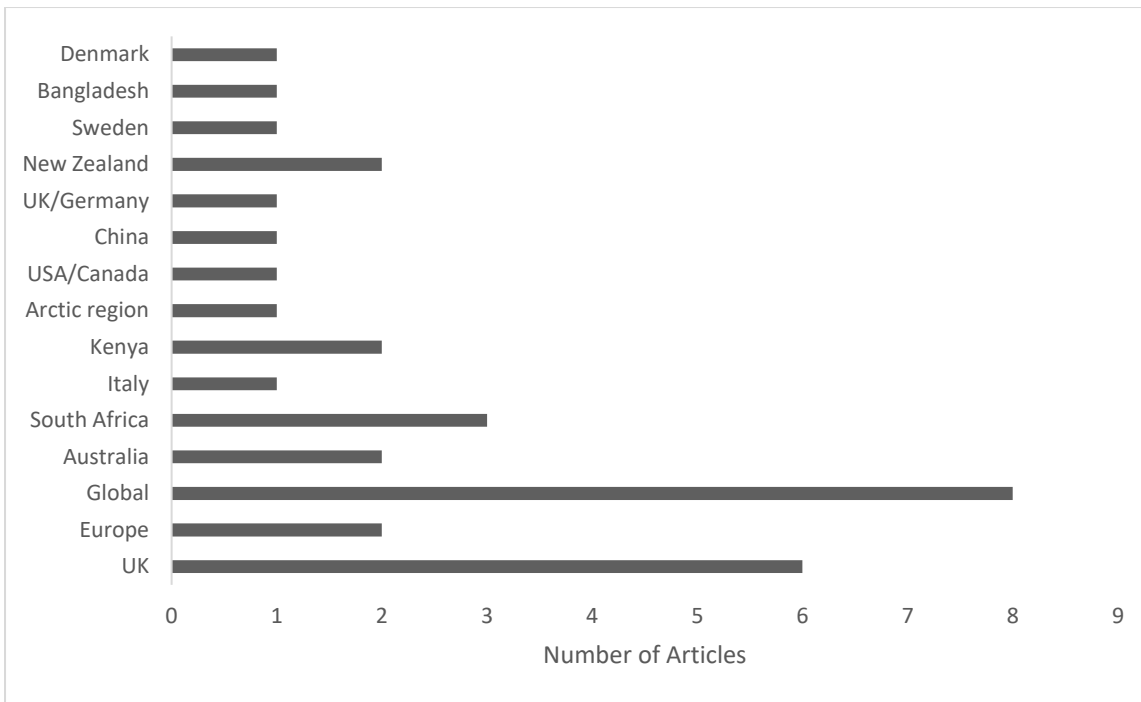


Figure (3) Number of articles per geographical spread

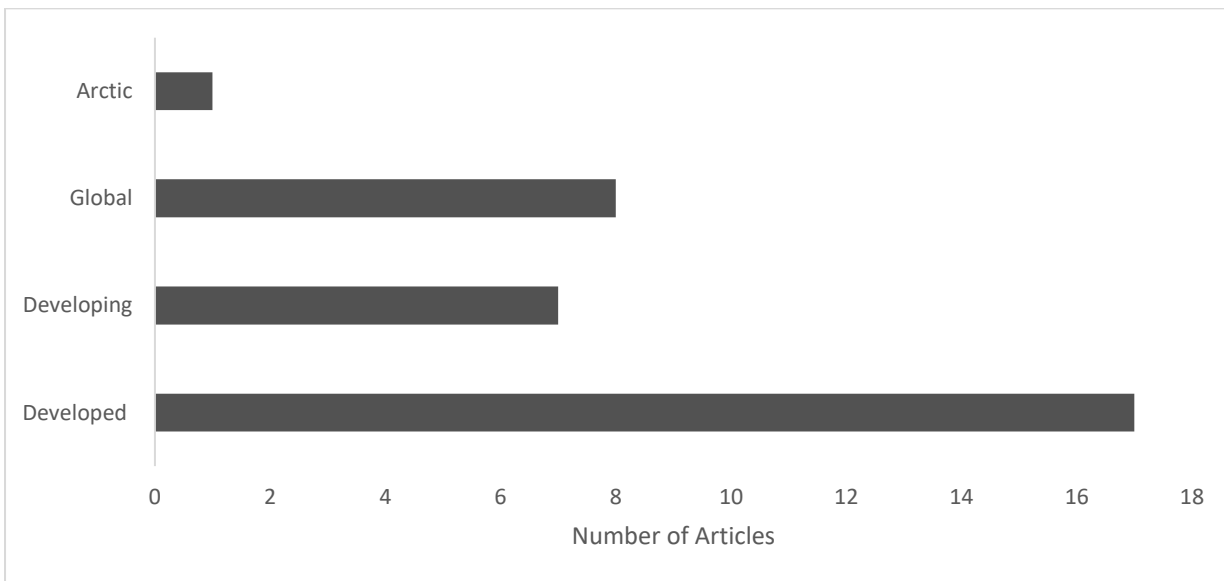


Figure (4) Number of articles per developing or developed country

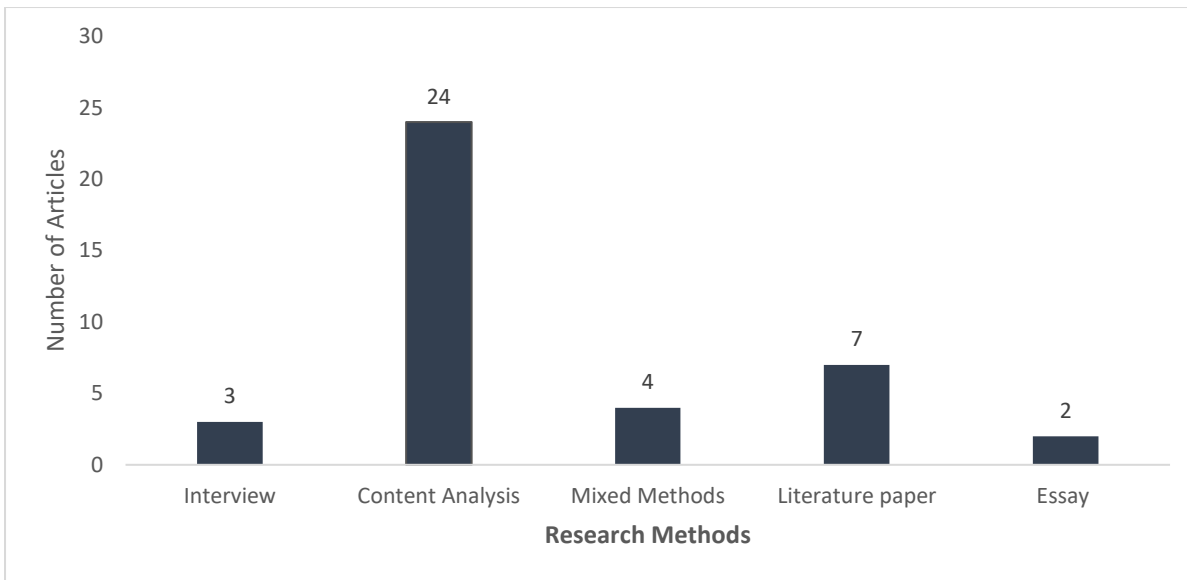


Figure (5) number of articles by research method

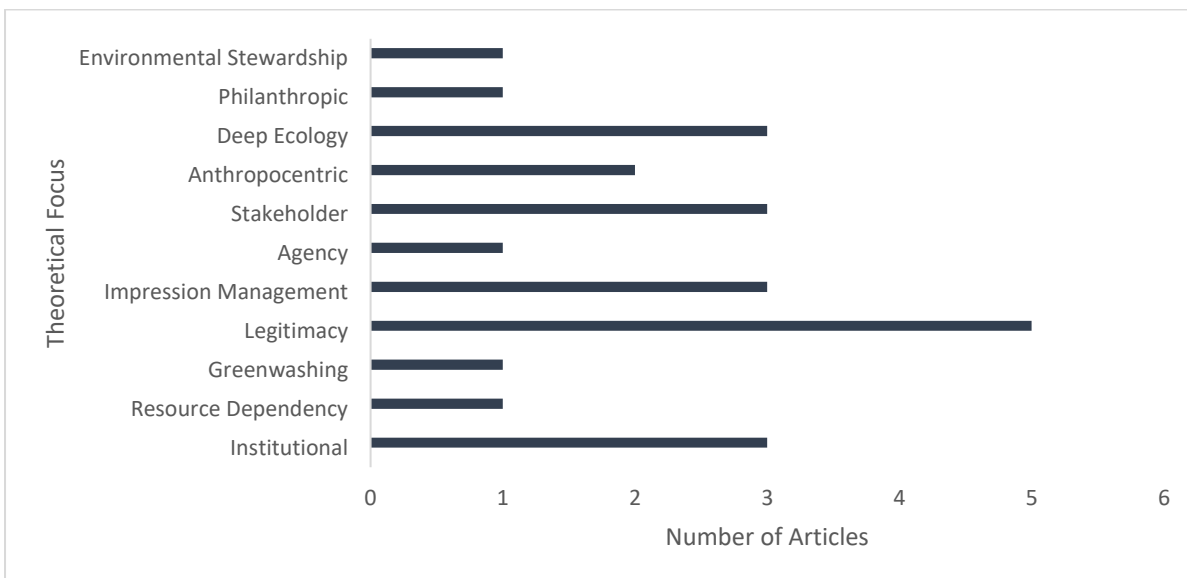


Figure 6. Number of articles by theoretical focus