STRATEGIC ENVIRONMENTAL RISK MANAGEMENT IN SOUTH AFRICAN COMPANIES

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DECLARATION

I declare that this Thesis is my own, unaided work. It is being submitted for the degree of Doctor of Philosophy at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at any other University.

Claudia Kitsikopoulos

31st day of May, 2018 in Johannesburg

ABSTRACT

Past and current corporate sustainability management approaches to natural resource use have been characterised by a short-term financial focus, while natural systems have been viewed as stable, linear and predictable. This approach disregards the multidimensional characteristics of social-ecological systems, of which humanity forms an integral part. Such systems are dynamic, complex and non-linear in space and time and can change in unpredictable ways. Human activities have led to a significant increase in the pressure on ecosystem services, resulting in severe degradation of most ecosystems and causing the global ecological system to become increasingly unstable and unpredictable and weakening the planet's ecological resilience. To account for these dynamics, the sustainability concept has evolved from conceptualising the Triple Bottom Line (TBL) model, still giving preference to the financial aspects of business conduct, to applying risk and resilience theory. To manage natural resources more sustainably, reduce risk exposure resulting from natural resource degradation and ensure sustained human wellbeing, more strategic approaches are required by integrating environmental risks into corporate sustainability management practices to establish whether these are aligned with risk and resilience thinking as part of sustainable development. It will also identify whether businesses are starting to reconsider their position as part of a complex social-ecological system, and not as separate entities disconnected from it. A reassessment of corporate sustainability practices is necessary to enable sustainable management of natural resource use and enhance resilience during times of increasing uncertainty and unpredictability.

The aim of my PhD thesis was to advance our understanding of whether businesses address social-ecological system complexity as part of their business strategy and the risks associated with ecosystem degradation to strengthen resilience. Annual, integrated and sustainability reports of 30 of the Top 100 Johannesburg Stock Exchange (JSE)-listed companies were assessed on the quality of environmental

impact disclosures between 2008 and 2013 as well as on the extent of environmental risk reporting between 2008 and 2015. To identify whether company reports address system complexity indicating a paradigm shift in business practices, annual, integrated and sustainability reports were compared to two risk maps that were created from existing literature. Interviews with sustainability managers were conducted to identify factors affecting environmental reporting and management as well as strategic environmental risk management approaches.

The environmental impact disclosure quality was found to be average to poor and environmental risks were rarely addressed. The most frequently reported environmental risk was related to water and climate change with 20-25% in 239 reports. These were connected to other sustainability and business risks or strategic objectives in only few cases. Interviews suggest that JSE listing requirements, King III and other legal obligations appeared to be a driving force in moving businesses towards sustainable practices but that reporting fatigue, as well as resource and time constraints were found to negatively affect the advancement of corporate sustainability. Further, understanding of complexity and acknowledgement of business' dependence on natural capital and strategic management of environmental risks were rarely evident.

The findings indicate that, while the sustainable development concept has shifted towards multi-level, multi-system complexity of social-ecological systems of which businesses are a part, corporate sustainability still displays a disconnection from the system as well as short-term, linear and retrospective views and management approaches. The ability to sustain economic, social and environmental wellbeing during and after the planet's transition from a stable state to a new, unpredictable one is thus compromised. Some companies were found to practice strategic environmental risk management, thus creating a resilient business and providing long-term value to all parties involved and affected by their business operations. A number of recommendations are made that could advance corporate sustainability.

DEDICATION

I dedicate this work to my husband, Prodromos Kitsikopoulos, for his unconditional love, support and belief in me.

Thank you for everything.

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LIST OF ACRONYMS

CDP	Carbon Disclosure Project
EBIT	Earnings Before Interest and Tax
EPS	Earnings Per Share
FSC	Forest Stewardship Council
GHG	Greenhouse Gases
GRI	Global Reporting Initiative
GRPS	The Global Risks Perception Survey
G2	Global Reporting Initiative guidelines Version 2
G3	Global Reporting Initiative guidelines Version 3
G3.1	Global Reporting Initiative guidelines Version 3.1
G4	Global Reporting Initiative guidelines Version 4
IASA	Internal Auditors of South Africa
ICT	Information and Communication Technology
IIRC	International Integrated Reporting Framework
IISD	International Institute for Sustainable Development
IPCC	International Panel on Climate Change
<IR> Framework	Integrated Reporting Framework
ISO	International Organization for Standardization
JSE	Johannesburg Stock Exchange
King I	King Code on Corporate Governance Version 1
King II	King Code on Corporate Governance Version 2

King III	King Code on Corporate Governance Version 3
King IV	King Report on Corporate Governance Version 4
MEA	Millennium Ecosystem Assessment
NYSE	New York Stock Exchange
P:E	Price-Earnings Ratio
ROA	Return on Assets
ROCE	Return on Capital Employed
ROE	Return on Equity
ROS	Return on Sales
ROTA	Return on Total Assets
SRI	Socially Responsible Investment Index
SSE	Shanghai Stock Exchange
SSEs	Sustainable Stock Exchanges
TBL	Triple Bottom Line
UN	United Nations
UNEP	United Nations Environment Programme
WEF	World Economic Forum

CHAPTER 1

Introduction

Society is inevitably dependent on ecological systems; the profound interconnection between the natural environment and society is reflected in humanity's dependence on the services ecological systems provide (ecosystem services; Walker and Salt 2006; ESDN 2012). These are necessary for security and wealth creation (Walker and Salt 2006; ESDN 2012), with the raw materials provided by the environment being transformed into economic products (Farley and Voinov 2016). The raw materials are therefore "structural building blocks of global ecosystems" (Farley and Voinov 2016, p. 389). They are also life-sustaining, since they regulate climate, purify water and absorb waste (Farley and Voinov 2016). Ecological systems are dynamic and non-linear in space and time (Berkes 2007). They change in unpredictable ways, can self-regulate and adapt, are able to exist in multiple stable states and function at different temporal and spatial scales (Folke *et al*. 2002; Walker and Salt 2006). Disturbances can, however, cause instabilities which may cause systems to cross thresholds into a new, unknown and dynamic state (Gunderson 2000; Berkes 2007; Folke *et al*. 2010; ESDN 2012; Brunner and Grêt-Regamey 2016). A return to a previous ecological state is not possible, as every state is characterised by a different interplay of regimes, behaviours and processes (Gunderson 2000). The capacity to expect, absorb and recover from disturbances while systems maintain their functionality is termed ecological resilience (Adger 2000; Gunderson 2000; Rockström *et al.* 2009; IPCC 2012a). Including the social aspect of system functioning, social-ecological systems display the same characteristics as ecological systems, and their resilience can be defined as "the capacity of linked social-ecological systems to absorb recurrent disturbances such as hurricanes or floods so as to retain essential structures, processes, and feedbacks" (Adger *et al.* 2005, p. 1036). Such disturbances (floods,

droughts) negatively impact water availability and quality (Cisneros *et al.* 2014; CRO 2015; WEF 2015), putting for example food production and human health at risk (Kasperson and Kasperson 2001; Millennium Ecosystem Assessment 2005c; IPCC 2012b; Cisneros *et al.* 2014; WEF 2015). The earth's thresholds are defined as planetary boundaries (Rockström *et al.* 2009). The nine identified planetary boundaries are climate change, ocean acidification, stratospheric ozone depletion biogeochemical flows (nitrogen and phosphorus), global freshwater use, land system change, rate of biodiversity loss, atmospheric aerosol loading, and chemical pollution (Rockström *et al.* 2009). While the last 11 000 (Holocene) years have been characterised by relatively high ecosystem and climatic stability, the Anthropocene – the time since the Industrial Revolution – has seen increasing global environmental change due to human influences (Steffen *et al.* 2007; Rockström *et al.* 2009; ESDN 2012).

Increasing urbanisation, population growth, resource consumption and production, over utilisation of natural resources and globalisation have led to a substantial increase in the pressure on ecosystem services (Biggs *et al.* 2012). Majority of ecosystem goods and services have been degraded as a result of this pressure (Millennium Ecosystem Assessment 2005a; Rockström *et al.* 2009). Changes in local land use and cover, technology adaptation, external inputs such as fertilisers, pest control and irrigation, harvest and resource consumption and climate change are some of the direct drivers of ecosystem change and degradation (Millennium Ecosystem Assessment 2005b). For example, between 1980 and 2005 nearly 20% of mangroves have been destroyed globally (WWF 2015) and 30% of the planet's coral reefs are threatened (Burke *et al*. 2011). Between 1970 and 2000, freshwater species populations declined by 50% and marine as well as terrestrial populations by 30% (Millennium Ecosystem Assessment 2005c). The current species extinction rate is around 1 000 times higher than before, based on fossil records (Millennium Ecosystem Assessment 2005b). Also of concern, at least seven of the 14 biomes have been converted by up to 50% for human use (Millennium Ecosystem Assessment

2005b). In Africa alone, soil erosion, pollution and deforestation have led to the degradation of 500 000 square kilometres of land, which in turn has negatively affected food security and human health (UNEP 2016a).

Climate change was identified by the United Nations (UN) as the greatest challenge currently being faced by humankind (UN 2015a). The increase in carbon emissions has caused dramatic changes to carbon storage, nutrient and water cycles, greenhouse gas (GHG) emissions and surface albedo (Kasperson and Kasperson 2001; Settele *et al.* 2014). Globally, just 90 private and state-owned companies are responsible for almost 60% of the anthropogenic carbon emissions (Starr 2016). The large-scale increase in aerosol and gas concentrations in the atmosphere reached a point at which the decade between 2003 and 2012 was documented as the warmest on record (Burkett *et al.* 2014). Global mean temperatures have risen by more than 1°C since 1880, half way to the level suggested to result in "dangerous climate change" (Connor 2015). The rise in global mean surface temperatures on land and across oceans, as well as the change in frequency and intensity of extreme weather events are a result of rising GHG emissions. With fewer cold and more warm temperature extremes, there has been a shift in plant and animal species distributions, with species abundance and species' seasonal activity changing in some cases (Burkett *et al.* 2014; Settele *et al.* 2014). With the shrinking of glaciers that has been occurring, the global mean sea level rose by 0.19m between 1901 and 2010 (IPCC 2014a). There is also a high degree of certainty that water quality and availability will decline further (Millennium Ecosystem Assessment 2005b). Economic growth, industrialisation and urbanisation have drastically increased global water demand, which is projected to outstrip supply by 40% in the next 12 years (WRG 2014). Cumulative effects due to climate change, and changes to biodiversity and ecosystems, are intensifying water resource challenges (IPCC 2014a). Given the extent of impacts from anthropogenic environmental degradation, there is an urgent need to understand and discuss how to balance economic growth and natural resources depletion and degradation (Sneddon *et al.* 2006; Bonevac 2010).

The environment's capacity to continue providing ecosystem services and goods within a stable system is thus increasingly being compromised (Farley and Voinov 2016). The earth's thresholds have partially been crossed. Out of the nine identified planetary boundaries, four have been crossed due to economic activities (Rockström *et al.* 2009). In terms of climate change and land-system change we have entered a *zone of uncertainty*, whereas with biochemical flows and genetic diversity (biosphere integrity) we have moved beyond the *zone of uncertainty* (Steffen *et al.* 2015; Figure 1). Crossing thresholds beyond the *zone of uncertainty* indicates that a safe operating space for humanity is no longer present and high risks and uncertainty exist (Rockström *et al.* 2009).

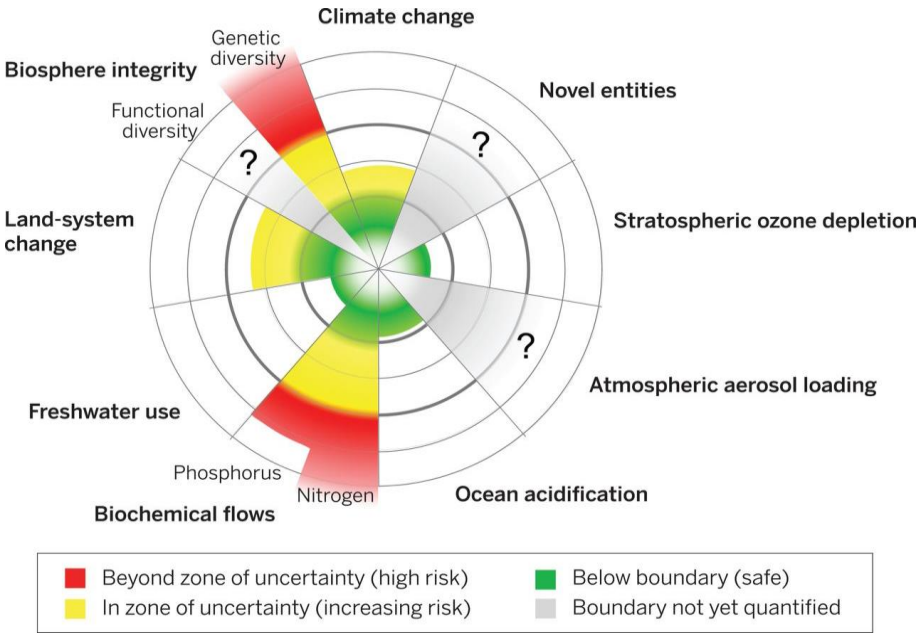

FIGURE 1. The current status of the control variables for seven of the nine planetary boundaries. The green zone is the safe operating space (below the boundary), yellow represents the zone of uncertainty (increasing risk), and red is the high-risk zone. The planetary boundary itself lies at the inner heavy circle. The control variables have been normalised for the zone of uncertainty (between the two heavy circles); the centre of the figure therefore does not represent values of 0 for the control variables. The control variable shown for climate change is atmospheric CO2 concentration. Processes for which global-level boundaries cannot yet be quantified are represented by gray wedges; these are atmospheric aerosol loading, novel entities, and the functional role of biosphere integrity. Source: Steffen *et al.* 2015, p. 6).

1.1 The sustainable development concept

Already in the 1960s and 1970s various authors concerned themselves with the effects of exponential global population growth on natural resources and environmental health, also known as the "theory of limits" (Mebratu 1998). Environmental groups demanded more awareness of the environment in business practices and market liberalisation (Kolk 2003; McDonald 2004). This as well as an increase in international trade in the 1970s and 1980s provided further building blocks for the concept of sustainable development (Kolk 2003; McDonald 2004). Since the UN Conference on the Human Environment in 1972 and with the publication of the Brundtland Report in 1987 (UN 1987), environmental sustainability became increasingly embedded in governance and corporate bodies (Kolk 2003; McDonald 2004; Sneddon *et al.* 2006, UN 2015b). Sustainable development has been viewed as a means to alleviate the difficulties related to environmental degradation (SDC 2011a). It was defined in the Brundtland Report as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (UN 1987, p. 41). Yet only after the Rio Earth Summit in 1992 did sustainable development receive global attention and become recognised as a global challenge (SDC 2011a). Especially increasing globalisation has led to an increase in the complexity of the global economy (Aras and Crowther 2009) as well as the challenges related to sustainable development (Daub 2007; UNDP 2014). Thus the way the concept of sustainable development is viewed today has also changed.

Previously, emphasis was mainly placed on the efficiency of products, processes and uses (Goodland 1995). Sustainability was further conceptualised in the form of a Triple Bottom Line (TBL) model, which was mainstreamed in 2002 at the World Summit on Sustainable Development (WSSD; UN 2015b). The TBL model, representing not only the economic, but also the social and environmental pillars as capitals of business (Epstein 2008; Bonevac 2010; Kuhlman and Farrington 2010;

Gurvitsh and Sidorova 2012), gives preference to the financial over both the environmental and social bottom line (Gray and Milne 2002). Driven by the United Nations Millennium Declaration (UN 2000), social dignity and equity values were incorporated into sustainable development. Social aspects of sustainability also received attention as parts of the environment were acknowledged as public goods. As environmental degradation would harm public health, corporations were to ensure the provision of these ecosystem services (Emas 2015). This also highlighted the connection and interdependence between the environmental and social spheres (Emas 2015). The TBL model focuses on impacts on the environment arising from business activities, which led to the notion that business practices can be slightly adjusted to achieve corporate sustainability and a rethinking of business practices is not required (Ählström *et al.* 2009; Tregidga *et al.* 2013). The TBL concept developed further into the four capitals model (manufactured capital, human, social and relationship capital as well as natural capital) which was later expanded to the five capitals concept which added financial capital. Currently in use is the six capitals model which also incorporates intellectual capital (IIRC 2013a; Figure 2). It places natural capital as the foundation which all other capitals depend on and represents the influence business activities have on the capitals (Cheng *et al.* 2014). The use of the capitals concept was also thought to better align companies' broad range of stakeholder demands, the language of shareholders and company sustainability objectives (White 2010). It is guided by the principles of strategy, longtermism, connectivity, materiality and the management of risk to the company (SDC 2011b; Cheng *et al.* 2014). Sustainable development will not only translate into reduced risk exposure and benefits for the corporation, but allow for the environment, society and economy as a whole benefit as well (SDC 2011b). Governance is also a key component of sustainability, aiming to ensure equality, equity and fairness (UNDP 2014). More recently, resilience theory has been incorporated into sustainable development approaches, although there is little evidence to suggest that businesses are considering resilience, as most consider continuity (Xu and Marinova 2013; Xu *et al.* 2015). Resilience views humanity not only as a driver of ecosystem degradation but also as part of the system that can drive

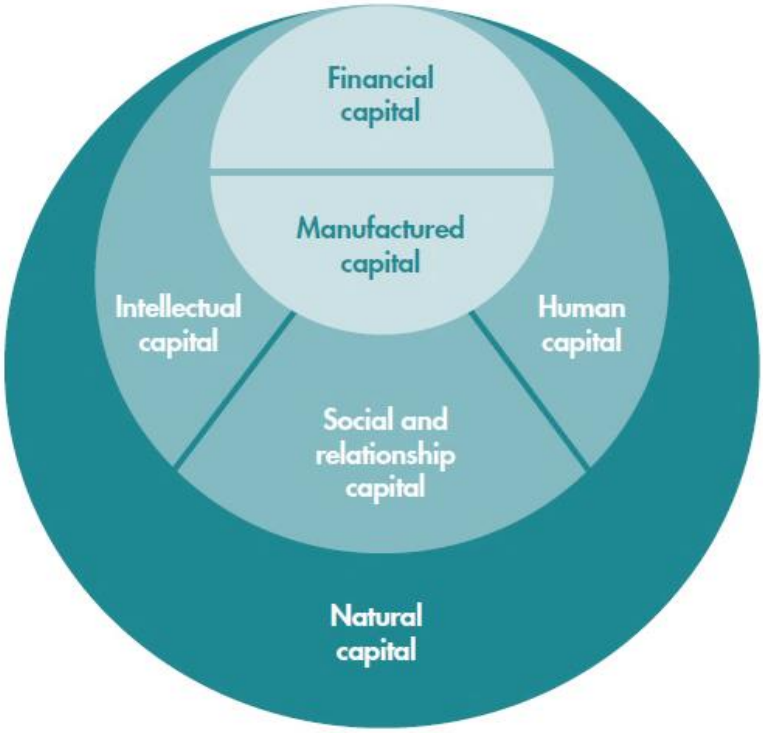

FIGURE 2. Six capitals model. Source: IIRC 2013a, p. 3.

changes and foster sustainability (Sterk *et al.* 2017). Both sustainable development and resilience theory view the human and natural systems as interdependent (Folke *et al*. 2002; Walker and Salt 2006). Sustainability is the "capacity to create, test, and maintain adaptive capacity" and "the process of creating, testing, and maintaining opportunity" (Holling 2001, p. 390). Resilience thinking is thus increasingly placed at the basis of sustainability (Benson and Garmestani 2011). The aim of sustainable development can then be defined as "fostering adaptive capabilities while simultaneously creating opportunity" (Holling 2001, p. 390).

1.2 Sustainability reporting and management

Increased public, stakeholder, political and international pressure on corporations has driven corporate non-financial disclosures (Vormedal and Ruud 2009). Also termed sustainability reporting, a considerable increase in the number of disclosures globally was noted by several researchers over the last two decades (Wheeler and Elkington 2001; Cerin 2002; Marshall and Brown 2003; White 2010; Gurvitsh and Sidorova 2012; KPMG 2013). The information presented in annual, integrated and sustainability reports provides the means to communicate corporate activities to stakeholders, the links between corporate natural resource use management and financial profitability as well as sustainability progress (Samkin 2012; Fernandez-Feijoo *et al.* 2014). The reports are therefore a reflection of company management (Fernandez-Feijoo *et al.* 2014) and sustainability reporting can contribute to better corporate sustainability management (Lozano and Huisingh 2011). Sustainability reporting was found to have positive influences on competition, financial savings and stakeholder satisfaction (Cerin 2002; Epstein 2008). Annual reporting has focused on integrated TBL-reporting to incorporate sustainability matters, and moved towards integrated reporting (IIRC 2013b) to discuss financial and non-financial information in a more integrated manner, increase the transparency of a company's strategy, long-term performance and value-creation, and present company activities and performance more holistically (Vormedal and Ruud 2009; Cheng *et al.* 2014; de Villiers *et al.* 2014; Burke and Clarke 2016).

The increase in corporate disclosures was also driven by reporting standards, most notably the Global Reporting Initiative (GRI; Skoudoulis *et al.* 2009; Levy *et al.* 2010). In 1997 the GRI was formed by Ceres of Boston and the Tellus Institute (Marimon *et al.* 2012) and was supported by the United Nations Environment Program (UNEP; Labuschagne *et al.* 2005; Marimon *et al.* 2012). Five versions of the GRI guidelines have been published; the first one (G2) in 2000 was followed by the G3 in 2002, the G3.1 in 2006, and the G4 in 2013. Most recently the GRI Standards

were published in 2016. Version 3.1 was used as a reference in this study, and includes economic, environmental, and social criteria (GRI 2011). The 2013 version 4 (GRI 2013) published in May 2013 was applicable by January 2016, although some companies adopted the latter version before that date (Deloitte Touche Tohmatsu 2014). The GRI Standards will only be applicable to reports published on or after 1 July 2018 (GRI 2016). The objective of the GRI was to create reporting guidelines under which social and environmental aspects are key and to provide a global standard that is internationally comparable. The reports are useful as a means to making informed decisions and can be added to financial reports (Marimon *et al.* 2012).

In South Africa, corporate responsibility and sustainability were initially driven by the King Reports on Corporate Governance from the mid-1990s (King I, II, III, and IV; Malherbe and Segal 2001). Following the incorporation of the first King Code (King I) into the listing requirements of the Johannesburg Stock Exchange (JSE) in 2000 (Malherbe and Segal 2001; Rossouw *et al.* 2002) and the release of King II in 2002, the JSE launched its Socially Responsible Investment (SRI) Index in May 2004. It included the requirement for TBL reporting and the identification of companies reporting well on their integration of corporate sustainability into their business practices (JSE Limited 2007; JSE Limited 2010). King III, published in 2009, required integrated sustainability reporting and disclosure, as discussed in Section 9 of the Code (IoDSA 2009). In terms of this requirement, listed companies were obligated to submit integrated annual reports since April 2011 (JSE Limited 2010). South Africa was one of the first countries globally in which it was mandatory for listed companies to produce annual integrated reports (Cheng *et al.* 2014; de Villiers *et al.* 2014; Burke and Clarke 2016; Stacchezzini *et al.* 2016). King III required an "apply or explain" approach, meaning that principles laid out in the code needed to be followed or explanations provided why principles were not applied. Reasons for omitting principles also needed to be supplied in the annual report. Amongst its other recommendations, King III further proposed adoption of the GRI

reporting guidelines (IoDSA 2009). Since April 2017, companies are required to follow the new King IV principles, which adopted an "apply and explain" application regime (IoDSA 2016). The JSE's active drive for sustainability reporting is reflected in 98% of companies disclosing corporate responsibility issues in annual reports, the highest percentage globally shared with Japan (KPMG 2013).

Corporate disclosures have mainly addressed environmental reduction targets such as emissions, water and energy as well as waste. They do however also address environmental risks, yet mostly as part of financial disclosures (see for example Sinclair-Desagné and Gozlan 2003, Beretta and Bozzolan 2004, Linsley and Shrives 2006, Ntim *et al*. 2013). The identification of, for example, climate change risks to businesses feature in the literature as part of environmental risk management strategies and in response to policy changes (see for example Luís *et al.* 2015; Bui and de Villiers 2017; Kumarasiri and Gunasekarage 2017), but are not often discussed as part of corporate reporting and its performance. Similarly, systems thinking focuses on management strategies but it has hardly been explored in the context of corporate reporting (see for example Benson and Garmestani 2011; Fiksel 2012; Sun *et al.* 2018).

Some general issues encountered with sustainability reporting were linked to a perceived mismatch between what corporates report and what they do, leading to ineffective sustainability reporting and loss of value creation for shareholders and companies (Brammer and Pavelin 2006; Aras and Crowther 2009; Font *et al.* 2012; Comyns *et al.* 2013; Maubane *et al.* 2014; Barkemeyer *et al.* 2015; Cho *et al.* 2015). While there is guidance provided for sustainability reporting, stronger assistance tools on strategy implementation, integration and management are needed (Hansen and Schaltegger 2012; Garcia *et al.* 2016). Marimon *et al.* (2012) critically pointed out that the GRI guidelines need to become more flexible to accommodate various economic groups. Many companies were also found not to adhere to the GRI guidelines or lacked a clear strategy to apply the guidelines. Instead, internal

company criteria are used to disclose environmental impacts which negatively affects comparability and standardisation across different companies (Cerin 2002; Marshall and Brown 2003; Epstein 2008; White 2010).

1.3 Integrating strategic environmental risk management into corporate sustainability

Risk assessment, management and disclosure are an integral part of business conduct (Pojasek 2011). A risk is an "effect of uncertainty on objectives" (ISO 2009, p. 13). In order to ensure a business' long-term survival and value-creation, thus ensure its long-term sustainability, factors that threaten maintaining business functioning need to be identified, managed, monitored and evaluated (Pojasek 2011; Haywood *et al.* 2017). The management of environmental risks is about finding strategies to prevent ecosystem degradation and promote sustainable resource use (Kasperson and Kasperson 2001). It can be defined as the "threats (to human beings and what they value) resulting from human-induced environmental change, either systemic or cumulative […]." (Kasperson and Kasperson 2001, p. 5). Environmental risks can thus affect any aspect of society. Systemic risks have modifying properties at various spatial scales, such that alteration of the environment in one place may have severe impacts elsewhere (Kasperson and Kasperson 2001). Cumulative risks have escalating effects and impact on various spatial (local, regional, global) and temporal (short- and long-term) scales.

Environmental risk assessments and management have already been considered since the early 1990s (McNichols 1994; Matten 1996), mainly in the banking and insurance sector. An increasing number of claims by the public relating to compensation for damages to personal health caused by industrial pollution resulted in banks steering clear of projects which may come into conflict with the public or the law (Calow 1998). The benefits of environmental risk management have been associated with

enhanced product image, health and safety, investment attraction, improved engagement with community, shareholder and regulators as well as staff productivity, although these are difficult to quantify (Aras and Crowther 2009).

To attain corporate sustainability, there is a growing need for companies to act more strategically by incorporating an environmental risk approach to natural resource management. Yet few businesses have started adopting a strategic approach to integrating corporate sustainability that accounts for environmental risks or incorporated environmental risks into annual reports (Haboucha 2010; Rochlin and Grant 2010). Environmental management is meant to take ecological system dynamics into consideration (Linnenluecke and Griffiths 2010; Beermann 2011; Mumby *et al.* 2014; Schaltegger *et al.* 2017). It should also reflect the concept of corporations as part of the social-ecological system operating within finite limits (Schaltegger *et al.* 2017). Thus, strategic risk management requires the understanding of the system in which a company operates, not only the risk drivers (Haywood *et al.* 2017). A company would need to understand social-ecological system functioning and that it is part of this system as well as the risk factors affecting the stability of the system and in turn the business (Haywood *et al.* 2017). But companies consider themselves as detached from this system (Haywood *et al.* 2017). Further, difficulties were related to uncertainty, long-term strategy planning, awareness of the cumulative nature of environmental impacts and risks, non-financial risk quantification and incomplete data sets (Whyte and Burton 1980; Calow 1998; Kasperson and Kasperson 2001; Ntim *et al.* 2013; Engert *et al.* 2016). Risk management approaches have typically focused on credit and financial as well as political risks, and have not, for example, identified disparities and shortfalls in the environmental field. Instead, a more holistic risk management approach is necessary (CRO 2013). A further challenge is a potential mismatch between the importance of environmental and financial risks – a risk from an ecological stand point may be high, yet not economically important, and vice versa (Kasperson and Kasperson 2001). The complexity of environmental risks (Figure 3) stands in contrast to financial processes

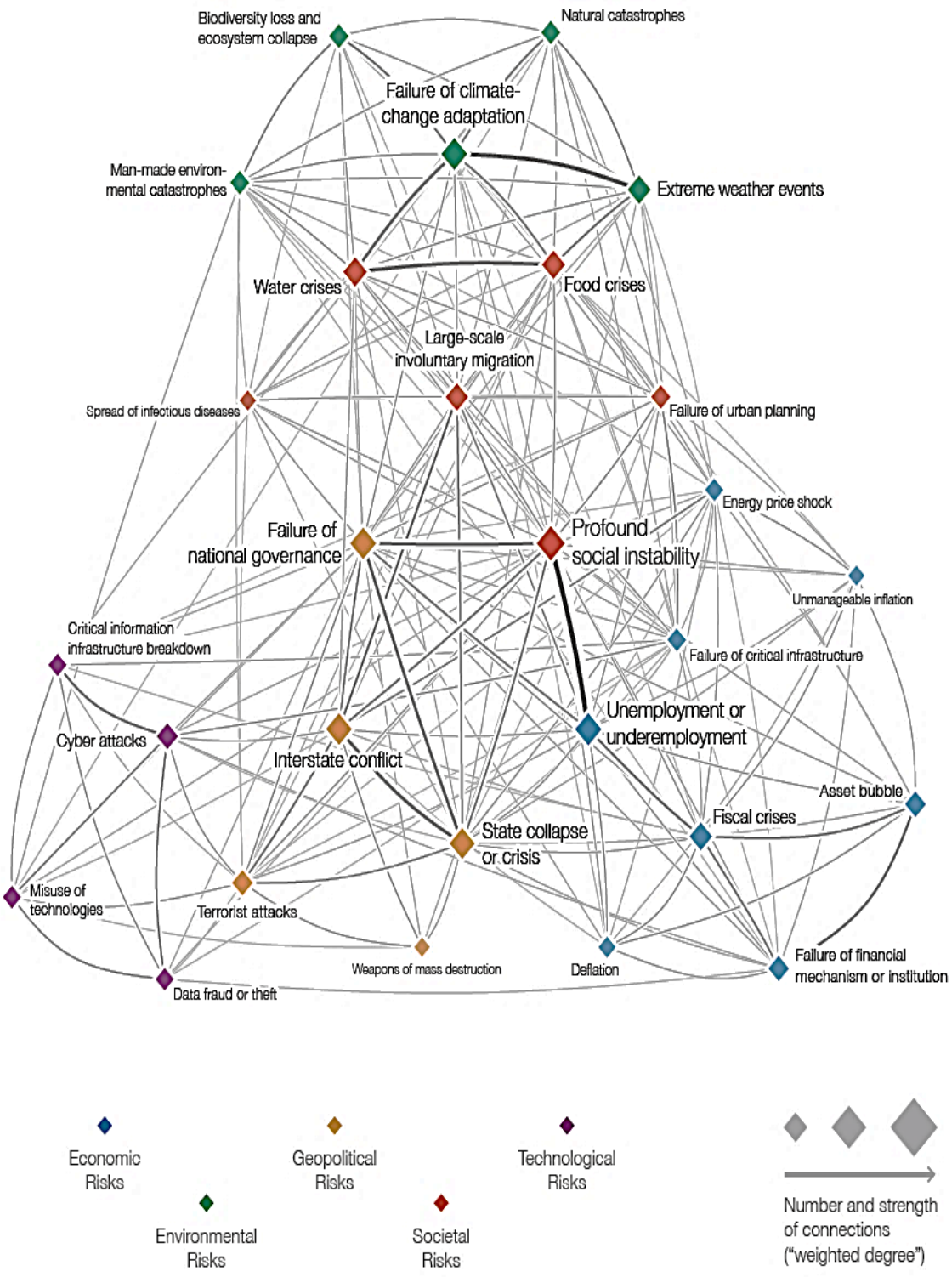

FIGURE 3. The Global Risk 2015 Interconnections Map. Source: Global Risks Perception Survey 2014 (WEF 2017, p. 4).

that are dominated by strongly internalised processes, retrospective and short-term thinking (Ntim *et al.* 2013), as well as highly linear financial risk models. In collaboration with business leaders and experts the World Economic Forum's risk interconnections map (Figure 3) identified not only the most pressing global long-term risks, but also their underlying causes (WEF 2015). The resulting map highlights system complexity, the deep and multi-tiered interconnectivity of geopolitical, environmental, social, economic and technological spheres. Climate change adaptation not only impacts on weather events or biodiversity loss, but both directly and indirectly poses risks to, for example, energy prices, social and political stability. These in turn can be linked again to other risks of different sectors. This visualisation challenges the financial assumptions by providing a more realistic view of global system functionality within which businesses operate. They are thus influenced by system components and at the same time exert influence on the system.

Economic variables are considered to be fast-changing, whereas variables of ecological and cultural nature changing more slowly. It is difficult, but necessary, to adopt strategies that include both, without jeopardising either of them (Carpenter 2003). Further, the predictions surrounding the magnitude of environmental risks, their likelihood of occurrence, and the accuracy of various environmental models showing different levels of uncertainty, make it difficult to manage natural resource use effectively (Burkett *et al.* 2014; UNEP 2016a) and to implement short- and long-term business strategies (Kasperson and Kasperson 2001). The uncertainty factor around environmental risks and future scenarios is nevertheless unavoidable, and businesses should therefore "acknowledge uncertainty" and choose "responses, understand the limits to current knowledge, and expect the unexpected" (Millennium Ecosystem Assessment 2005b, p. 74).

From a broader perspective, factors contributing to companies struggling to move forward in sustainability (Engert *et al.* 2016) are related to policies and business practices for natural resource use management having viewed the ecological system

as stable, linear, predictable and single-layered (Gunderson 2000; Folke *et al.* 2002; Folke 2006; Benson and Garmestani 2011). The ecological system has thus been seen to be controllable and to have the ability to regenerate as soon as human pressures are removed (ESDN 2012). Hence management efforts have been focused on controlling impacts on the environment to maximise production (Gunderson 2000), also called the command-and-control approach (Folke 2006). This has resulted in the deterioration of social-ecological systems (Gunderson 2000). Similarly, management efforts are aimed at maintaining systems the way they were, thus applying a so-called "restoration" focus (Benson and Garmestani 2011, p. 394), not taking into consideration their current and future inevitable change and the need to have strategies in place to manage uncertainties of future events (White 2010). Social and ecological systems have also been treated separately instead of recognising their inevitable complex relationships (Gunderson 2000; Folke *et al.* 2002). Not surprisingly, the focus of resource use management has also been reactive, rather than proactive (Benson and Garmestani 2011) and has failed to acknowledge that institutions are dependent on the natural environment (Styhre 2002).

Considering these interactions and characteristics, one can conclude that the concept of environmental risk is embedded in the resilience framework. Environmental risk management incorporating social-ecological risks would therefore encourage the management of risks to companies and identify ways to create long-term sustainable business practices. As environmental risk management is embedded in resilience and sustainability thinking, it applies holistic, integrated and systems thinking. Environmental risk management therefore allows for opportunity, development and innovation (Holling 2004; Folke 2006).

The need to integrate environmental risks into the business strategy also comes with a need for specific guidance for companies (Baumgartner and Rauter 2017). The evolution of the sustainability concept has driven the frameworks that assist companies with sustainability management and reporting (Baumgartner and Rauter

2017). As discussed, the JSE listing requirements, GRI guidelines and the King Codes have assisted South African companies in advancing their sustainability interests. The International Integrated Reporting Framework (<IR>; IIRC) provides guidance on integrated reporting based on the capitals model and integrated thinking (IIRC 2013a; IIRC 2013b). The same frameworks should therefore guide companies towards the reporting and management of environmental risks. Although the <IR> makes references to risks and opportunities, they are very general and are not related to natural capital. The South African King III Code of Corporate Governance (IoDSA 2009) did not address environmental risks in any form and made weak links between risk management and company duties with overarching sustainability objectives. King IV (released in 2016) approaches company risk management with a focus on long-term strategic goals and sustainable business practices (IoDSA 2016). Although reference is made throughout the report for the need to apply the various principles for the short-, medium- and long-term, no further clarification is provided. The recommended practices for strategy, performance and reporting for example are that "risks, opportunities and other significant matters connected to the triple context in which the organisation operates" (IoDSA 2016, p. 47) are addressed. A separate sustainability section is thus no longer present. Further, the GRI 3.1 guidelines mention risk a few times in the "Relevance" section of some environmental indicators, but do not explicitly require companies to report on them (GRI 2011). The new G4 (GRI 2013) reporting guidelines include the reporting of risks and opportunities, yet still define the report as one that "conveys disclosures on an organization's impacts – be they positive or negative – on the environment, society and the economy" (GRI 2013, p. 3). Instead of dealing with risks to companies, emphasis is placed on sustainable development effects on firms. Although the new GRI Standards call for the reporting of the links between economic, environmental and/or social issues and the company's long-term strategy, potential risks, opportunities and goals (GRI 2016), their aim still relates to an organisation's impact on the three spheres economy, environment and society (GRI 2016); they have therefore not incorporated the recent developments in the sustainability concept.

In line with the developments in the sustainability concept, strategic environmental risk management and not only company impacts should be incorporated into corporate sustainability. This would place businesses within and as part of the social-ecological system. Without the environment, both human wellbeing and business operations cannot be sustained (Goodland 1995). Such an approach supports the argument that environmental risk management needs to form the foundation for effective business sustainability (ESDN 2012), allowing businesses to consider and improve their understanding of human, natural and economic activities as part of a global interconnected system (ESDN 2012). This increases the ability to forecast changes and respond to them (Berkes *et al.* 2003) as well as dealing with unpredictability (Folke *et al.* 2002), essentially contributing to resilience development (ESDN 2012). Integrating environmental risks would also allow for flexibility in natural resource use management (Nelson 2007). Management strategies can be drafted that enable businesses to strengthen resilience and maintain business functionality during ecosystem changes (ESDN 2012). However, improving natural resource use management and creating the capacity to adapt to a changing world would require companies to continuously test, monitor and re-evaluate risks, systems and thresholds (ESDN 2012). A focus on a regional rather than a local context would be necessary as well as placing natural capital as the fundamental variable all other capitals depend on, which until now has seldom been the case (Farley and Voinov 2016).

1.4 Research purpose

To ensure sustained economic, social and environmental wellbeing, the preservation of ecological systems is indispensable (Millennium Ecosystem Assessment 2005d; Farley and Voinov 2016). However, human activities have led to an acceleration of natural processes on a temporal scale (Steffen *et al.* 2007). The inherent risks that economies, societies and the environment are facing from ecological degradation,

subsequently eroding the planet's resilience, have left global societies in a profound dilemma (Stern 2007). As the natural environment is a finite system, unlimited physical growth cannot be sustained (Farley and Voinov 2016). According to Adger *et al.* (2011), "the speed, severity, and complexity of known and unknown changes in climate and ecosystems will challenge the ability of society to generate fitting responses" and "the appearance of novel risks at different levels will test the ability of societies to adapt and continue to develop" (p. 758). To foster resilient societies, further ecosystem degradation needs to be restricted (Farley and Voinov 2016).

The shift from corporate sustainability focusing on environmental impact management towards integrating environmental risk management that is embedded in the resilience framework presents a new path for corporate management in the context of environmental change. To account and plan for the described system dynamics, this approach would (1) acknowledge natural capital as the quintessence of social and economic – and therefore company – functioning; (2) recognise the natural environment as heterogeneous in space and time, complex and unpredictable in nature and linked by biological and physical mechanisms (Holling 1973); (3) recognise social-ecological systems as dynamic (Walker *et al.* 2004); and (4) would replace the still dominating linear and short-term thinking in business practices with a more holistic systems-based approach, while recognising unexpected future events (Holling 1973; Folke 2006). This would facilitate value-creation for business and society, reduced risk exposure for businesses, enhance resilience to retain and maintain environmental, economic and social functionality during and after ecological state changes, and thus foster sustainable development.

Until now few business leaders have started addressing longer-term social-ecological concerns, with many still failing to acknowledge that the management of one risk may inadvertently affect another part of the system. This ultimately bears negative consequences for business sustainability (Adger *et al*. 2011; Farley and Voinov 2016). Despite the developments in the sustainable development concept and

environmental reporting requirements for listed companies, the progress towards sustainable societies with adaptive capabilities has been slow. Some of the global ecological thresholds have already been crossed (see Rockström *et al.* 2009), global resilience is deteriorating (Gunderson 2000) and uncertainty and unpredictability are increasing (Folke *et al.* 2002; ESDN 2012). Environmental risks should therefore be integrated across various corporate levels and systems, into business culture and policies, business governance, as well as into strategic targets (Baumgartner and Rauter 2017).

South Africa is at present experiencing severe environmental challenges such as water scarcity, increasing temperature anomalies and changing frequencies and intensities of severe weather events (Christensen *et al.* 2013; Cubasch *et al.* 2013; Kirtman *et al.* 2013; Burkett *et al.* 2014; Cisneros *et al.* 2014). The economy's heavy dependence on non-renewable resources makes the country the sixth's largest coal producer globally (Krupa and Burch 2011; Hancox and Götz 2014; Msimanga and Sebitosi 2014; Thopil and Pouris 2015). Without competition for alternative energy production, managing the impact on climate change and other environmental risks is difficult (Krupa and Burch 2011; Hancox and Götz 2014; Msimanga and Sebitosi 2014; Thopil and Pouris 2015). Although the reporting history of the country has been relatively short, South Africa is one of the leading nations in terms of the number of corporate disclosures (Baumgartner 2011). South African companies performed well in the area of climate change risk disclosure and reportedly integrated climate change risks into business strategy (CDP 2016c). Yet the climate change report of the Carbon Disclosure Project (CDP 2016c) report on climate change in South Africa highlighted a 3% increase in carbon emissions from 2015 to 2016. Moreover, many science-based environmental targets expire by 2020 and company sustainability performance may be stagnating (CDP 2016c). This implies an increased need for innovation and scope to stay ahead and remain competitive, especially in light of the Paris Agreement objectives and frameworks (CDP 2016d).

Companies possess the capacity to reduce environmental degradation, manage its associated business risks and enhance their resilience. It is necessary though to translate this capacity into action. The International Institute for Sustainable Development (IISD 2016) stated in their report that "One of the biggest challenges when it comes to attaining the SDGs [Sustainable Development Goals] is determining where we are on the journey towards accomplishing them." (p. 5). Applying this notion to the relationship between sustainable development and corporate sustainability, one of the biggest challenges of attaining corporate sustainability is to determine where businesses are on the journey in understanding and applying the most recent theories applicable to sustainable development.

So far, approaches in environmental sustainability management focus on the identification and reporting of environmental impacts and much research has been conducted in this field in South Africa (see Malherbe and Segal 2001; de Villiers and van Staden 2006; Mitchell and Hill 2009; Hanks and Gardiner 2012; Ntim *et al.* 2012; Maubane *et al.* 2014). Studies on strategic environmental risk integration to foster resilient and sustainable economies and societies on the other hand appear to be minimal. The current literature has not yet explored whether and to what extent the shift from corporate impact management to risk and resilience approaches has taken place. The main focus so far has been on corporate risk disclosure and risk reporting as part of financial disclosures (see for example Sinclair-Desagné and Gozlan 2003, Beretta and Bozzolan 2004, Linsley and Shrives 2006, Ntim *et al.* 2013). The research conducted for this thesis addresses this knowledge gap. As part of this, it is necessary to understand whether business reporting and management has evolved from impact to risk, and is distinguishing between the two. In order to understand and manage environmental risks, environmental impacts need to be understood. Therefore, the research provides a baseline assessment of impact reporting and management to identify whether companies address this aspect of sustainability well. Building on that, it provides an assessment on the extent of environmental risk reporting and management. The research lastly assesses whether corporate

sustainability practices and management systems are aligned with the most recent developments in sustainability related to risk and resilience. It also identifies whether the corporate environmental sustainability paradigm is shifting towards recognising businesses' role as part of a complex, highly interconnected social-ecological system, not only as drivers of ecosystem change that are disconnected from the system. This allows us to determine whether South African companies can manage natural resource use sustainably and enhance resilience to maintain functionality during times of increasing uncertainty and unpredictability.

1.5 Aim and objectives

The aim of my PhD thesis was to advance our understanding of whether businesses address social-ecological system complexity as part of their business strategy and the risks associated with ecosystem degradation to strengthen resilience.

The objectives were:

Objective 1: To assess the environmental disclosure quality of 30 of the Top 100 JSE-listed companies between 2008 and 2013 in line with the GRI reporting guidelines (Version 3.1; Chapter 2);

Objective 2: To identify factors influencing environmental management and reporting within South African companies based on interviews with sustainability managers of JSE-listed companies (Chapter 3);

Objective 3: To test for a correlation between environmental disclosure quality (scores obtained from Chapter 2) and financial performance indicators ROCE, ROTA, P:E and ROS for the 30 selected JSE-listed companies (Chapter 4);

Objective 4: To test to what extent company reports addressed the system complexity outlined in the two risk interconnections maps that were created from existing literature. These describe the complex relationships between (1) climate change, biodiversity and economic risks, and, as South Africa is currently experiencing droughts and water stress, (2) water availability, social and economic risks (Chapter 5);

Objective 5: To analyse JSE-listed companies' annual, integrated and sustainability reports between 2008 and 2015 to identify in what way environmental risks were addressed (Chapter 5);

Objective 6: To conduct interviews with sustainability managers on their strategic environmental risk management approaches and management structures (Chapter 5).

Various data collection tools and methods were used to collect both qualitative and quantitative data for this research. Qualitative data as part of content analysis was collected from company reports, more specifically from annual, integrated and sustainability reports and turned into quantitative data for further analyses. Any information that related to the GRI indicator parameters or parameters identified to analyse risk reporting was used for the scoring processes and their processing into secondary data. Qualitative data collected from interviews were also converted to quantitative data. Financial data was of quantitative nature and needed no further transformation for comparison to data obtained from report analyses.

1.6 Thesis layout

The chapters of this thesis, excluding the introduction and discussion chapters, are written in the form of research papers formatted for submission to a scientific journal. Although care has been taken to avoid overlap between the introduction and method

section of each chapter, this was not always possible, especially when describing various global and local aspects of environmental management and reporting, the sample selection and method of analysis.

Chapter 1 provides an introduction to the thesis, a literature review in an international and local context and establishes research aim and objectives. Chapter 2 covers the environmental reporting quality of 30 JSE-listed companies and its change between 2008 and 2013. Focus is also put on differences between economic groups and environmental impact levels as well as GRI indicator selection. Chapter 3 outlines factors influencing environmental reporting and management which could explain the slow progress in sustainable development. Chapter 4 investigates a possible relationship between environmental reporting quality and the financial performance indicators in terms of: (1) return on capital employed (ROCE); (2) return on total assets (ROTA); (3) price-earnings ratio (P:E) and (4) return on sales (ROS). Chapter 5 assesses how the selected JSE-listed companies address environmental risks through the analysis of: (1) annual, integrated and sustainability reports between 2008 and 2015; and (2) company interviews. Chapter 6 is a general discussion that consolidates the findings and discussions of the four preceding chapters. A combined reference list for all chapters is provided at the end of the thesis, followed by the appendices. Figures and tables are renumbered in every chapter due to Chapter 2 having been submitted to a journal and Chapter 3 having been accepted for publication.

Chapter 2

Environmental disclosure quality and progress: A study of South African JSE-listed companies[1]

Abstract Despite that the number of companies disclosing sustainability information has increased considerably the disclosure quality in many countries and various industry sectors was found to be poor. Given the current environmental challenges, the increasing complexity of the sustainability reporting landscape, and 98% of South African companies disclosing sustainability information, this study assessed the environmental disclosure quality of 30 South African Johannesburg Stock Exchange (JSE)-listed companies over a six year period (2008 to 2013) against the Global Reporting Initiative (GRI) reporting guidelines (Version 3.1). Research findings indicate that environmental disclosure was mostly of average to poor quality with marginal improvements until 2010, levelling out in 2011. Company reports covered few of the environmental aspects identified by the Millennium Ecosystem Assessment, Planetary Boundaries Framework and Intergovernmental Panel on Climate Change as highly important in the management and reduction of environmental degradation. Research findings also suggest that the GRI 3.1 guidelines approach environmental reporting from a short-term, regressive standpoint independent of social and economic factors, which has not progressed the economic, social or environmental assessment of a company. As current and future environmental challenges are becoming more prevalent and are increasingly posing risks to businesses, the disclosure of key environmental indicators needs urgent improvement.

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Keywords Disclosing sustainability information · environmental challenges · environmental reporting quality · JSE · GRI · risks to businesses

1 Introduction

The demand for non-financial information in corporate reporting, a reflection of company management (Fernandez-Feijoo *et al.* 2014), has steadily increased as traditional financial reporting has been deemed insufficient in addressing risks to business sustainability (KPMG 2011; Cohen *et al.* 2012; Burke and Clarke 2016). The number of reports covering sustainability information has risen considerably, especially since the 2008/2009 financial crisis (KPMG 2015). Also, the complexity of reporting and its standardisation and regulation have increased (de Villiers *et al.* 2014; Velte and Stawinoga 2016). The two main aims of sustainability reporting are the economic, social and environmental assessment of a company and the communication of sustainability progress to stakeholders (Lozano 2013). Sustainability reporting has recently moved towards integrated reporting, which links financial and non-financial information (IIRC 2013b). This would increase the transparency of a company's strategy, long-term performance and value-creation (Cheng *et al.* 2014; de Villiers *et al.* 2014; Burke and Clarke 2016).

Assistance with evaluating, managing and communicating a company's sustainability performance is available in form of reporting guidelines and frameworks (Lozano and Huisingh 2011). Globally the most widely used guidelines are provided by the Global Reporting Initiative (GRI; Alazzani and Wan-Hussin 2013). Although the number of reports covering social and environmental information has increased globally, the disclosure quality however remains rather poor (Comyns *et al.* 2013). Among the 150 largest German companies the disclosure quality has even declined while the number of reporting entities has increased (Dietsche *et al.* 2017). Annual reports of Greek companies, for example, have been found to lack comprehensiveness, materiality consideration and lag behind

international standards (Skouloudis *et al.* 2010). Similarly, the disclosure quality at Yemeni oil and gas companies was found to be poor (Alazzani and Wan-Hussin 2013). Levels of comprehensive reporting at publicly listed Belgian companies also remained low (Bouten *et al.* 2011). Asia and South America have seen an increased uptake of the GRI guidelines by public firms, yet materiality consideration was neither sector- nor country-specific (Barkemeyer *et al.* 2015).

Due to increasing water scarcity, temperature anomalies and changing frequencies and intensities of severe weather events due to climate change, environmental issues have played a more important role in South Africa in recent years (Christensen *et al.* 2013; Cubasch *et al.* 2013; Kirtman *et al.* 2013; Burkett *et al.* 2014; Cisneros *et al.* 2014; UNEP 2016a). In addition, currently 98% of South African listed companies disclose corporate sustainability information in annual integrated and sustainability reports – the highest percentage globally shared with Japan (KPMG 2013). South Africa was also one of the first countries to make annual integrated reporting mandatory for listed companies (Cheng *et al.* 2014; de Villiers *et al.* 2014; Burke and Clarke 2016), which most of them are based on the GRI (Versions 3.1 and 4; KPMG 2013).The country's sustainability reporting journey began with the establishment of the King Committee on Corporate Governance in 1992, which contributed a great deal to the development of sustainable business practices (Rossouw *et al.* 2002; West 2006). The first King code (King I) was adopted into the listing requirements of the Johannesburg Stock Exchange (JSE) in 2000 (Malherbe and Segal 2001; Rossouw *et al.* 2002). Since then, the code was updated multiple times (King II, King III, King IV). King III focused on integrated reporting and recommended, amongst others, the GRI guidelines for the sustainability section of the report (IoDSA 2009; IoDSA 2016), while King IV, applicable since 1 April 2017, currently focuses on a more inclusive and integrated reporting approach as well as integrated thinking (IoDSA 2016).

While the disclosure quality globally was found to be poor (see for example Skouloudis *et al.* 2010; Bouten *et al.* 2011; Comyns *et al.* 2013; Dietsche *et al.* 2017), this study aimed to assess the environmental disclosure quality as proxy for

sustainability management performance in South Africa, especially given the growing environmental concerns and high disclosure levels. Disclosure quality could serve as representation of environmental management performance as environmental management performance is meant to be reflected in reports (Fernandez-Feijoo *et al.* 2014). Environmental information contained in annual, integrated and sustainability reports of 30 JSE-listed companies was assessed against the environmental protocol set of the GRI reporting guidelines (Version 3.1; GRI 2011) in the form of content analysis. Here, disclosure quality refers to the "comprehensiveness of information: providing the reader with a sense that no important aspect has been left undisclosed" (Hooks and van Staden 2011, pg. 202). This study further investigated the difference in quality disclosure of the economic groups of resources, basic industries, non-cyclical consumer goods, cyclical services, non-cyclical services, and financials. Past research in other countries has identified sector-specific differences (see for example Skouloudis *et al.* 2010; KPMG 2011; Lozano 2013; Ramos *et al.* 2013). It was therefore predicted that companies of resources and basic industries would show better environmental disclosure quality. Because the JSE required high impact companies (companies that have a significant impact on the environment such as mining companies) to report on a broader range of sustainability issues in more detail (JSE Limited 2010, Section 13), it was predicted that high impact companies would show better environmental reporting quality. Most studies focusing on the disclosure quality according to reporting frameworks considered only one reporting cycle (see for example Vormedal and Ruud 2009; Hooks and van Staden 2011; Alazzani and Wan-Hussin 2013; Lozano 2013) or have a short-term focus ($\leq$ 3 years; see for example van Staden and Hooks 2007; Gurvitsh and Sidorova 2012; Barkemeyer *et al.* 2015). Studies assessing the reporting quality of environmental information over an extended period (>3 years) to identify changes in environmental disclosure quality seem to be absent. This study therefore included a longer reporting time frame to develop a better understanding of the changes in environmental disclosure quality. It also allows us to draw better conclusions from the possible influence various frameworks and guidelines could have exerted on environmental disclosure quality.

2 Methods

2.1 Sample selection

The various listing guidelines, rules and initiatives implemented at the JSE, such as the Socially Responsible Investment (SRI), the JSE Environmental Policy (JSE Limited 2010) and the various King Codes, that are enforced on listed companies have made environmental (and overall sustainability) disclosure and management key aspects at the JSE. King III, released in 2009, was a JSE-listing requirement during the time this study was conducted and thus applicable to listed companies whose reports were assessed. Annual and annual integrated reports made available to the public by listed companies are considered an important communication tool which should reflect a company's strategy, performance and governance (IIRC 2013b). The environmental information provided in these documents should therefore also reflect a company's environmental management performance. Since some companies also provide stand-alone sustainability reports, published environmental information was collected from the companies' annual, annual integrated and sustainability reports and all parts covering environmental information in these reports were taken into consideration to assess the quality of environmental disclosures. It was found though that the sustainability report contains more detailed environmental information on a company's environmental performance (Hooks and van Staden 2011). It is also referred to as *supplementary material* in the main annual document.

To analyse JSE-listed firms' reports on environmental disclosure quality, companies belonging to six different economic groups were chosen, specifically: resources, basic industries, non-cyclical consumer goods, cyclical services, non-cyclical services, and financials (FTSE International Limited 2002; Appendix 1). The market capitalisation of 2008 of all JSE-listed companies was obtained from the JSE. From the largest 100 listed companies according to this market capitalisation, five companies were chosen at random per economic group (except for basic industries (4) and financials (6)). Large firms, which often have significant economic, social and

environmental impacts, were found to be more engaged in sustainability management and reporting, to have better management tools, more qualified staff and better stakeholder involvement compared to smaller firms (Hörisch *et al*. 2015). They were therefore suitable for an analysis of environmental disclosure quality. The company selection consisted of thirty of the Top 100 JSE-listed companies from 22 different sectors. Companies of resources and basic industries were predicted to show better environmental disclosure quality as past research has identified sector-specific differences (see for example Skouloudis *et al.* 2010; KPMG 2011; Lozano 2013; Ramos *et al.* 2013). Company reports were examined from 2008 to 2013, totalling 179 reports. Table 1 outlines the sample size per economic group and sector. No report was available for the company representing the food producers sector for the year 2009. Although holdings companies were generally excluded from this study as their annual, integrated and sustainability reports would not reveal any environmental performance of their operations, two holdings companies were included in the company selection because of their narrow business focus with a more centrally managed sustainability strategy. They were therefore suitable for the analyses.

Table 1 Sample selection by economic groups and industries

Economic Group	Sector	*N*
Resources	Mining	1
	Industrial Metals & Mining	2
	Oil & Gas Producers	2
		[*5*]
Basic Industries	Chemicals	1
	Construction & Building Materials	1
	Forestry & Paper	2
		[*4*]
Non-cyclical Consumer Goods	Beverages	1
	Food Producers	1
	Health Care Equipment & Services	1
	Personal Goods	1
	Tobacco	1
		[*5*]

Cyclical Services	General Retailers	2
	Travel & Leisure	1
	Media	1
	Industrial Transportation	1
		[*5*]
Non-cyclical Services	Food & Drug Retailers	3
	Mobile Telecommunications	2
		[*5*]
Financials	Banks	1
	Nonlife Insurance	1
	Life Insurance	1
	Financial Services	2
	Real Estate Investment Trusts	1
		[*6*]
Total		30

2.2 Method of analysis

GRI 3.1 as reference

The GRI guidelines are the most widely used guidelines globally (Alazzani and Wan-Hussin 2013) and therefore provide a global standard that allows for comparative studies nationally as well as internationally. They are internationally recognised (Farneti and Guthrie 2009), are considered to be a rigorous framework for the application of triple bottom line (TBL) reporting (Lamberton 2005), and are applicable to various industry sectors and were drafted by a wide variety of experts (Reynolds and Yuthas 2008). When this study commenced, the GRI 3.1 guidelines were in use for annual integrated reporting. Shortly after the initial phases of this research in 2013, the G4 guidelines were released. These were only effective as of 1 January 2016, although some companies started adopting them earlier (Deloitte Touche Tohmatsu 2014). This study therefore based the report analyses on G3.1. The GRI guidelines were also referred to by King III for further guidance on sustainability reporting. Although King III was replaced by King IV in 2017 which does not refer to

the GRI guidelines, the latter was only effective as of 1 April 2017. It had not been released when this study commenced and was not applicable to the reports analysed between 2008 and 2013. Most listed companies were therefore expected to have been guided by or be compliant with the GRI guidelines.

To determine the validity of the GRI guidelines in terms of environmental concerns, indicators were assessed against key scientific literature to confirm whether the environmental concerns raised in these publications are in fact reflected in the GRI indicators. The Millennium Ecosystem Assessment (MEA; Millennium Ecosystem Assessment 2005a) and Planatary Boundaries Framework (Rockström *et al.* 2009) discuss high level global environmental issues such as water, climate change, energy and biodiversity, among others, from an ecological perspective. The various reports of the Intergovernmental Panel on Climate Change (IPCC; see for example Cubasch *et al.* 2013; Hartmann *et al.* 2013; Kirtman *et al.* 2013; Burkett *et al.* 2014; Cisneros *et al.* 2014) cover climate change-related ecological issues in great detail. The discussed environmental topics in these documents were extracted, including their relation to other environmental issues. This was compared to the environmental indicator protocol set of the GRI guidelines, which includes a list of overall environmental topics that require company disclosure. The GRI guidelines, which emphasise social and environmental aspects and which are aimed at monitoring and reducing company impacts on the environment (Levy *et al.* 2010), broadly cover the above mentioned environmental variables included in the MEA, Planetary Boundaries Framework and IPCC. The GRI covers environmental indicators with respect to consumption, usage and time frame (first-level assessment). However, environmental indicators are not linked to social or economic aspects and focus on the past. In contrast, the MEA, Planetary Boundaries Framework and IPCC cover environmental variables in conjunction with social and economic factors with a long-term focus. They are considered as an interconnected web of direct and indirect drivers of ecosystem change and its long-term implications. The GRI thus provides a structured overview of the base content of corporate social responsibility reporting

(Bouten *et al.* 2011) and served as an appropriate starting point for the development of the coding structure for the content analysis.

Content analysis

Content analysis was used to assess the quality of the published environmental information in annual, integrated and sustainability reports. The JSE-listed company reports were assessed against the GRI environmental indicators (Version 3.1). The GRI guidelines provide clear definitions for each environmental indicator and what information should be provided in reports, which make it easy and accurate to assess the quality of environmental reporting. The GRI index provided occasionally at the end of companies' reports was not used for the analysis as indicators listed to have been reported on were not always addressed. The disclosure of environmental information in the reports was expected to reflect the environmental activities and management performance by the company. The term "disclosure quality" refers to the "comprehensiveness of information: providing the reader with a sense that no important aspect has been left undisclosed" (Hooks and van Staden 2011, pg. 202).

To calculate the reporting quality score for each company report, the five-point scale (0-4) developed by Hooks and van Staden (2011), who also tested it for objectivity, was applied (Table 2). The highest score (4) was allocated for truly extraordinary disclosures that included evidence of targets and performance measurement against targets and previous years.

Table 2 Scoring system for environmental reporting quality (Source: Hooks and van Staden 2011).

Score	Definition
0	Not disclosed, no discussion of the environmental issue
1	Descriptive: more detail, but characterising only selected facilities and lacks detailed information, e.g. tables and figures disclosing measured data
2	The impact of the company or its policies was clearly evident, the information provided fully complies with requirements outlined in the

	GRI guidelines (3.1)
3	Includes trends over past years and included these for strategies for the following year
4	Truly extraordinary, includes trends over past years which are fully integrated into strategies for the following year, critically analyses if targets were met

The environmental indicator protocol set of the GRI 3.1 guidelines encompasses 30 indicators of which 17 are listed as *core* (essential), and the remaining 13 as *add* (optional). This study rated only against the *core* indicators, because (1) they cover the key environmental variables listed in the MEA (2005), Planetary Boundaries Framework (Rockström *et al.* 2009) and IPCC (see for example Cubasch *et al.* 2013; Hartmann *et al.* 2013; Kirtman *et al.* 2013; Burkett *et al.* 2014; Cisneros *et al.* 2014); (2) are deemed material to most organisations, whereas *add* indicators may be sector or company specific (GRI 2011); (3) the reporting of add indicators was found to be highly variable; and (4) scored low.

One or more indicators make up an aspect of which there are nine in total; for example, "materials used by weight or volume" (indicator 1/EN1) and "percentage of materials used that are recycled input materials" (indicator 2/EN2) make up the aspect "materials". Each indicator additionally consists of multiple subsections that require reporting. A score out of 4 was allocated for each of these subsections and the total score per indicator was calculated by adding all subsection scores. All indicator scores were then added to obtain an overall score for the report. No weighting of indicators was done as the GRI does not apply any weighting. A *core* indicator not reported on incurred a zero score. The GRI further makes provision to omit *core* indicators if they are "not material" to the business. A company can then still be fully GRI compliant. Because the GRI environmental indicators broadly reflect the critical aspects requiring business attention to reduce further environmental degradation discussed by the MEA, Planetary Boundaries Framework and IPCC, a zero score was allocated if an indicator was reported as omitted. A total score of 200 could be

obtained if a company reported against all *core* environmental indicators exceptionally well (Appendix 2).

Statistical analyses

A percentage for the overall reporting quality was calculated:

$$reporting\ quality\ \% = \frac{n}{N} \text{ x } 100$$

Where *n* is the score a report obtained and *N* is the total potential score (200) a report could have received if four points were allocated for every *core* indicator. The percentage for environmental disclosure quality of all company reports per economic group was calculated for each of the six years (2008-2013) and compared to identify potential differences. Unless otherwise specified, environmental disclosure quality refers to the overall percentage a report obtained.

In order to establish whether South African JSE-listed companies addressed all current and critical environmental issues (based on the MEA, Planetary Boundaries Framework and IPCC and reflected in the GRI 3.1) in their annual, integrated and sustainability reports, the most reported indicators were identified, their reporting frequency tabulated and a percentage for each year calculated.

JSE-listed companies were categorised according to the intensity of their environmental impact (JSE Limited 2011) into high (H), medium (M), and low (L) impact companies. Company reports were collated according to the impact group and the environmental reporting quality (calculation above) used to identify best reporters.

To detect potential changes between 2008 and 2013 in (1) environmental disclosure quality of the six economic groups, (2) reporting frequency of the most reported environmental indicators, and (3) environmental disclosure quality of the three impact groups (H/M/L), statistical analyses of the data were performed using Statistica 10 (StatSoft 2010). The data were checked for normality by inspecting Q-Q

plots. The residuals of all dependent variables showed a non-normal distribution. Therefore, analyses for each dependent variable were conducted separately using Spearman rank correlations. Significance levels were set at $p<0.05$.

To identify which GRI environmental indicators were best reported on by which economic group, the scores allocated for each report and each year for every economic group were added separately. Also for high, medium and low impact company reports the scores a report obtained for each indicator were combined per impact group and year to identify which impact group disclosed which indicator best. Because the number of companies per economic group partially differed, the combined points per year were then divided by the number of companies in the respective economic group to remove bias.

Analyses to identify potential differences between disclosure quality, economic groups, year, and environmental impact level as well as to identify which indicators were best disclosed by which economic and environmental impact level group were performed using RStudio (version 1.0.143; RStudio Team 2016). The data were checked for normality by inspecting Q-Q plots. The residuals of all dependent variables showed a non-normal distribution. Therefore, analyses were conducted using a generalised linear mixed model, using the glmmPQL function (MASS, nlme packages) using maximum likelihood with a Poisson distribution and a log link function. Economic group was the fixed effect and year of assessment and the environmental impact levels were random effects. To identify the indicators best reported on, economic group/GRI indicator was the fixed effect and year of assessment was the random effect. Wald statistics were generated to assess whether the economic group/GRI indicator predicted each dependent variable. Pairwise post-hoc comparisons were conducted when the fixed effects were significant predictors (lsmeans package; p values adjusted with the Tukey method). Significance levels were set at $p<0.05$.

3 Results

3.1 Environmental disclosure quality

The analysis of 179 reports released from 2008 to 2013 revealed that company reports of the different economic groups showed no consistency in environmental disclosure quality which improved moderately for the resources (r=0.60, p=0.0004), non-cyclical services (r=0.40, p=0.03), and financials group (r=0.45, p=0.006). The resources and financial economic groups showed the greatest improvement in environmental disclosure quality by 15% and 10% respectively. No significant changes occurred in environmental disclosure quality between 2008 and 2013 in the basic industries (r=0.28, p=0.19), non-cyclical consumer goods (r=0.003, p=0.99) and cyclical services groups (r=0.02, p=0.91; Figure 1). The environmental disclosure quality of companies belonging to the resources and basic industries group were found to be significantly better than that of companies of the remaining four economic groups (χ^2_5=75.56, p=7.15e^{-15}). The analysis of each individual company's environmental disclosure quality, regardless of the economic group, revealed great differences in disclosure quality over the six year period. In only very few cases the disclosure quality improved between 2008 and 2013. For example, within the resources, non-cyclical services and financials group only one company each showed a steady increase in disclosure quality. Companies of all six economic groups reported best on EN16 (total direct and indirect GHG emissions by weight; resources: χ^2_{13}=251.93, p=2.2e^{-16}; basic industries: χ^2_{13}=142.93, p=2.2e^{-16}; non-cyclical consumer goods: χ^2_{13}=109.24, p=5.19e^{-16}; cyclical services: χ^2_{13}=75.60, p=7.38e^{-11}; non-cyclical services: χ^2_{13}=109.24, p=2.2e^{-16}; χ^2_{13}=69.14, p=1.16e^{-09}; Figure 2). In addition, the resources, basic industries and non-cyclical consumer goods group also reported well on EN3 (direct energy consumption by primary energy source).

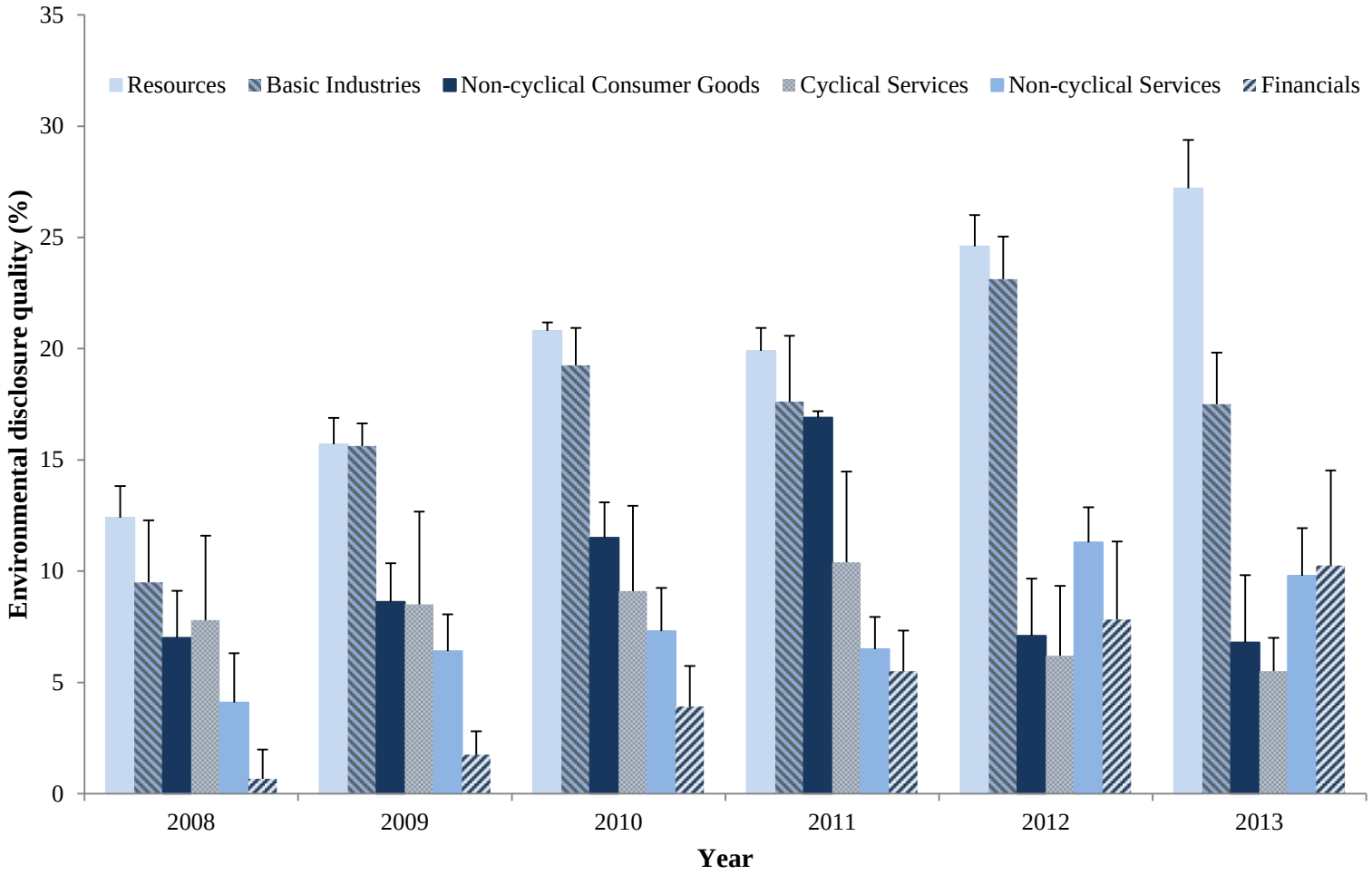

Fig. 1 Comparison of environmental disclosure quality (+SE) of economic groups from 2008 to 2013

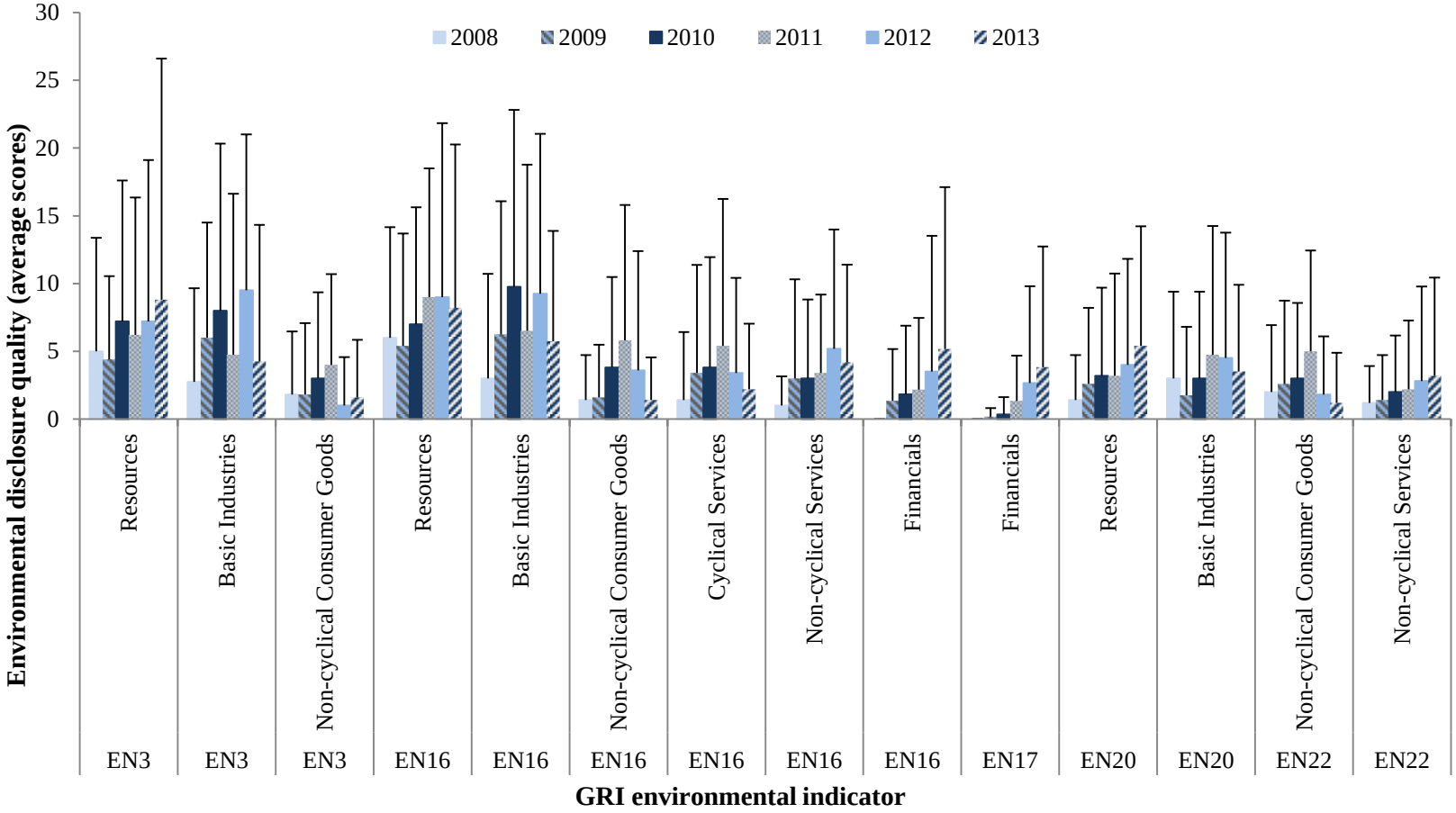

Fig. 2 Indicators of the GRI 3.1 environmental protocol set economic groups received most points for. EN3 = direct energy consumption by primary energy source; EN4 = indirect energy consumption by primary source; EN16 = total direct and indirect greenhouse gas emissions by weight; EN17 = other relevant indirect greenhouse gas emissions by weight; EN20 = NO_x, SO_x, and other significant air emissions by type and weight; EN22 = total weight of waste by type and disposal method

3.2 Reporting frequency of GRI indicators

Of all 17 *core* environmental indicators, 35% were reported on and 65% were not reported on. Further, a total of four indicators were covered by the majority of the companies between 2008 and 2013. These could be easily identified by a minimum reporting frequency of 50% of the 179 reports. These four indicators related to energy (EN3; 58%); water (EN8; 53%) and emissions, effluents, and waste (EN16; 72% and EN22; 54%). The results were analysed in more detail to identify whether reporting on these indicators improved from 2008 to 2013, but a slight decrease from 2008 to 2013 was present (EN3: r=-0.58, p=0.0002; EN8: r=-0.67, p=0.000009; EN16: r=-0.50, p=0.002; EN22: r=-0.52, p=0.001; Figure 3). Although an initial increase in reporting frequency of EN3, EN8, EN16 and EN22 was present, reporting frequency fluctuated from 2010 onwards. No increase in reporting frequency was seen for the EN3, EN 8 and EN16 indicators beyond 2011.

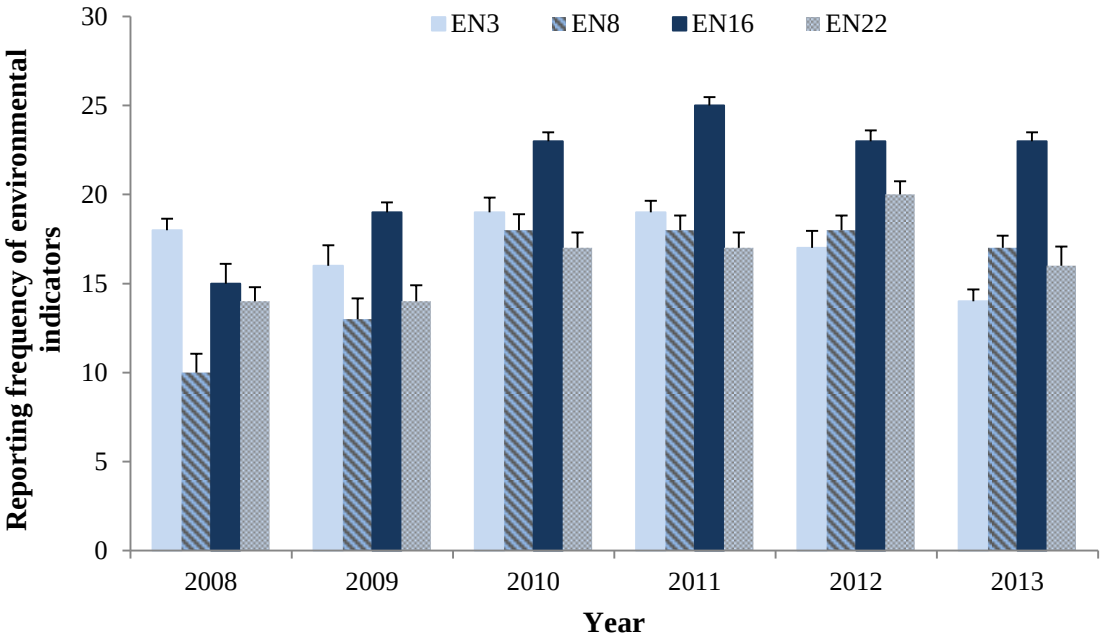

Fig. 3 Change in reporting frequency (+SE) between 2008 and 2013 of GRI indicator related to direct energy consumption by primary energy source (EN 3), total water withdrawal by source (EN 8), Total direct and indirect greenhouse gas emissions by weight (EN16) and total weight of waste by type and disposal method (EN22)

3.3 Environmental impact level and disclosure quality

The three environmental impact classes (H/M/L) were compared to the companies' environmental disclosure quality over the six year period (Figure 4). High, medium and low impact companies showed no significant improvement in their environmental disclosure quality from 2008 to 2013 (r_{High}=0.27, p=0.02; r_{Medium}=0.27, p=0.11; r_{Low}=0.26, p=0.03). High impact companies were the best environmental disclosure performers, followed by low impact companies. Medium impact companies were the worst performers. Significant differences were found between the disclosure quality of high and medium impact companies as well as between companies of high and low impact (χ^2_2=96.87, p=2.2e^{-16}; Figure 4). This difference was present between the years 2009 and 2012 for high and medium impact, and 2008 and 2012 for high and low impact. Companies with a high environmental impact disclosed indicators EN3 (direct energy consumption by primary energy source), EN16 (total direct and indirect greenhouse gas emissions by weight) and EN20 (NO_x, SO_x, and other significant air emissions by type and weight; χ^2_{13}=388.16, p=2.2e^{-16}) best, whereas medium and low impact company reports covered EN16 the best (medium: χ^2_{13}=124.59, p=2.2e^{-16}; low: χ^2_{13}=126.82, p=2.2e^{-16}).

The disclosure quality of high environmental impact company reports improved by 8% and that of low environmental impact company reports by 4% between 2008 and 2011 (Figure 4). During the same period, the disclosure quality of medium environmental impact company reports improved by only 1%. Environmental disclosure quality only increased faintly after 2011 for companies of the medium (3%) and low impact (1%) groups, whereas no improvement in the disclosure quality between 2011 and 2013 was present in the high impact group.

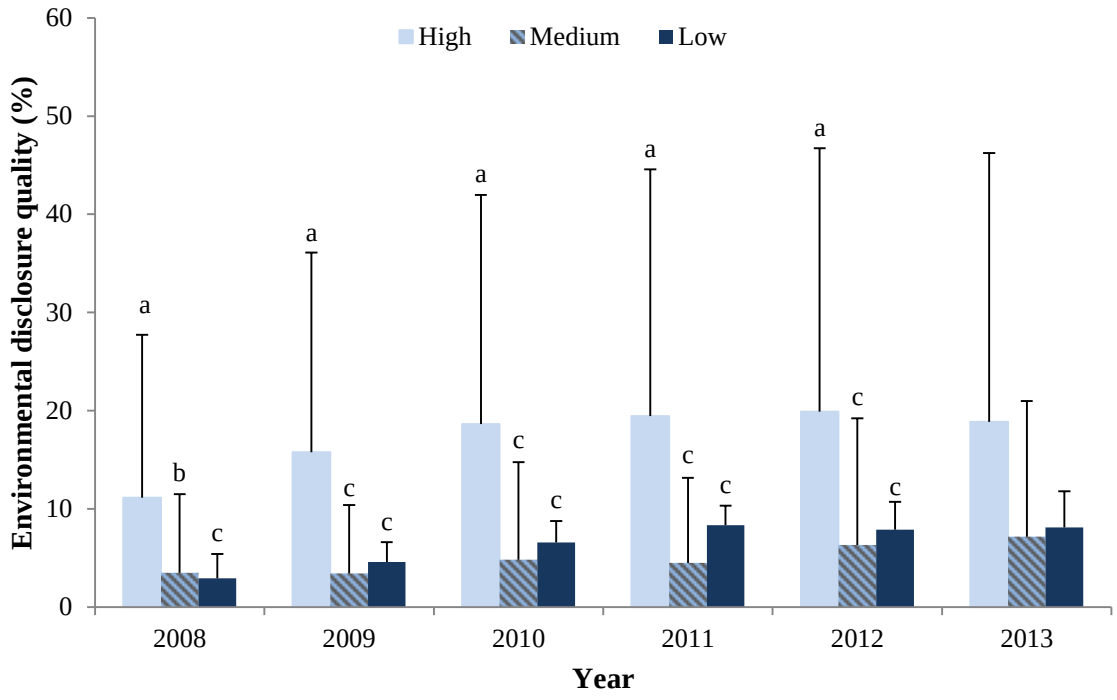

Fig. 4 Average environmental disclosure performance (+CI) of high, medium and low impact companies between 2008 and 2013. a = different to all others, b = equal, c = smaller than everything else, where significant differences in the Waldχ^2 were found

4 Discussion

4.1 Environmental disclosure quality

Although 98% of South African listed companies disclose corporate sustainability information in annual, integrated and sustainability reports (KPMG 2013), environmental disclosure quality analyses of companies representing six economic groups and 22 sectors between 2008 and 2013 showed that most GRI environmental indicators were poorly addressed. Numerous studies globally support these findings. Alazzani and Wan-Hussin (2013) for example reported a lack of disclosure quality and indicator coverage in their analyses of oil and gas companies in Yemen and

substandard reporting quality by Belgian listed companies was identified by Bouten *et al.* (2011). Various other sustainability report analyses showed poor environmental disclosures despite a steadily increasing number of reports containing corporate sustainability information (Skouloudis *et al.* 2010; Comyns *et al.* 2013; Barkemeyer *et al.* 2015; Dietsche *et al.* 2017). Also, yearly follow-ups of reported targets were done only by very few companies, confirming research findings by Jose and Lee (2007) and Maubane *et al.* (2014).

Several reasons for poor environmental disclosure quality have been proposed. Firstly, high costs are involved in data collection which could result in the absence of complete datasets (Biddle and Koontz 2014). The alignment of company policy with environmental initiatives is also time intensive. At the same time, much time is also invested in the reporting of company sustainability performance leading to reporting fatigue and limiting the time available for the implementation and management of current and proposed environmental management activities (Kitsikopoulos *et al.*, accepted). Although external factors such as the global financial crisis, the resulting economic slowdown in South Africa and uncertainty as well as energy prices, service delivery protests and high living costs impacting on consumer behaviour were, according to the reports, weighing on companies as outlined in many of the 179 reports, rather increased media attention and stakeholder pressure have repeatedly been shown to actually affect sustainability reporting (Hahn and Kühnen 2013; D'Amico *et al.* 2016). Holistic approaches in the reporting guidelines were also absent, which explained the substandard quality of European sustainability reports (Lozano 2013). During times of increasing uncertainty caused by the ongoing decline of environmental degradation that is progressively weakening the planet's ecological resilience, holistic approaches that enable companies to identify long-term strategies and to anticipate future changes are necessary. Therefore, reports should cover the key environmental aspects that the MEA, Planetary Boundaries Framework and IPCC identified as being of greatest concern and which should be addressed in the business' strategy. This allows for a more accurate economic, social and environmental assessment of a company and communication of sustainability progress to its

stakeholders, thereby achieving the two aims of sustainability reporting. Sustainability management and reporting are also an ongoing process which requires companies to continually test, monitor and re-evaluate targets and systems and redefine their strategies (ESDN 2012; Lozano 2013). Research findings suggest that the first-level assessment (consumption, usage and time frame) approach to environmental impacts provided by the GRI 3.1, the absence of long-term foci and the environment's complex interactions (also with social and economic factors) neither advanced the economic, social and environmental assessment of a company, nor the communication of a company's sustainability progress.

Further, analyses indicated that the economic groups of resources and basic industries performed best in environmental disclosures. These economic groups mainly consist of high impact companies, which showed better disclosure quality compared with medium and low impact companies. Iatridis (2013) conducted research into the environmental reporting performance of Greek companies and identified beverages, chemicals, food producers, forestry and paper and industrial metal and mining to be the best reporters. Except for beverages and food producers, the findings by this research and Iatridis' (2013) concur. Better reporting performance by companies with a greater environmental footprint was also identified by Jose and Lee (2007), who studied environmental reporting by the 200 worldwide largest corporations, and Ramos *et al.* (2013), whose research focused on Portuguese firms' corporate sustainability reporting. Reporting patterns related to SRI requirements in South Africa have previously also shown high impact companies to report most on environmental issues (Maubane *et al.* 2014). Greater public pressure, media coverage, stricter listing requirements and legislation, which companies with a more significant economic, social and environmental impact are subjected to, have had a positive influence on the quality of disclosing environmental information (Cho *et al.* 2012; Hörisch *et al.* 2015). This also suggests that increased pressure by, for example, Stock Exchanges and legislators needs to be exerted on medium and low impact companies to increase their environmental reporting standards. A statement by the sustainability manager of one of the medium impact companies from the retail sector,

when asked as to why medium impact companies are such poor performers compared with the other two impact groups, mentioned that a much greater focus is put on social issues due to the nature of their business, and much better disclosure quality is achieved in that field, whereas environmental performance is considered of less importance (Kitsikopoulos *et al.*, accepted). In that sense, irrespective of a company's environmental impact level (H/M/L), environmental risks will affect all companies alike, thus the level of importance of environmental performance should urgently be increased.

Environmental disclosure quality improved only marginally until 2010, levelling out in 2011. Only company reports of the resources group showed a moderate improvement until 2013. During the six years of environmental reporting, an initial increase in reporting efforts was evident. However, this was often reduced, discontinued or indicators were disclosed during alternate years and contributed to the high variability in environmental reporting quality. Very few company reports maintained consistency throughout the six-year period. This confirms the legitimacy theory which suggests that companies initially increase their efforts of accurate reporting, but make no further efforts to disclose more information once credence from stakeholders has been obtained (Comyns *et al.* 2013) and disclosure quality may even decline (Comyns *et al.* 2013; Kolk 2003). Hence, no improvement in environmental disclosure is expected over a longer time frame (Comyns *et al.* 2013). This was found to be more prevalent in developing economies (de Villiers and van Staden 2006). Also de Villiers and van Staden (2006) provided evidence to support legitimacy theory in their analysis of 140 annual integrated reports of South African companies over a nine-year period with a focus on mining and industrial companies.

4.2 Reporting of key environmental impacts

The environmental indicators covered most often by the various economic and environmental impact groups' reports belong to the aspects energy (EN 3), water (EN 8), and emissions, effluents, and waste (EN16 and EN22) and address only few of the

current most important environmental issues in South Africa (see Pegels 2010; WWDP 2012). Also, they cover few of the key environmental indicators listed in the MEA, Planetary Boundaries Framework and IPCC that were identified as crucial from an ecological point in successfully reducing current environmental degradation levels. Although these indicators were covered most often in comparison to the remaining 26 indicators, it should be noted that energy and water issues were addressed in only 50% of all 179 annual reports examined. As the business risks of pressing issues such as water shortages related to climate change increasing (Pegels 2010; Niang *et al.* 2014; Liphadzi and Vermaak 2017; Mueller *et al.* 2015), it was expected that more companies would have addressed these in their annual integrated and sustainability reports. It was also expected that the reporting frequency of these four indicators would steadily increase between 2008 and 2013, which was not the case. This may also be related to legitimacy theory as discussed in the previous section.

The greater and better coverage of energy, water, GHG emissions and waste aspects may not only be due to the significant economic risks they present to companies, but because data are most accessible for these indicators or best portray the company aims (Barkemeyer *et al.* 2015). Greek companies were also found to report mostly on energy (EN3) and carbon emissions (EN18; Skouloudis *et al.* 2009), and focused mainly on initiative development instead of reduction targets. Barkemeyer *et al.* (2015) discovered that indicator coverage was relatively consistent between continents and did not show country-level preferences. This provides evidence that the use of the GRI guidelines results in very comparable but too static and uniform reports and that indicator consideration is certainly not based on materiality (Barkemeyer *et al.* 2015). The GRI guidelines may be in line with financial reporting and are a suitable tool to be integrated into existing structures, yet they do not reflect the needs of sustainability management which requires a proactive, long-term and interconnected approach (Benson and Garmestani 2011) which may add to the predicament of poor environmental reporting quality. Although the new G4 (GRI 2013) reporting guidelines include the reporting of risks and opportunities, they

still define the report as one that "conveys disclosures on an organization's impacts – be they positive or negative – on the environment, society and the economy." (GRI 2013, p. 3). This would enable companies to use this information to understand and manage their strategy and activities (GRI 2013). A risk to companies resulting from impacts on and changes to natural capital is not covered. Since this study was completed, the G4 guidelines have been superseded by the GRI Standards. These will only be applicable to reports published on or after 1 July 2018 (GRI 2016). These include instructions to companies to report on the links between economic, environmental and/or social issues and the company's long-term strategy, potential risks, opportunities and goals (GRI 2016). The overall aim of the GRI Standards though is still defined "to be used by organizations to report about their impacts on the economy, the environment, and/or society." (GRI 2016, p. 3). Future research could identify whether this change in reporting requirements will positively impact on sustainability reporting and management. Concerning is also the finding that only 35% of all company reports addressed the GRI *core* environmental indicators. These cover the most important variables according to the MEA, Planetary Boundaries Framework and IPCC needing business attention to manage, for example, the effects of climate change. In order for businesses to be able to manage these effects, such important indicators in company management and in reports need to be taken more seriously.

Research conducted by the Internal Auditors of South Africa (IASA 2014) between 2012 and 2013 may provide further explanations for the disregard of key environmental indicators in annual integrated and sustainability reports. Their research highlighted that the Information Communication Technology (ICT) at companies was not well aligned with the performance and sustainability objectives of these organisations. It therefore becomes very difficult to implement sustainability objectives when communication between departments is absent. The report also revealed that climate change, one of the most pressing environmental issues, was neither listed as one of companies' top five emerging nor top five governance risks. This shows that, although climate change results in more intense droughts and

impacts on water availability, human health, food production and infrastructure (Burkett *et al.* 2014; Cisneros *et al.* 2014), companies have still not realised the risks it poses to their businesses in the short- and long-term. Although this requires urgent attention and board level, key environmental indicators have not been given the necessary attention.

5 Conclusion

As already reported for many other countries and continents (Skouloudis *et al.* 2010; Bouten *et al.* 2011; Alazzani and Wan-Hussin 2013; Comyns *et al.* 2013; Barkemeyer *et al.* 2015; Dietsche *et al.* 2017), environmental disclosure quality of South African JSE-listed companies was also found to be average to poor. The GRI 3.1 guidelines apply a regressive, short-term focus without taking the deep interconnection of social, environmental and economic aspects into account. The new G4 guidelines do neither take risks to businesses into account nor do they apply a holistic view on environmental performance indicators. As current and future environmental challenges are becoming more prevalent and are increasingly posing risks to businesses, the disclosure of key environmental indicators needs urgent improvement.

CHAPTER 3

Limited progress in sustainable development: Factors influencing the environmental management and reporting of South African JSE-listed companies[2]

ABSTRACT

Although public, governmental, international and stakeholder pressure have led to corporations conforming to better sustainability performance, there has been an insignificant reduction in environmental degradation levels and progress in sustainable development is limited. This study examines which factors influence environmental management and reporting in South Africa that could potentially contribute to this limited progress. The study was based on a series of interviews with sustainability managers of JSE-listed firms. Results suggest that stock exchange listing requirements, internal processes and structures, experienced staff and the sustainability committee positively influence environmental and overall corporate sustainability, yet that resource and time constraints, as well as reporting fatigue, potentially limit the advancement of sustainable development. This restricts the further reduction of environmental degradation which is urgently necessary in light of the harmful impacts for example climate change has on the environment, societies and economies.

Keywords: Stakeholder pressure; environmental degradation; progress in sustainable development; environmental management; JSE

[2] *Kitsikopoulos, C., Dr U. Schwaibold, and D. Taylor. Limited progress in sustainable development: Factors influencing the environmental management and reporting of South African JSE-listed companies. Business Strategy and the Environment: accepted.

Introduction

Continuous environmental degradation has led to increased public, stakeholder, governmental, and international pressure on corporations to conform to better sustainability performance (Epstein, 2008) and to improve accountability for their social and environmental impact (Charlo et al., 2013). Corporate attention to sustainable development has grown internationally (Du et al., 2013; Mårtensson and Westerberg, 2016; Jizi, 2017). Sustainable development is of vital importance considering the harmful impacts climate change has on societies, economies and the environment (IPCC, 2014a; Mårtensson and Westerberg, 2016). Various international organisations such as the Global Reporting Initiative (GRI), the International Organization for Standardization (ISO) and the International Integrated Reporting Framework (IIRC) provide guidelines and frameworks to assist corporations in their stakeholder communication relating to non-financial performance. Sustainable Stock Exchanges (SSEs) such as the New York Stock Exchange (NYSE), Shanghai Stock Exchange (SSE) and the Johannesburg Stock Exchange (JSE) have aided in establishing environmental indices, listing rules and financial systems that reflect company sustainability (SSE Secretariat, 2017).

Despite the advances in corporate environmental management practices and a steady increase in corporate non-financial reporting globally (Editorial, 2009; KPMG, 2013), progress in sustainable development and the reduction of environmental degradation levels is limited (Skouloudis et al., 2010; Baumgartner, 2011; Bouten et al., 2011; Jabbour et al., 2012; UN, 2012; Alazzani and Wan-Hussin, 2013; Comyns et al., 2013). One factor influencing this has been related to corporate sustainability management and disclosures becoming merely a modification of business-as-usual (BAU; Mårtensson and Westerberg, 2016; Jizi, 2017). Further, regulatory and stakeholder pressures, competitive advantages as well as external standards and legitimacy have driven environmental management instead of sustainable development as a central company value (Jose and Lee, 2007; Paulraj, 2009; Ramos et al., 2013; Deegan, 2014; Lokuwaduge and Heenetigala, 2017). External pressures

can only effectively lead to a transformation of company processes towards more sustainable business practices if internal structures and processes have integrated sustainability into the business strategy and management plans (Baumgartner and Rauter, 2017; Sullivan and Gouldson, 2017). Yet it was reported that sound environmental management systems, practices and frameworks to track impacts are either absent (Skouloudis et al., 2010; Jabbour et al., 2012; Ramos et al., 2013; Maubane et al., 2014), not well developed or not well implemented (Searcy, 2016). Too little focus was given to actual improvements (Brammer and Pavelin, 2006; Skouloudis et al., 2010).

In South Africa, a country that is at present experiencing severe environmental challenges such as water scarcity and increasing temperature anomalies as well as changing frequencies and intensities of severe weather events (Christensen et al., 2013; Cubasch et al., 2013; Kirtman et al., 2013; Burkett et al., 2014; Cisneros et al., 2014), sustainable development was positively influenced by the Johannesburg Stock Exchange (JSE) and the King Codes on Corporate Governance (King I, II, III and IV; Malherbe and Segal, 2001; JSE Limited, 2010). King II brought the sustainability concept into a business context, encouraging companies to practice environmental responsibility and support a "precautionary approach to environmental challenges" (IoDSA, 2002, page 93). King III focused on integrated sustainability reporting, as discussed in Section 9 of the code (IoDSA, 2009). King IV, released in 2016 and effective as of 1 April 2017, makes reference to integration without a strong emphasis on environmental reporting (IoDSA, 2016), and positioning sustainable development as one of the fundamental concepts of the report. Despite this initial drive, recently many corporate targets were found to lack ambition, to be short-term and operationally rather than strategically focused (CDP, 2016a). Environmental impact and risk reporting were also found to be static (CDP, 2016b; Kitsikopoulos et al., unpublished). Considering this development and that no considerable reduction in environmental degradation levels has been achieved (IPCC, 2014a), it is necessary to understand the factors potentially limiting sustainable development progress. Specifically, this study aimed to identify the factors that

influence the environmental management and reporting at South African companies based on a series of interviews with sustainability managers of JSE-listed firms. This study contributes to the existing discussions on aspects impacting corporate environmental management and reporting, but also provides evidence to develop a better understanding of this issue in a South African context.

Methods

To investigate the factors affecting environmental management and the reporting thereof, a representative sample of 30 JSE-listed companies was selected for interview. Companies belonged to six economic groups (resources: 5; basic industries: 4; non-cyclical consumer goods: 5; cyclical services: 5; non-cyclical services: 5; financials: 6; FTSE International Limited, 2002). Greater levels of engagement with sustainability management have been found at large firms, which may be due to the presence of qualified staff, management tools and stakeholder involvement as well as their more significant economic, social and environmental impact (Hörisch et al., 2015). Large listed firms are thus suitable for an analysis of their environmental management and reporting approaches. Accordingly, the selected companies also needed to be part of the JSE Top 100, which are the largest listed firms according to their market capitalisation of 2008.

Each company was contacted to request the details of the relevant staff member dealing with environmental management, which was usually the sustainability manager. Sixteen of the thirty companies contacted agreed to participate in this research. The empirical work for this study was carried out in South Africa (Johannesburg, Pretoria and Durban regions) between May and July 2014. Fourteen interviews were held in person while two interviews were conducted over the telephone. Interviews were carried out with sustainability managers or staff involved in the environmental sustainability work of companies in mining, industrial metals and mining, oil and gas producers (resources), construction and materials,

forestry and paper (basic industries), food producers (non-cyclical consumer goods), general retailers, travel and leisure, industrial transport (cyclical services), mobile telecommunications (non-cyclical services), banks, nonlife insurance, life insurance, financial services, and real estate investment trusts (financials).

The semi-structured interviews were focused on obtaining the manager's or staff member's perspectives on environmental reporting in their organisations. The interview questions focused on the level of importance of environmental issues at the company, the motivation for environmental management and reporting, and the importance of the sustainability committee for corporate environmental management. Because competencies and experiences were found to greatly contribute to the successful implementation and management of environmental strategies (Mårtensson and Westerberg, 2016), the interviewees were asked to outline the criteria used by the company to select new staff for the sustainability department. As both internal communication and the integration of environmental systems in the overall control and structure of the business were reported to positively influence environmental management (Siebenhühner and Arnold, 2007; Mårtensson and Westerberg, 2016), interview questions also covered the following topics based on the King III principles (applicable to companies at the time the research was conducted; IoDSA, 2009): controls present in the company to verify and safeguard the integrity of the integrated annual report (principle 9.1.1); company efforts to ensure substance over form (principle 9.1.5) and the role of the audit committee in overseeing assurance of sustainability issues (principle 9.3.3). While this research was undertaken, King III was applicable to JSE-listed companies. Although it was replaced by King IV, the new principles were only effective on 1 April 2017 (IoDSA 2016). Hence interview questions were based on King III. An opportunity was given to the interviewee to discuss any concerns or issues around environmental sustainability not covered by the interview schedule. [Appendix 3]

Ethics clearance was obtained from the University of the Witwatersrand Human (non-medical) Ethics Research Committee (H13/11/08). The interviews were

transcribed and answers were analysed for commonalities and aggregated into key words, phrases and expressions. Percentages were calculated for levels of consensus.

Results

Eight of the 16 interviewees responded that economic, social and environmental issues are equally important to their company. Only 3 interviewees said that economic issues outweighed environmental and social issues. The remaining responses varied as to which of the three aspects had more weight in their firm. Both the company responsibility/understanding the importance of environmental issues (55%) and JSE listing requirements (27%) were seen as most important in motivating the reporting on environmental issues (Figure 1).

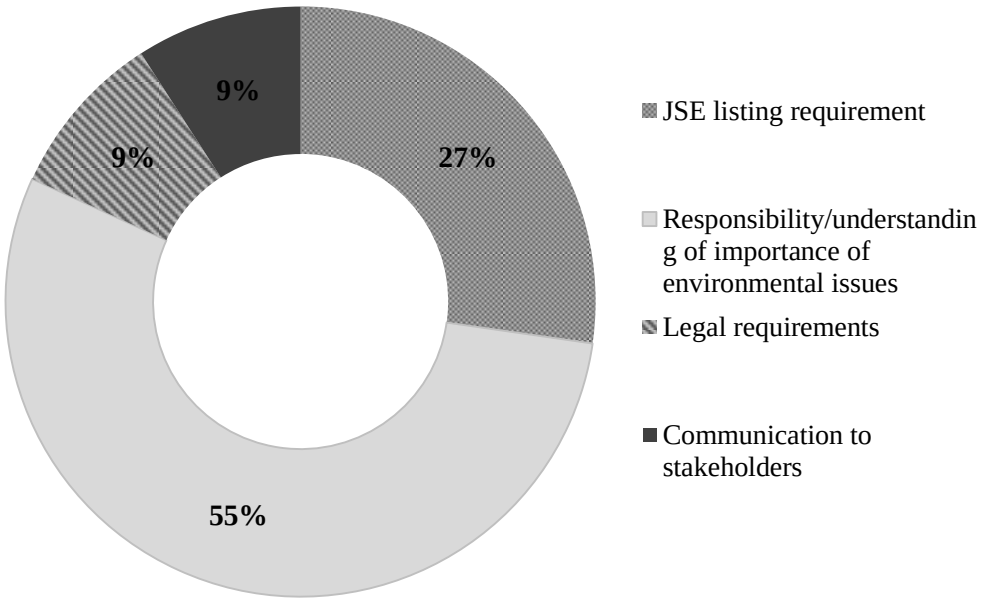

Figure 1. Most common reasons provided for reporting on environmental issues in the company

All participating companies had sustainability committees (or similar committees) in place. This was either in response to the Companies Act (19%), which took effect in 2008, in response to King III (25%), or due to other reasons such as to improve visibility of sustainability, the need for attention at board level, or to maximise efficiency (56%).

The sustainability committee was also seen to improve environmental performance by 15 of the 16 interview participants, as it supports communication to the board, improves company management and awareness, and drives company change. One interviewee suggested that the company itself was the driver of sustainability, not the committee.

When selecting new staff, most companies looked for experience and expertise (52%) as well as a skill mixture (20%). An understanding of the industry and reporting was another criterion mentioned (16%). Only a few companies were concerned with qualification (8%). One company did not have any hiring strategy in place.

Internal assurance was found to be the main control system to verify and safeguard the integrity of integrated reports (46%; King III principle 9.1.1; Figure 2). Interviewees also stated that internal verification processes and sound internal company structures play an important role in the management of environmental issues. Substance over form (King III principle 9.1.5) was achieved in many different ways and no single standard measure could be identified. The strategies applied by companies included data verification (20%), reporting of examples in the annual report (20%), reporting against targets (20%), identification of materiality (16%), making use of various management systems (12%), as well as the use of GRI guidelines, King III principles and/or IIRC guidelines (8%). All 16 companies had an audit committee overseeing the assurance of sustainability issues (King III principle 9.3.3). Strategies mentioned for principle 9.1.5 (substance over form) also serve to reinforce this process.

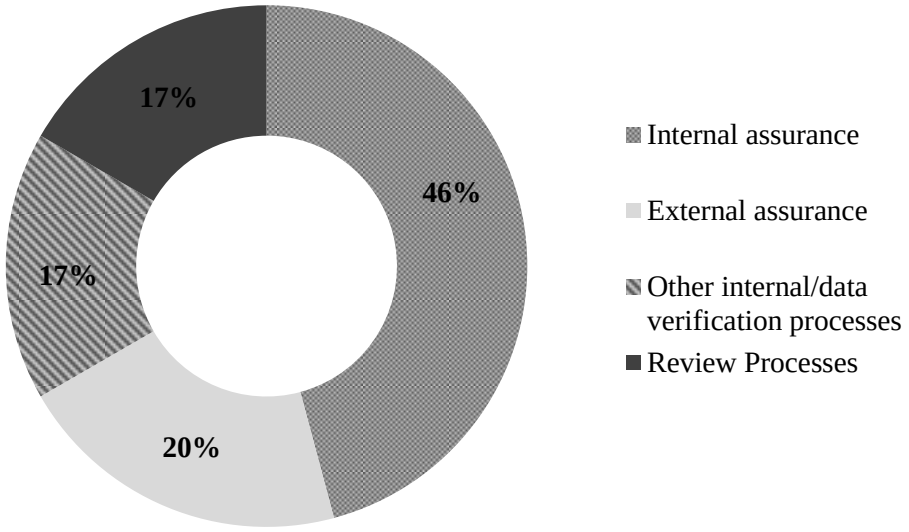

Figure 2. Controls present at companies to verify and safeguard the integrity of the integrated annual report

Being given the opportunity to raise any additional issues, interviewees brought up similar concerns. The following key issues were identified:

(a) difficulties in determining what is material to the business;

(b) companies experience reporting fatigue (reporting on, for example, the GRI, Carbon Disclosure Project (CDP, water and carbon), Greenhouse Gas (GHG) Protocol, United Nations' (UN) Global Compact, ISO 14000, AA1000, and other industry- and or sector-specific reporting tools or certification systems such as the Forest Stewardship Council (FSC)); reporting guidelines available to companies are not necessarily aligned

(c) most companies experience cost and resource constraints for managing data and the reporting thereof.

Discussion

Although most interviewees indicated that economic, social and environmental aspects carried equal weight in their respective companies, it is not clear whether this view was shared across the company, especially at board level. The responses given appeared to be partly dependent on the sector or economic group in which the relevant company operated. Companies within the financial sector, for example, tended to prioritise economic over social and environmental aspects, having the creation of profits for investors as their main goal. Different economic groups and sectors are also exposed to different levels of external pressures (Cho et al., 2012; D'Amico et al., 2016; Mårtensson and Westerberg, 2016). For example, the JSE at the time distinguished between high, medium and low environmental impact companies, depending on which sector they operate in (JSE Limited 2010; Section 13). Companies in the resources group, among others, were required to report on a wider range of sustainability issues and in more detail than a company operating in the financials group (JSE Limited 2010; Section 13).

Until a few years ago, companies globally reported on environmental issues for example to increase their competitive advantage, to conform to regulatory and stakeholder pressures, or to comply with external standards (Paulraj, 2009; Jose and Lee, 2007; Ramos et al., 2013; Deegan, 2014; Lokuwaduge and Heenetigala, 2017). Research findings here indicate that South African companies mainly report on environmental issues in compliance with JSE listing requirements and because it is viewed as a responsibility or companies understand the importance of environmental issues. This confirms that external pressures and standards positively influence corporate environmental reporting, as reported previously, and shows that companies aim to abide by the regulatory norms. The results obtained in this study could further indicate that companies may have developed a greater understanding of their responsibility regarding their impacts on natural resources and management needs. This could be verified with departments other than the sustainability department and at board level and would eliminate the possibility that the outcomes presented here

are related to views shared by sustainability managers only. Other studies identified a lack of reporting by competitors and an absence of interest from stakeholders as possible reasons not to report on environmental issues (Kolk, 2004; Ramos et al., 2013). This concurs with the response given by one interviewee from the financial sector: environmental reporting is held to a minimum as stakeholders have expressed no interest in these matters.

The majority of the companies included in this study have a sustainability committee in place, although the name of the committee may vary among firms. Sustainability committees were identified as playing a vital role in company sustainability management and in communication to both the board and the employees. Such a committee is viewed as necessary in order to include a sustainability approach into the daily operations. Although the King III Code of Corporate Governance does not make mention of such a committee (or similar), it was included *inter alia* in response to the Companies Act of 2008, which prescribes the appointment of a social and ethics committee (Department of Trade and Industry, 2008). Other research has shown that the presence of a sustainability committee as well as a Chief Sustainability Officer positively affects the disclosure of greenhouse gas (GHG) emissions (Peters and Romi, 2014). The environmental sustainability function fell within the social and ethics committee in 80% of companies. This differs with results obtained by Jose and Lee (2007), which showed that only 30% of the Fortune's Global 200 companies had separate environmental committees in place and 18% were part of the health and safety unit. This may be a result of significant social issues affecting South Africa, which take priority in sustainability management (IRMSA, 2015).

Most corporations value competency and experience when selecting new staff to assist with company environmental sustainability. This is in accordance with findings by Mårtensson and Westerberg (2016). Competent and experienced staff are an important factor that can positively influence environmental management and the reporting.

The three King III principles (controls present to verify and safeguard the integrity of the integrated annual report; ensuring substance over form; assurance of sustainability issues by the audit committee) included in this study give some insight into the internal company systems. As they are listed in Section 9 of the Code, it would be important to the reporting and disclosure of company sustainability matters. Interviews revealed that most companies opted for internal verification systems in order to safeguard the integrity of the annual integrated report. Eighty percent of companies included other internal processes and review systems into internal auditing systems. Similarly, interviewees were of the opinion that, in order to manage sustainability issues successfully, a sound internal assurance system is required. This was in response to inquiring about the application of King III principle 9.3.3 (oversight of the audit committee over the provision of assurance of sustainability issues), which was evident at all companies. It was proposed during the interviews that a company should have a well-functioning and effective internal audit system, as this would indicate a good level of understanding within and between company departments in addition to a well-aligned business strategy. Research supports the notion that well-functioning and well-aligned internal processes and structures and company management systems to run a more sustainable business, and positively influence environmental management are very important (Siebenhühner and Arnold, 2007; Songini and Pistoni, 2012; Romolini et al., 2014; Mårtensson and Westerberg, 2016; Sullivan and Gouldson, 2017). Although, according to the interviewees, the King III principles were followed, the quality of internal verification systems and their level of implementation were not verified here. Future research should assess this quality at South African listed companies. King III further refers to "substance over form" as a principle (IoDSA 2009), but leaves it open as to how this can be achieved. The principles do not provide any guidance in this matter. This is reflected in the different strategies employed by the companies. Reporting on data and initiatives seemed to be the main strategy, but there was no clear indication as to how this issue was addressed and achieved.

Another aspect raised was the importance of materiality in the management of environmental issues. It is essential to correctly identify which issues are core to the business strategy and values and not to allow, for example, the GRI guidelines to define a business. A lack of materiality understanding would in turn mean that the business could firstly encounter difficulties understanding how environmental issues affect the business (Barkemeyer et al. 2014). Secondly, the GRI guidelines might be used as a tick-box-system (de Colle et al. 2013), potentially affecting sustainability reporting quality as well as the sustainability management. According to most interviewees, it was necessary to have made mistakes in sustainability management over the past years as these errors provided the opportunity to better understand materiality and slowly progress in this field. Sustainability management and reporting is a journey with constant adjustments to improve the relationship with stakeholders and contribute to sustainable economic growth (Lozano, 2013). This view was also shared by interviewees who participated in this study. Despite this learning curve, annual report analyses (Kitsikopoulos et al., unpublished) indicate that the reporting of key environmental indicators showed no further improvement after 2011.

Reporting fatigue, resource and time constraints were two aspects pointed out during interviews which negatively impact on corporate environmental management and reporting. A large number of reporting initiatives and guidelines, such as the GRI, the CDP, the CDP Water Disclosure, and the International Organization for Standardization (ISO), are applied by companies. Firms spend a significant amount of time on reporting for both compliance (e.g. legal and listing requirements) and voluntary purposes (e.g. sector competition). The measures these frameworks provide do not always allow for easy comparison between companies within or between sectors (Lokuwaduge and Heenetigala, 2017). In addition, aside from the financial year end reporting deadline, the various reporting initiatives and guidelines have their submission dates at different times of the year and are not necessarily aligned in their information or data requirements. Very little time is therefore left for the implementation and management of sustainability initiatives. The clear message sent by interviewees was that reporting is not what sustainability should be about. Cost

and resource constraints only add to this problem. An increased need for resources and time for all aspects of environmental management and as well as reporting fatigue were also identified by Brown *et al*. (2009) and Lozano (2013). More than a decade ago research already showed that CEO expectations were not in line with what the sustainability team felt they could achieve: adequate resources and time constraints would impact on the quality of the report and how much information could be disclosed (Adams and McNicholas, 2007). This internal company issue has not yet been resolved.

Irrelevant of whether factors such as adhering to regulatory norms, an understanding of the importance of environmental issues, experienced staff, a sustainability committee and well-aligned internal processes and structures positively influence environmental management, its reporting and overall corporate sustainability. If the staff managing environmental sustainability do not have the necessary resources, time and are fatigued, environmental management can only be improved to a certain point. This means that progress in environmental management and reporting would ultimately reach a plateau, and annual integrated and sustainability report analyses have shown that the quality of reporting has not improved since 2011 (CDP, 2013; Kitsikopoulos et al., unpublished). It is proposed that by alleviating the reporting fatigue, resource and time constraints company staff experience when managing and reporting on environmental sustainability further progress in corporate sustainable development can be realised.

Conclusion

Although corporate environmental management practices have improved and corporate non-financial reporting has increased globally (Editorial, 2009; KPMG, 2013), sustainable development progress was found to be limited (Skouloudis et al., 2010; Baumgartner, 2011; Bouten et al., 2011; Jabbour et al., 2012; UN, 2012; Alazzani and Wan-Hussin, 2013; Comyns et al., 2013). Research findings indicate

that although factors such as regulatory norms, an understanding of the importance of environmental issues, experienced staff, a sustainability committee and well-aligned internal processes and structures positively impact the management of company environmental sustainability, reporting fatigue, resource and time constraints potentially limit further progress. These aspects negatively impact on the quality of sustainability management and its reporting quality and, therefore, the extent to which corporate natural resource use can be managed. Yet further progress in sustainable development is urgently needed considering the harmful impacts climate change has on societies, economies and the environment due to the continuing natural resource degradation.

Chapter 4

Investigating the link between environmental disclosure quality and financial performance of South African JSE-listed companies

Abstract

Many studies have investigated the link between environmental and financial performance, although the debate in an African context is scarce. A clear economic benefit related to environmental initiatives is necessary, else companies would have no motivation to engage in long-term environmental management. This research examines the relationship between environmental disclosure quality and financial performance, measured by return on capital employed (ROCE), return on total assets (ROTA), price-earnings ratio (P:E) and return on sales (ROS). Using a sample of 30 of the Top 100 South African Johannesburg Stock Exchange (JSE)-listed companies covering the period 2008 to 2013, and employing Spearman Rank Correlation tests, no correlation between environmental disclosure quality and ROCE, ROTA and P:E was found. A slight negative relationship between environmental disclosure quality and ROS was present. Factors such as accounting systems not capturing environmental expenditures and benefits, the widely experienced environmental reporting fatigue, but also the type of environmental management performance measures influence the type of correlation between environmental and financial performance. It is suggested that in order to establish clear links between environmental and financial performance that, in addition to the implementation of more holistic and inclusive internal accounting systems, a more robust qualitative measure of environmental performance is applied that captures the characteristics of the various environmental issues.

Keywords Financial performance · environmental management · environmental reporting quality · ROCE · ROTA · P:E · ROS · JSE-listed companies

4.1 Introduction

Due to the increasing number of environmental concerns since the Kyoto Protocol was adopted in 1997 (Jones 2010) and the growing demand for their inclusion in corporate management (Sneddon *et al.* 2006; Martínez-Ferrero and Frías-Aceituno 2015; Lee *et al.* 2016), industry-related environmental performance has been featuring in annual integrated and sustainability reports for many years. In South Africa, many Johannesburg Stock Exchange (JSE)-listed companies have reported on environmental impacts since 2000, especially since initiatives such as the King Code of Corporate Governance (King I-IV), the Socially Responsible Investment (SRI) Index and the Global Reporting Initiative (GRI) have driven environmental disclosures.

Corporate sustainability and reporting have been linked to increased competitive advantages, reputation and stakeholder satisfaction (Cerin 2002; Epstein 2008; Yadav *et al.* 2016) and have become a key driver for companies when engaging with social demands (Porter and Kramer 2006). A reduction in operating costs can also be derived from more efficient processes as well as the reduction of fines (Epstein 2008). Yet providing a clear link between environmental and financial performance has been rather difficult and research findings of various studies have been inconclusive. Some studies could identify a positive relationship between environmental and financial performance (Raiborn *et al.* 2011; Iatridis 2013; Endrikat *et al.* 2014; Lee *et al.* 2016; Gonenc and Scholtens 2017; Song *et al.* 2017), while others reported a negative relationship or no relationship at all (Hassel *et al.* 2005; Pintea *et al.* 2014; Qui *et al.* 2016; Santis *et al.* 2016). Measuring corporate responsibility has been rather difficult and thus providing clear links between

environmental and financial performance as well. For example, the ongoing predominance of short-term objectives (Iatridis 2013) and the absence of disclosing environmental costs and benefits in financial statements, reports or accounting systems have been factors related to the absence of a positive environmental-financial performance link (Raiborn *et al.* 2011). Because environmental sustainability involves long-term approaches, environmental initiatives and strategies may take longer to translate into measurable profits (Horváthová 2012; Qui *et al.* 2016). Further, while financial data is generated by standardised systems, the opposite applies to environmental performance indicators (Horváthová 2012; Lucas and Noordewier 2016). It was argued by Song *et al.* (2017) that, if no clear economic benefit can be related to environmental initiatives, companies would have no motivation to engage in long-term environmental management.

Most research conducted in this field to date has focused on industrialised countries, with literature for developing countries being scarce (Pintea *et al.* 2014). This study aimed to add to the discussion in an African context. Foreign direct investment is made into resource-rich African countries such as South Africa to extract raw materials for the global market (Asiedu 2006). Also taking past and current strains on natural resources due to overexploitation and climate change into account (Millennium Ecosystem Assessment 2005a; Millennium Ecosystem Assessment 2005c; UNEP 2016a) this suggests that natural resources and their extraction would play an important role in the South African economy and society. Companies either transform raw materials into economic products or base their business on the use of such economic products and publicise their environmental performance through annual reporting (Fernandez-Feijoo *et al.* 2014). Based on environmental information provided between 2008 and 2013 in annual, integrated and sustainability reports, analysed in Kitsikopoulos *et al.* (submitted), this study examined the relationship between environmental disclosure quality and financial performance, measured as ROCE, ROTA, P:E and ROS, of 30 of the Top 100 JSE-listed corporations.

4.2 Methods

The environmental disclosure quality scores for each of the 30 of the Top 100 JSE-listed companies and each year (2008 to 2013; from Kitsikopoulos *et al.*, submitted) were used to compare these to financial indicators (see below). This was done to identify whether companies that provide comprehensive disclosures on environmental issues also perform better financially. The disclosure quality analysis was based on content analysis of annual, integrated and sustainability reports (Kitsikopoulos *et al.*, submitted). The report analyses focused on the 17 core environmental indicators of the GRI Version 3.1, which were applicable at the time the research was conducted. The GRI indicators address the base content of corporate social responsibility reporting (Bouten *et al.* 2011) in form of consumption, usage and time frame of environmental variables.

The data for the dependent financial variables were extracted from the Standard Bank online share trading portfolio. The data were extracted from the Standard Bank online share trading portfolio. Accounting-based indicators were used for the analyses as they provide internal, such as company management performance and decision-making competencies (Orlitzky *et al.* 2003), rather than external (shareholder) reflections. They therefore provide a good understanding how well the company is functioning internally. As return on equity (ROE) and return on assets (ROA) data, as suggested by Santis *et al.* (2016), were not available for the selected companies for all six years, four alternative accounting profitability ratios were used: (1) return on capital employed (ROCE), calculated by taking earnings before interest and tax (EBIT) and divided by capital employed; (2) return on total assets (ROTA), dividing EBIT by total net assets; (3) price-earnings ratio (P:E), which is calculated by taking the market value per share and dividing it by the earnings per share (EPS); and (4) return on sales (ROS), determined through dividing the net income by sales revenue.

Spearman Rank Correlation tests were conducted to determine a possible relationship between environmental reporting quality and the four financial performance indicators between 2008 and 2013. Statistica 10 (Statsoft 2010) was used for all statistical tests. Significance levels were set at 0.05.

4.3 Results

The Spearman Rank Correlation tests identified no significant link between environmental disclosure quality and any of the three financial indicators ROCE (r= -0.06, p=0.43; Figure 1), ROTA (r=-0.10, p=0.17; Figure 2) and P:E (r = -0.02, p = 0.79; Figure 3) from 2008 to 2013. The data however suggest that many of the companies poorly disclosing environmental issues show higher ROCE. A similar pattern was evident for ROTA, whereas companies generally had low P:E ratios between 2008 and 2013, regardless of their environmental disclosure quality. A slight negative correlation between environmental disclosure quality and ROS was found (r = -0.26, p = 0.0004; Figure 4). Regardless of environmental disclosure quality, most companies reported an ROS of below 40%.

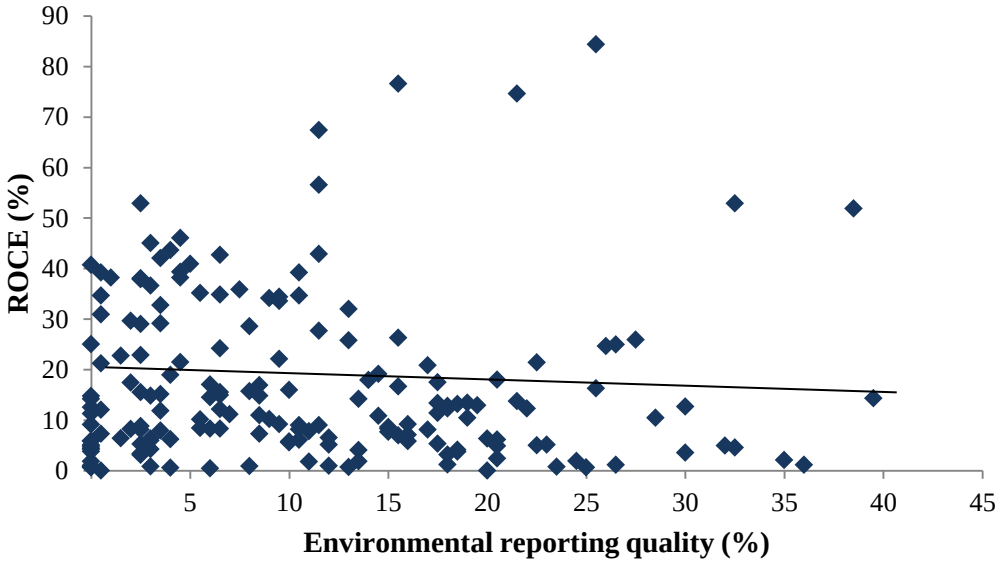

FIGURE 1. Relationship between environmental disclosure quality and return on capital employed from 2008 to 2013 (ROCE; +regression line).

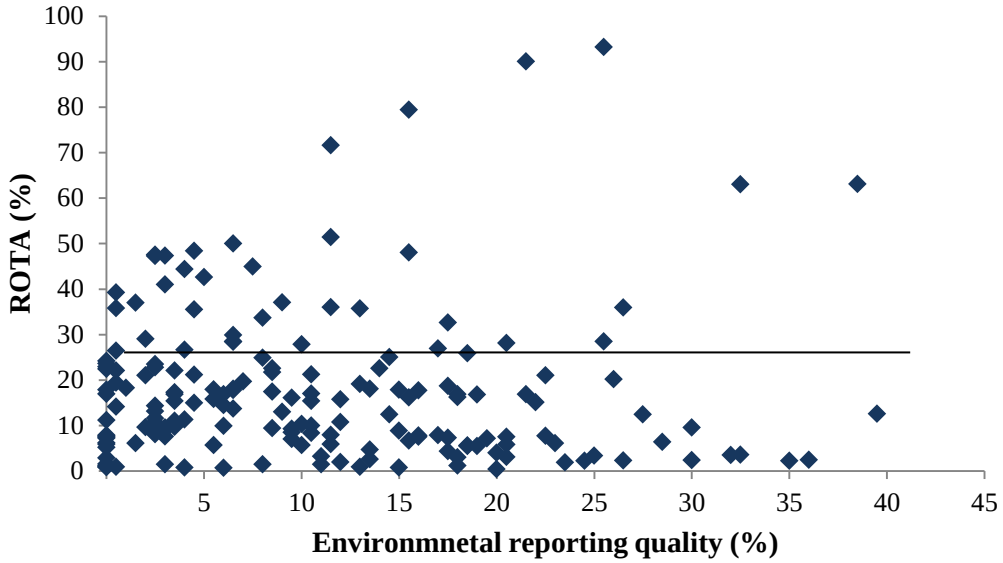

FIGURE 2. Relationship between environmental disclosure quality and return on total assets from 2008 to 2013 (ROTA; +regression line).

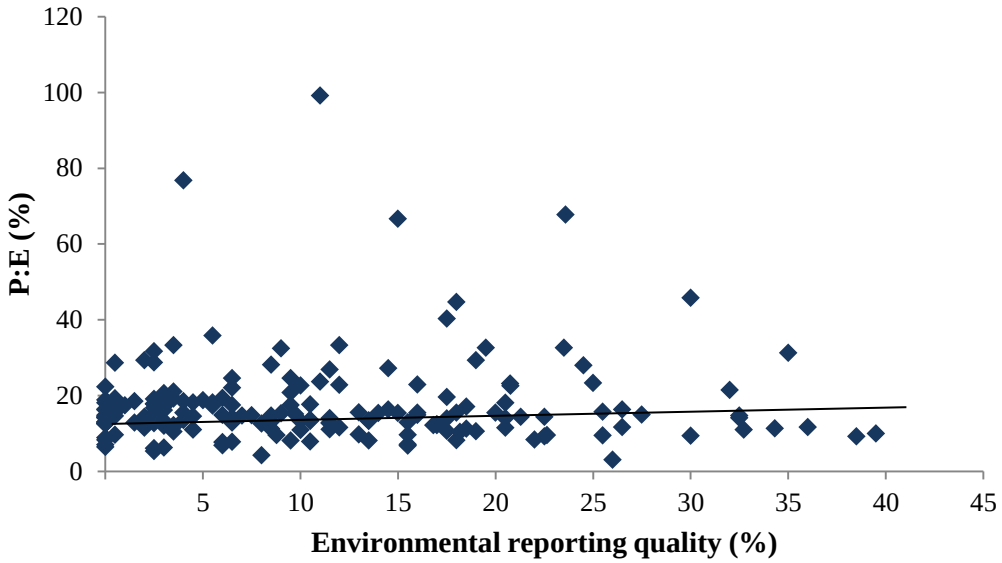

FIGURE 3. Relationship between environmental disclosure quality and price earnings ratio from 2008 to 2013 (P:E; +regression line).

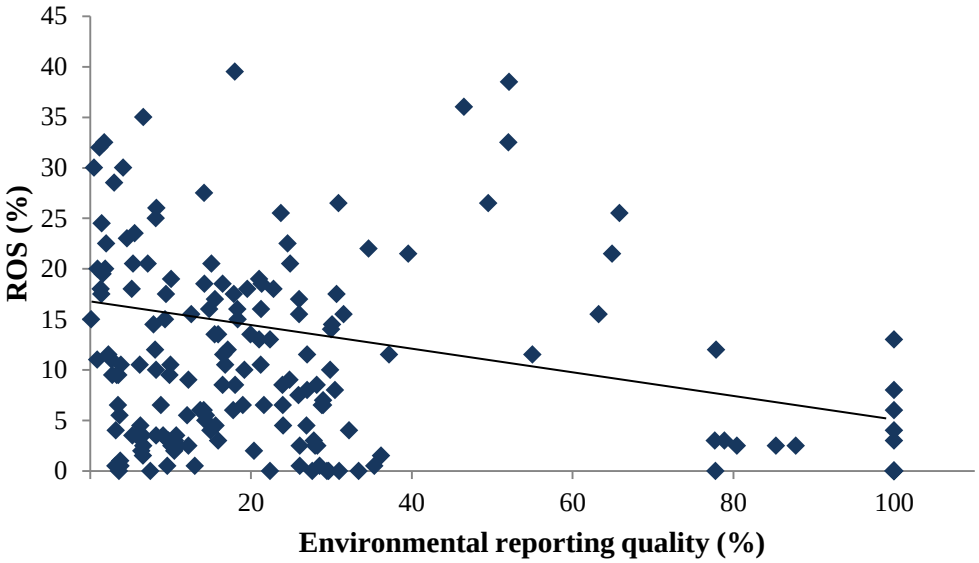

FIGURE 4. Relationship between environmental disclosure quality and return on sales from 2008 to 2013 (ROS; +regression line).

4.4 Discussion

In the past many researchers have debated the statistical links between environmental reporting and financial performance, mostly in developed countries, while literature concerning this issue in South Africa is scarce (Pintea *et al.* 2014). Research findings have also provided conflicting evidence (see Hassel *et al.* 2005; Raiborn *et al.* 2011; Iatridis 2013; Endrikat *et al.* 2014; Pintea *et al.* 2014; Lee *et al.* 2016; Qui *et al.* 2016; Santis *et al.* 2016; Gonenc and Scholtens 2017; Song *et al.* 2017).

The three financial indicators ROCE, ROTA and P:E neither showed a significant positive nor significant negative link to environmental reporting performance. Environmental reporting quality could only be minimally related to ROS. With increasing environmental reporting quality a company's ROS – the company's profitability – decreases. This also supports various past study findings in this field (Iatridis 2013; Pintea *et al.* 2014; Qui *et al.* 2016; Santis *et al.* 2016). A number of

reasons were proposed for an absent and negative relationship between the environmental and financial variables. Firstly, current accounting systems do not capture the consequences of a company's environmental impacts (Jones 2010). It was further suggested that merging costs incurred from environmental impacts with other company costs prevents long-term environmental risk identification (Raiborn *et al.* 2011; Iatridis 2013). Traditional accounting systems do not fully disclose expenditures and benefits linked to environmental management practices, therefore financial statements are not reflective of the link between environmental performance and financial profitability (Raiborn *et al.* 2011). Furthermore, because environmental sustainability management requires a long-term approach, it can in turn affect the capital structure of companies and therefore also lead to the absence of evidence for a positive relationship between environmental reporting quality and financial profitability (Santis *et al.* 2016; Song *et al*. 2017). The investor focus has also been shown to influence environmental disclosure performance as investors tend to place greater emphasis on social performance (Qui *et al*. 2016). The lack of correlation between environmental disclosure quality and financials was further attributed to the fact that the relationship is dependent on the type of disclosure (Qui *et al.* 2016).

The environmental reporting quality of South African JSE-listed companies between 2008 and 2013 was generally average to poor with few companies reporting well on the various impacts such as direct energy consumption, water consumption and total direct and indirect greenhouse gas emissions (Kitsikopoulos *et al.*, submitted). Although the annual, integrated and sustainability reports are meant to detail the economic, social and environmental assessment of a company and communicate the firm's sustainability progress (Lozano 2013), the reporting may not always fully represent a company's actual behaviour. In addition, the sustainability teams were found to experience extreme reporting fatigue as well as resource and financial constraints to manage and report on environmental issues (Kitsikopoulos *et al.* accepted). This could have affected the quality and extent of the disclosure, regardless of the company's financial position and thus the correlation results.

In order to improve the statistical links between environmental and financial performance, the literature has suggested the following strategies: (1) managers should focus more on forecasted opportunity costs rather than actual costs from regulatory compliance (Al-Tuwaijri *et al.* 2004); (2) the accounting system should be changed to a more holistic one that takes account of corporate environmental impacts (Jones 2010); (3) an environmental cost report should be introduced (Raiborn *et al.* 2011); (4) implement a clear business strategy, which has been shown to greatly influence a firm's market value (Yadav *et al.* 2016). These could be useful tools for companies to link environmental and financial performance more clearly, and could thus further assist companies in tracing which environmental management strategies are viable in the roadmap to a more sustainably run business, and which are not.

It was also suggested that, because a consensus about standardised performance measures to relate environmental management performance to financial performance is not present (Lucas and Noordewier. 2016), emphasis should be placed on finding a more robust qualitative measure of environmental performance (Horváthová 2010; Horváthová 2012). This measure should capture the characteristics of the various environmental issues as well as of the company, as the relationship between environmental and financial performance was found to be dependent on the firms' environmental impact, proactiveness and type of practices (Chen *et al.* 2016; Lucas and Noordewier 2016). This can assist in identifying the management practices that truly translate into significant financial returns, also taking the operating environment into account (Lucas and Noordewier 2016). Improved resource preservation, the mitigation of subsequent regulatory costs and improved efficiency of company processes can emanate from this (Lucas and Noordewier 2016). This is especially important considering the suggested significant role of natural resources in the South African economy and the strain put on them due to continuous environmental degradation and climate change (Millennium Ecosystem Assessment 2005a; Millennium Ecosystem Assessment 2005c; UNEP 2016a).

4.5 Conclusion

This study highlighted the relationship between environmental reporting quality and financial performance in the context of South African JSE-listed firms. Although many authors have investigated the link between environmental and financial performance, few studies have examined this relationship in an African context (Pintea *et al.* 2014). The absence of a correlation between environmental reporting quality and the accounting profitability ratios ROCE, ROTA and P:E, and the slightly negative correlation between environmental reporting quality and ROS may be related to a variety of factors proposed in this and other research. More than developing and implementing holistic, inclusive internal accounting systems that trace and reflect the financial impact of chosen environmental sustainability strategies, finding a more robust qualitative measure of environmental performance should be focused on. This would allow establishing a clearer link between environmental and financial performance, and the environmental management strategies most viable for enhancing sustainable financial performance can be identified. The reduction of a company's impact on natural resource degradation can then be managed more effectively and strains on current levels of natural resource degradation be reduced.

Chapter 5

Strategic environmental risks and systems approaches in annual reports and corporate management practices

Abstract

Human-induced natural resource degradation has left the environment in a critical state. The continuous levels of ecosystem degradation are eroding Earth's ecological resilience, jeopardising social and economic stability. To remain resilient and manage natural resource use more sustainably, businesses are required to change their natural resource use management strategies by integrating an environmental risk approach into the business strategy to account for system complexity and connectivity. The aim of this study was to identify how 30 selected JSE-listed companies are addressing environmental risks and to what extent company reports addressed the system complexity by analysing their annual, integrated and sustainability reports. Sustainability managers were also interviewed on their company's strategic environmental risk management approaches and management structures. Although water and climate change were the most frequently reported environmental risks, only 20-25% of company reports included these. These were rarely connected to other sustainability risks or strategic objectives. Environmental risks featured in the top 10 company risks at only four companies. Most companies did not seem to acknowledge their dependence on the environment, strategically manage environmental risks, and systems-based views were rarely present. The findings indicate that the lack of strategic environmental risk and systems-based approaches risks environmental, economic and social wellbeing, leaving society exposed to various climate and environmental risks.

Keywords Natural resource degradation · ecological resilience · environmental risk · business strategy · system complexity · JSE · annual reports

5.1 Introduction

Human-induced natural resource degradation has left the environment in a critical state. Various comprehensive reports (see for example Millennium Ecosystem Assessment 2005a, b, c; Cubasch *et al.* 2013; Hartmann *et al.* 2013; Kirtman *et al.* 2013; Burkett *et al.* 2014; Cisneros *et al.* 2014; Steffen *et al.* 2015; UNEP 2016b) discuss the most concerning environmental issues, the state of ecosystems and risks to societies resulting from the severe ecosystem degradation and natural resource use due to human activities. Anthropogenic drivers such as acid mine drainage, chemical fertilisers and the tremendous waste production from human consumption, for example, have led to the degradation of ecosystem goods and services (Millennium Ecosystem Assessment 2005c). All five aspects of human wellbeing (basic material needs, health, social relations, security, freedom of choice and action) were found to be directly or indirectly affected by the declining state of the global ecosystem (Millennium Ecosystem Assessment 2005d). Water stress, soil erosion and extreme weather events threaten food security and human health (UNEP 2016b). Especially the climatic changes as well as the ongoing decline of water availability and quality will intensify existing risks such as extreme weather events, food and water security and biodiversity degradation (Millennium Ecosystem Assessment 2005b; UNEP 2016b). With high certainty it is also predicted that water quality and availability will decline further (Millennium Ecosystem Assessment 2005b). Economic growth, industrialisation and urbanisation have drastically increased global water demand (CDP 2014), which is projected to be 40% higher than could possibly be supplied in the next 15 years (WRG 2014).

Businesses are considerable contributors to ecosystem degradation (Aras and Crowther 2009) yet are inevitably dependent on the environment (Walker and Salt 2006; ESDN 2012). Businesses are exposed to economic, operational and reputational risks, including increased water costs, limited production of goods or limited industrial and manufacturing operations, reduction in sales, higher costs for maintenance, lower efficiency and effectiveness of production processes, increased insurance pay-outs, interrupted supply chains and transport systems (Sato and Seki 2010; Busch 2011; Lambooy 2011; Bakker 2013; CDP 2014; The CEO Water Mandate 2014; UNEP 2016b). Environmental degradation levels thus far have compromised Earth's ecological resilience (Farley and Voinov 2016) and further ecological instability and erosion of global ecological resilience would risk human wellbeing and environmental, social and economic stability (IPCC 2014b; WEF 2017). To reduce current pressures on the ecosystem and associated risks to humanity, as well as ensure sustained economic, social and environmental wellbeing, a change in corporate sustainability practices is required (Millennium Ecosystem Assessment 2005d; Farley and Voinov 2016).

Businesses require the inclusion of the knowledge of system dynamics (IRCSA 2014; Baumgartner and Rauter 2017). The consideration of sustainability matters at the strategic level would need to filter across the various corporate levels within business such that it is embodied in systems, the business culture and policies and in strategic targets (IRCSA 2014; Baumgartner and Rauter 2017). Integrating environmental risks into the business strategy and aligning business goals with sustainability goals would make a company's financial wellbeing dependent on its natural capital (see six capitals model; IIRC 2013a). Businesses thus need to adopt a "systems view" as illustrated by the World Economic Forum's (WEF) risk interconnections map (WEF 2017, p. 4). This provides a view on and understanding of the complex interactions between environmental, social and economic risks in relation to their own business activities (Holling 2004; Smith 2011; ESDN 2012), with a change in one affecting the other (Walker *et al*. 2004; ESDN 2012; Farley and Voinov 2016). This has already

been shown to aid strategic risks and opportunities identification in the case of climate change (Beermann 2010). By incorporating integrated risk approaches into sustainability management would enable a company to address long-term value creation due to understanding the connectivity and interdependency with natural capital (IIRC 2013). A systems-based approach would facilitate changes in evaluating environmental risks and improve risk management (IPCC 2007; Rockström *et al*. 2009). Corporations would be able to address long term planning as integrated risk management would enable them to anticipate changes and uncertainty which would enable them to make provisions to enhance their resilience (IPCC 2007; Rockström *et al*. 2009; Smith 2011).

Businesses have only recently started recognising the importance of understanding business risks resulting from environmental degradation and climate change (Haboucha 2010; Rochlin and Grant 2010) with extreme weather events, failure of climate change mitigation and adaptation, and water crises consistently featuring in the global risk landscape (WEF 2017). Yet this challenges traditional financial short-term, linear and retrospective views and management approaches (WEF 2015). Businesses have experienced difficulties with the interconnected and complex nature of the global system (WEF 2015), as well as with uncertainty, long-term strategy planning, non-financial risk quantification and incomplete data sets (Whyte and Burton 1980; Calow 1998; Kasperson and Kasperson 2001; Ntim *et al.* 2013; Engert *et al.* 2016). Financial risks still take precedence over the environmental field, thus a more holistic risk management approach is necessary (CRO 2013). Also, only few companies were found to have adopted a strategic approach to integrating sustainability-related risks (Haboucha 2010; Rochlin and Grant 2010). The integration of a strategic approach would entail the alignment of financial sustainability risks, opportunities and sustainability with a company's aims and direction (Rochlin and Grant 2010).

In relation to risk disclosures, the main emphasis so far was put on corporate risk disclosure as part of financial disclosures (see for example Sinclair-Desagné and Gozlan 2003, Beretta and Bozzolan 2004, Linsley and Shrives 2006, Ntim *et al*. 2013). In addition, previous research showed that environmental disclosure performance and quality are still below acceptable levels in South African JSE-listed companies (see for example Maubane *et al* 2014; Kitsikopoulos *et al.*, submitted). Reasons for this may be related to reporting guidelines not providing holistic, long-term approaches to environmental reporting Kitsikopoulos *et al.*, submitted), a lack of time and resourcing, as well as reporting fatigue (Kitsikopoulos *et al.*, accepted). In South Africa, increasing temperature anomalies, changing frequencies and intensities of severe weather events as well as water risks such as droughts, water stress and water scarcity have worsened over the past years (Christensen *et al*. 2013; Cubasch *et al*. 2013; Kirtman *et al*. 2013; Burkett *et al*. 2014; Cisneros *et al*. 2014). Water restrictions have even affected South Africa's economy and have become a significant concern for South African companies (CDP 2016b). It is evident that the benefits businesses and societies derive from ecological systems and their services have come at a great cost in the form of unpredictable system change disrupting social functioning, environmental stability, and business continuity (Millennium Ecosystem Assessment 2005a; Rockström *et al*. 2009).

The aim of this research was to assess the presence of environmental risk and systems approaches in annual reports and corporate sustainability management practices. If the incorporation of environmental risks into the business strategy and company management is an important step in complex systems understanding, do corporate firms identify and manage environmental risks strategically? South Africa is at present experiencing environmental issues especially related to water in the form of scarcity and quality, as the current water crisis in Cape Town shows (Christensen *et al.* 2013; Cubasch *et al.* 2013; Kirtman *et al.* 2013; Burkett *et al.* 2014; Cisneros *et al.* 2014; Evans 2018), this research also provided a more detailed focus on water risk reporting. This question was addressed by creating two risk interconnections maps

that highlighted the complex links between corporate, social and the most concerning environmental risks as well as water and corporate risks. Content analysis of annual, annual integrated and sustainability reports of 30 JSE-listed companies between 2008 and 2015 served to compare whether links outlined in the risk maps were also disclosed in company reports. Reports were further investigated with respect to the environmental topics (e.g. climate change, water) covered. Integrated risk management systems incorporate the presence or application of risk identification, treatment, monitoring and review and further risk assessments (Pojasek 2011). Thus, company reports were analysed on whether environmental risk targets were in place, whether these were monitored, if mitigation and adaptation measures are in place, whether the company reported to have conducted an environmental risk assessment and if risk reduction targets were disclosed. Lastly, interviews with sustainability managers were conducted on their strategic environmental risk management approaches and management structures.

5.2 Methods

Risk interconnections maps

Thirty literature sources (including Whyte and Burton 1980, Calow 1998, Kasperson and Kasperson 2001, Millennium Ecosystem Assessment 2005a, Millennium Ecosystem Assessment 2005b, Millennium Ecosystem Assessment 2005c, Denman *et al.* 2007, Rosenzweig *et al.* 2007, Arneth *et al.* 2010, Gilman *et al.* 2010, Mentis 2010, Settele *et al.* 2010, Dawson *et al.* 2011, Pielke *et al.* 2011, Bellard *et al.* 2012, Brown 2012, IPCC 2012b, Collins *et al.* 2013; CRO 2013, Cubasch *et al.* 2013, Peñuelas *et al.* 2013, Burkett *et al.* 2014, CDP 2014, IPCC 2014a, IPCC 2014b, The CEO Water Mandate 2014, UNEP 2016a, UNEP 2016b, World Bank 2016, WEF 2015) were examined to collect qualitative data on the documented connections between environmental, social and economic variables. For example, water

availability can impact on soil degradation and runoff; land cover change can affect insurance claims and food production. Risk factors that would be applicable to as many corporations of various economic groups and sectors as possible were included. A mining company would pay particular attention to biodiversity and water quality/availability risks as well as licensing and direct operational impact (Fonseca *et al.* 2014), whereas an insurance company would focus more on extreme weather events and insurance claims and how these could affect their bottom line (CRO 2013). These connections were extracted in linear form (water availability – soil degradation; water availability – runoff; land cover change – insurance claims; land cover change – food production). Each of the extracted variables that had at least two of such linear relationships to another variable and could directly or indirectly be linked to economic variables was included for further data processing and analysis. In total, 28 variables were selected. The variables were grouped into water, biodiversity, climate, social and business risks. To compute these interactions as a risk interconnections map, the data were entered into NodeXL (Smith *et al.* 2010), a network and content analysis tool. Two risk interconnections maps were computed (Fruchterman-Reingold layout algorithm). One risk interconnections map (Risk Map 1) focused on water, biodiversity, climate, social and business risks. The second map (Risk Map 2) focused on water and business risks. The focus of Risk Map 2 was specifically put on water availability, as it is a crucial current topic in South Africa and illustrates how a single factor can have multiple different business impacts that ultimately affect the bottom line. Instead of using the risk interconnections map created by the World Economic Forum (2015), which was based on a questionnaire, both risk interconnections maps created here were based on existing scientific literature focusing on the links between environmental, social and economic risk factors.

The information obtained from the report analyses (see section below) in the form of connections between the variables as described above could then be used to compare the system complexity as computed in Risk Map 1 Risk Map 2 to the connections of

variables identified in company reports. This was highlighted in "similarity maps". These maps included and highlighted which of the links between environmental, social and economic risk factors identified through the literature was also identified in annual, annual integrated and sustainability reports.

Report analyses

Sample selection

Thirty of the Top 100 JSE-listed companies were chosen according to their 2008 market capitalisation, obtained from the JSE (the same sample set used in Kitsikopoulos *et al.* (submitted). Companies belonging to six different economic groups of resources, basic industries, non-cyclical consumer goods, cyclical services, non-cyclical services, and financials, and of 22 different sectors were chosen (FTSE International Limited 2002; Table 1; Appendix 1). Every economic group contained five companies, except for basic industries (4) and financials (6). Two holdings companies were included in the company selection because of their narrow business focus with a more centrally managed sustainability strategy. They were therefore suitable for the analyses.

Table 1 Scoring system for environmental reporting quality (Source: Hooks and van Staden 2011).

Economic Group	Sector	*N*
Resources	Mining	1
	Industrial Metals & Mining	2
	Oil & Gas Producers	2
		[5]
Basic Industries	Chemicals	1
	Construction & Building Materials	1
	Forestry & Paper	2

		[*4*]
Non-cyclical Consumer Goods	Beverages	1
	Food Producers	1
	Health Care Equipment & Services	1
	Personal Goods	1
	Tobacco	1
		[*5*]
Cyclical Services	General Retailers	2
	Travel & Leisure	1
	Media	1
	Industrial Transportation	1
		[*5*]
Non-cyclical Services	Food & Drug Retailers	3
	Mobile Telecommunications	2
		[*5*]
Financials	Banks	1
	Nonlife Insurance	1
	Life Insurance	1
	Financial Services	2
		1
	Real Estate Investment Trusts	**[*6*]**
Total		30

Company reports were examined from 2008 to 2015, totalling 239 reports. No report was available for the company of the food producers sector for the year 2009. The reports made available to the public by listed companies are considered an important communication tool, which reflects a company's strategy, performance and governance (IIRC 2013b). They should therefore reflect a company's environmental management performance. Some companies provided stand-alone sustainability reports in addition to the annual or annual integrated report. All parts of the annual, integrated and sustainability reports that covered environmental risk information were taken into consideration for the analysis. The risk section of the annual or integrated report was also checked for environmental risk information in case of environmental risks not being mentioned in the sustainability section, although the sustainability

report contains more detailed environmental information on a company's environmental performance (Hooks and van Staden 2011). It is also referred to as *supplementary material* in the main annual document.

Method of analysis

Content analysis was used to analyse the qualitative data in form of environmental risk information published in JSE-listed company annual, integrated and sustainability reports. Reported environmental risks (e.g. water availability, water quality) were recorded and further examined whether this identified risk was linked to other environmental, social and economic risks risk factor/variable. For example, one company report stated that:

> "Water supply constraints could affect production at our current operations, as well as our future growth plans".

The link between water supply/availability and production was recorded. No further connection to any other variables was made by this company report. This example would be determined as a linear and direct link. Another company report stated:

> "Effectively dealing with the impacts that climate change and water security could have directly on the company and indirectly, through its value chain, remains a key challenge. When viewed within the context of a growing and increasingly affluent global population that is consuming more natural resources and producing more waste, there is increasing pressure on the environment. Key potential impacts include ecosystem disruption, food scarcity and rising energy costs, which further highlights the need for the business to constructively engage with the relevant stakeholders to identify solutions to mitigate these risks.

This description would indicate more complex links, as connections of two different environmental risk factors were identified to have direct and indirect impacts other social, environmental and economic factors. Although in this case the links were kept rather general and not very business specific. As described in the methods section "Risk interconnections maps", the links recorded from the report analyses were compared to the connections presented in Risk Map 1 and 2, which were based on literature assessments. Links made in the reports that matched the links in the risks maps were highlighted and presented as similarity maps.

Annual, integrated and sustainability reports were further analysed by recording the presence or absence of the following environmental risk categories: set environmental risk targets, target monitoring, mitigation and adaptation measures, risk assessment and risk reduction targets per year. For each of the categories and each year (2008 - 2015) the topics addressed (for example climate change water, energy) were recorded.

When this study commenced, the Global Reporting Initiative (GRI) guidelines Version 3.1 were in use for annual integrated reporting. Shortly after the initial phases of this research in 2013, the G4 guidelines were released. These only came into effect in January 2017, but some companies adopted them earlier (Deloitte Touche Tohmatsu 2014). In this company selection, 16 of the 30 selected companies applied the G4 guidelines by the 2015 financial year (53%). A possible change in environmental risk reporting due to the new guidelines could therefore be assessed. The 2013-2015 annual, integrated and sustainability reports were divided according to the reporting guideline version used (G3.1 and G4). This information was provided in the report. The total number each for presence of environmental risk target setting, target monitoring, mitigation and adaptation measures, risk assessment and risk reduction targets according to the GRI guideline used were added for the years 2013, 2014 and 2015. The totals were converted into mean percentages for each year and each reporting guideline version:

$$X_{\%} = \frac{\mathrm{N} \times 100}{reports_{max}}$$

where *N* is the number of times reports covered target setting, monitoring targets, mitigation/adaptation strategies, risk assessment presence and risk reduction targets per year per GRI reporting version, and $reports_{max}$ is the total number of reports per year per GRI reporting version. The topic (e.g. climate change) per category was not taken into account for this comparison.

The total numbers of the topics recorded per category and year were used to compare (1) the number of times categories were reported on for the years 2008 to 2015 combined; (2) topic reporting per category; (3) category reporting per economic group; (4) topic reporting per economic group; and (5) the reporting of each category per year to identify potential changes between 2008 and 2015.

Statistical analyses

To test whether there were any differences between company reports applying G3.1 and G4 when reporting on environmental risks between 2013 and 2015, a generalised linear mixed model was applied using RStudio (version 1.0.143; RStudio Team 2016). The data showed a non-normal distribution. Wald statistics were generated to assess whether the reporting frequency of environmental risk categories predicted each dependent variable. Pairwise post-hoc comparisons were conducted when the fixed effects were significant predictors (lsmeans package; p values adjusted with the Tukey method). Significance levels were set at $p<0.05$.

Analyses to identify potential differences between economic group, topic, year and GRI reporting guideline version (G3.1 and G4), as well as differences between economic group, category, year and GRI reporting guideline version (G3.1 and G4) were performed using RStudio (version 1.0.143; RStudio Team 2016). As all dependent variables showed a non-normal distribution, analyses for each dependent

variable (climate change, water, energy, air quality, biodiversity, waste, pollution, supply chain) were conducted separately using a generalised linear mixed model, in which economic group was the fixed effect and year of assessment and the GRI version were random effects, to account for a variation in the reporting of the various topics per annum and/or due to reports following one of the two reporting guideline versions (G3.1 and G4). Wald statistics were generated to assess whether the economic group predicted each dependent variable. Pairwise post-hoc comparisons were conducted when the fixed effects were significant predictors (lsmeans package; p values adjusted with the Tukey method). In the case of environmental risk category and yearly differences, a Kruskal-Wallis H test was used for the post-hoc comparisons when the fixed effects were significant predictors. Significance levels were set at $p<0.05$.

Interviews

To investigate the strategic environmental risk management approaches and management structures, staff involved with environmental management at the 30 selected companies were contacted for interviews. Ten of the thirty companies agreed to participate in this research. The empirical work for this study was carried out in South Africa (Johannesburg, Pretoria and Durban regions) between May and August 2016.

The semi-structured interviews were focused on obtaining the managers' or staff member's perspectives on key strategic environmental company risks, as these have the potential to impact business operations, shareholder value and the bottom line (Tonello 2012), where challenges in environmental risk management lie and which strategies could be put in place to improve it (Appendix 4). Seven questions (questions 3-9) were based on Vivian *et al.*'s (2003) in-depth study into environmental risk based on environmental risk identification, evaluation and

management, and comparison of various industry sectors. These questions addressed the responsibility of risk identification and management, horizontal and vertical reporting lines, connections between environmental and other company risk management systems, how well the company's codes of conduct, culture and policies support environmental risk assessment and internal control systems worked, and how effective monitoring processes and communication to the board are.

Ethics clearance was obtained from the University of the Witwatersrand Human (non-medical) Ethics Research Committee (H16/04/08). The interviews were transcribed and answers were analysed for commonalities and aggregated into key words, phrases and expressions. Percentages were calculated for levels of consensus.

5.3 Results

Environmental risk interconnections maps

Risk Map 1 (Figure 1) illustrates the complexity and interconnectivity of environmental, social and economic risk factors and Risk Map 2 (Figure 2) the interconnectivity of water, economic and social risks. For example, increased emissions, lead to changes in the stratospheric greenhouse gas (GHG) composition in the stratosphere (Kasperson and Kasperson 2001) which affects the thermal radiation budget (Kasperson and Kasperson 2001; Collins *et al.* 2013). While the troposphere experiences a reduction of radiative cooling and precipitation, an increase in CO_2 leads to slow temperature and water vapour increases in the atmosphere and thus increased radiative cooling and precipitation (Kasperson and Kasperson 2001; Collins *et al.* 2013; Burkett *et al*. 2014). Temperature increases also increase precipitation (Collins *et al.* 2013), causing ocean warming which in turn increases temperatures, precipitation and evaporation (Kasperson and Kasperson 2001; Collins *et al.* 2013). This has consequences for the global hydrological cycle, such as melting snow and

ice, leading to a rise in the sea level, increased runoff and water vapour, impacts on water quality of rivers and lakes, to more extreme weather events (for example in some regions more intense droughts and heavy rains), as well as a change in streamflow (IPCC 2012b; Cubasch *et al.* 2013; Burkett *et al.* 2014; Cisneros *et al.* 2014; IPCC 2014a). Both surface temperatures and water availability in turn impact soil moisture and biomass production (Calow 1998; Cisneros *et al.* 2014) which, together with low humidity and increased temperatures (IPCC 2012b), can lead to more wildfires, and coupled with subsequent rainfall to more intense erosion events (IPCC 2012b; Cisneros *et al.* 2014). Increasing temperatures also change species distribution patters, lead to loss of biodiversity and thus impact the climate, biodiversity and water quality (Millennium Ecosystem Assessment 2005c; Gilman *et al.* 2010; Dawson *et al.* 2011; Peñuelas *et al.* 2013; Settele *et al.* 2014). Land use and land cover change, both drivers and a consequence of changing climate, affect the cooling and warming capacity of the substrate and thus influence solar radiation, climate, water vapour and CO_2 fluxes (Pielke *et al.* 2011). They also impact on the amount of rainfall (Kasperson and Kasperson 2001; Burkett *et al.* 2014; Settele *et al.* 2014), which in turn can have impacts on soil degradation and biodiversity composition (Burkett *et al.* 2014; Settele *et al.* 2014).

The impacts and risks associated with the changing climate as described above, especially the pressure on the water cycle and thus water availability are intensified by human impacts and intensify competition among agricultural, ecosystem, human and industrial entities (Cisneros *et al.* 2014; CRO 2015; WEF 2015). Infrastructure maintenance and development, productivity, industry competition, food production and human health are at risk (Kasperson and Kasperson 2001; Millennium Ecosystem Assessment 2005c; IPCC 2012b; Cisneros *et al.* 2014; WEF 2015). Communities, farmers and businesses are dependent on good water availability and quality (Cisneros *et al.* 2014). Poor water quality at a business operation may require water

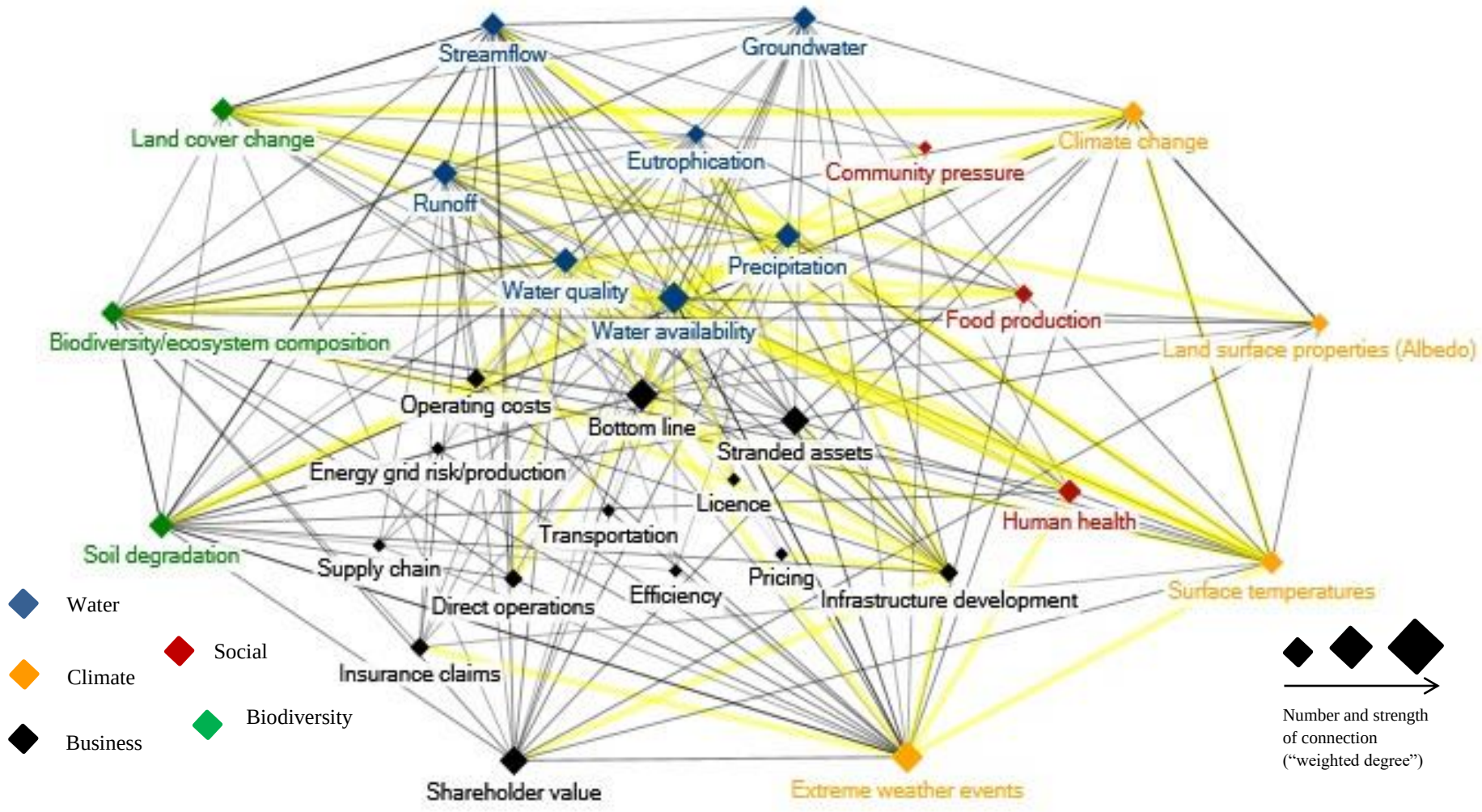

FIGURE 1. Risk interconnections map for environmental, social and business risks (Risk Map 1). Light yellow lines represent the connections described in text. Sources: Whyte and Burton 1980, Calow 1998, Kasperson and Kasperson 2001, Millennium Ecosystem Assessment 2005a, Millennium Ecosystem Assessment 2005b, Millennium Ecosystem Assessment 2005c, Denman *et al.* 2007, Rosenzweig *et al.* 2007, Arneth *et al.* 2010, Gilman *et al.* 2010, Mentis 2010, Settele *et al.* 2010, Dawson *et al.* 2011, Pielke *et al.* 2011, Bellard *et al.* 2012, Brown 2012, IPCC 2012b, Collins *et al.* 2013; CRO 2013, Cubasch *et al.* 2013, Peñuelas *et al.* 2013, Burkett *et al.* 2014, CDP 2014, IPCC 2014a, IPCC 2014b, The CEO Water Mandate 2014, UNEP 2016a, UNEP 2016b, World Bank 2016, WEF 2015.

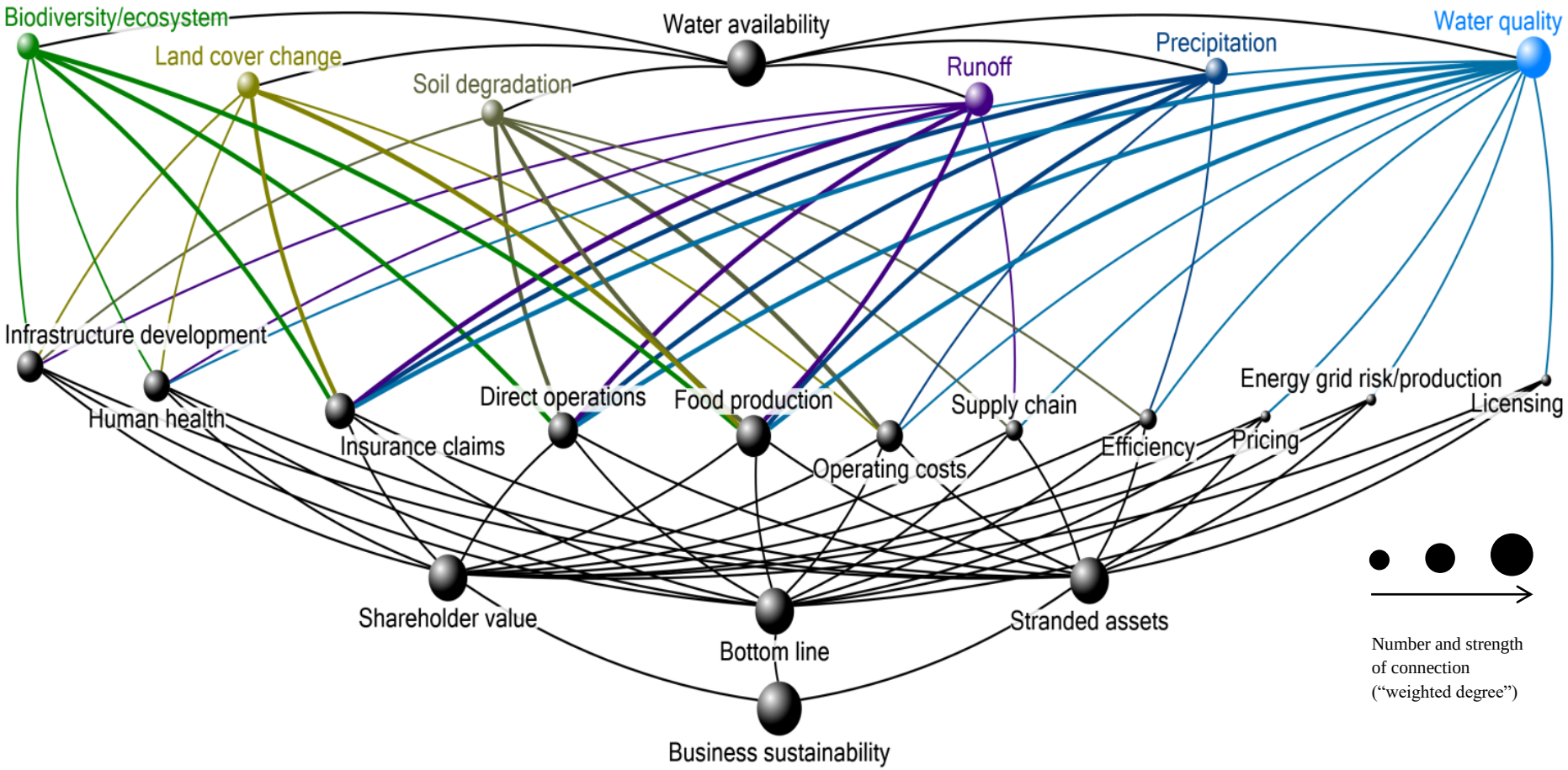

FIGURE 2. Water availability risk interconnections map (Risk Map 2). Sources: Whyte and Burton 1980, Calow 1998, Kasperson and Kasperson 2001, Millennium Ecosystem Assessment 2005a, Millennium Ecosystem Assessment 2005b, Millennium Ecosystem Assessment 2005c, Denman *et al.* 2007, Rosenzweig *et al.* 2007, Arneth *et al.* 2010, Gilman *et al.* 2010, Mentis 2010, Settele *et al.* 2010, Dawson *et al.* 2011, Pielke *et al.* 2011, Bellard *et al.* 2012, Brown 2012, IPCC 2012b, Collins *et al.* 2013; CRO 2013, Cubasch *et al.* 2013, Peñuelas *et al.* 2013, Burkett *et al.* 2014, CDP 2014, IPCC 2014a, IPCC 2014b, The CEO Water Mandate 2014, UNEP 2016a, UNEP 2016b, World Bank 2016, WEF 2015.

treatment and may increase operating costs, or water use licences may not be granted if water quality standards are compromised (Kasperson and Kasperson 2001; The CEO Water Mandate 2014). A business dependent on a water use license to operate would risk operational disruptions, thus impacting on both business profitability and survival (The CEO Water Mandate 2014). Extreme weather events can risk human safety/health, and insurance claims in affected areas would increase (IPCC 2012b; Cubasch *et al.* 2013; Burkett *et al.* 2014). Changes in rainfall frequency and/or intensity on the other hand affect water availability, which may require increased infrastructure development to provide sufficient supply to business operations. Infrastructure development is costly, and can therefore affect operating costs and product pricing (The CEO Water Mandate 2014). Risks to businesses emanating from environmental change and degradation would in turn affect the firm's shareholder value, bottom line and would ultimately jeopardise long-term business sustainability.

Report analyses

Of the 239 reports, 33 were annual reports (prior to 2010), 99 were annual integrated reports (from 2010 onwards) and 107 were sustainability reports. The analysis of the reports between 2008 and 2015 revealed that only 48 reports (20%) covered water risks. The water risks reported on were water availability (21), water access (2), water cost (8), water quality (7), water usage (2) and compliance (1). Here, water availability also included the terms *quantity*, *scarcity*, *security*, *shortage*, and *supply*. Water quality included *clean water* and *water pollution*.

Thirty one of the 48 reports made relatively linear and direct links between environmental, social and economic risk factors. Environmental risks were seldom reported on past one level of connectedness such as identifying that water scarcity hampers development and growth, or water usage is an aspect contributing to carbon emissions, and good water quality equates to obtaining/retaining the license to

operate. Both the similarity map of Risk Map 1 (Figure 3) and the similarity map of Risk Map 2 (Figure 4) highlight this. The complex interactions between different capitals and positive feedback loops were rarely considered in reports. An example of more complex interconnections would be both water quality and quantity impacting operations, and more so local communities' access to clean drinking water, linking this to human wellbeing (human health), ecosystem balance and food production. This was linked to reputation, operations and long-term business survival. Although some reports linked environmental, social and economic risks, most of these reports discussed these issues in a relatively isolated manner. The linear approach to linking water risks to other environmental, social and economic risks is illustrated in the similarity map of Risk Map 2 (Figure 3). Water risk was mostly linked directly to operational impacts, costs and impacts on business sustainability.

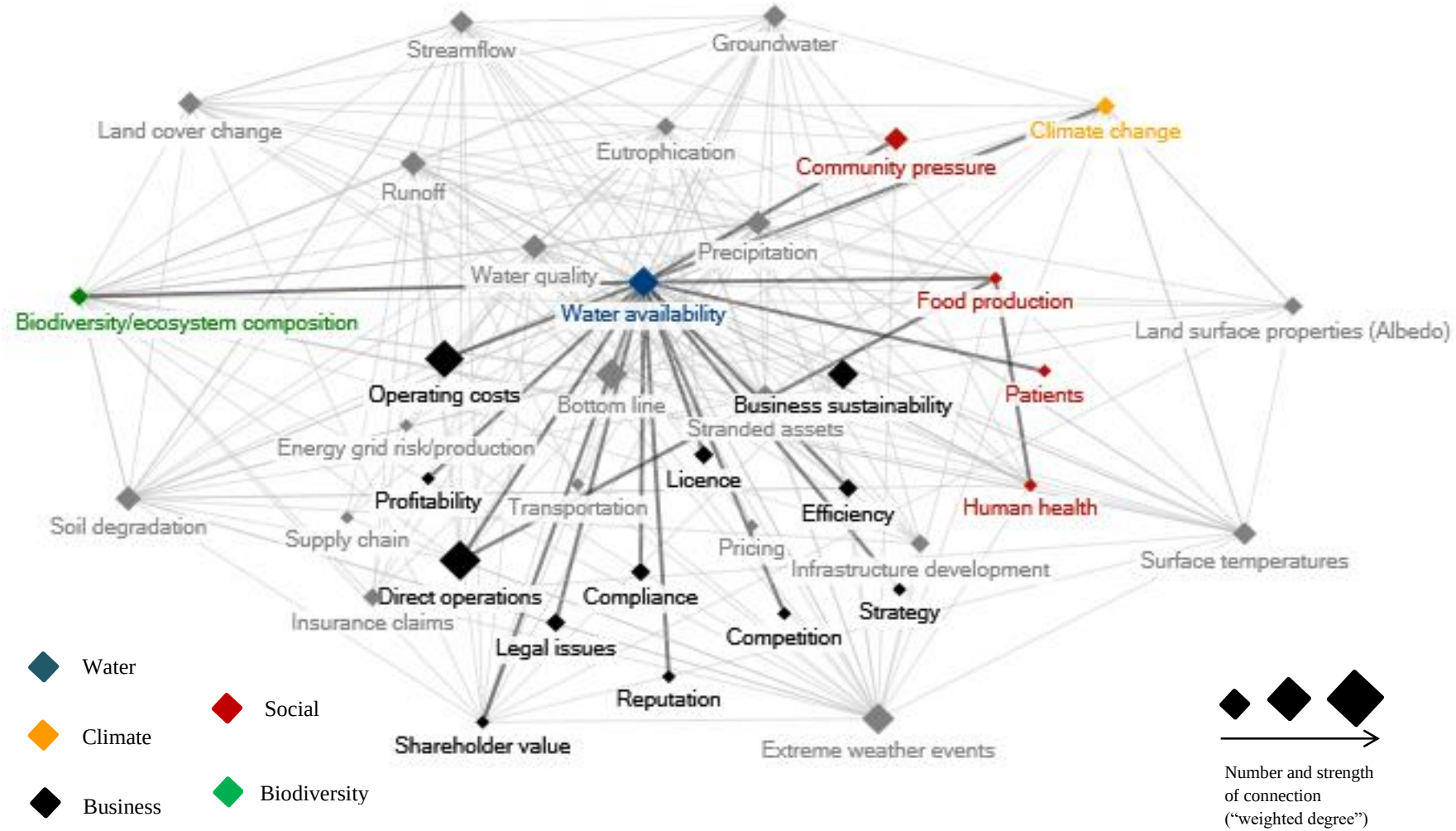

FIGURE 3. Similarity map of Risk Map 1 identifying water, climate, biodiversity, social, and economic risks linked to water availability. Patients, reputation, profitability, legal issues, strategy, competition, and compliance were risks not included in Risk Map 1, but linked to water risks in annual integrated/sustainability reports, and added here. Grey: areas not covered by annual integrated/sustainability reports.

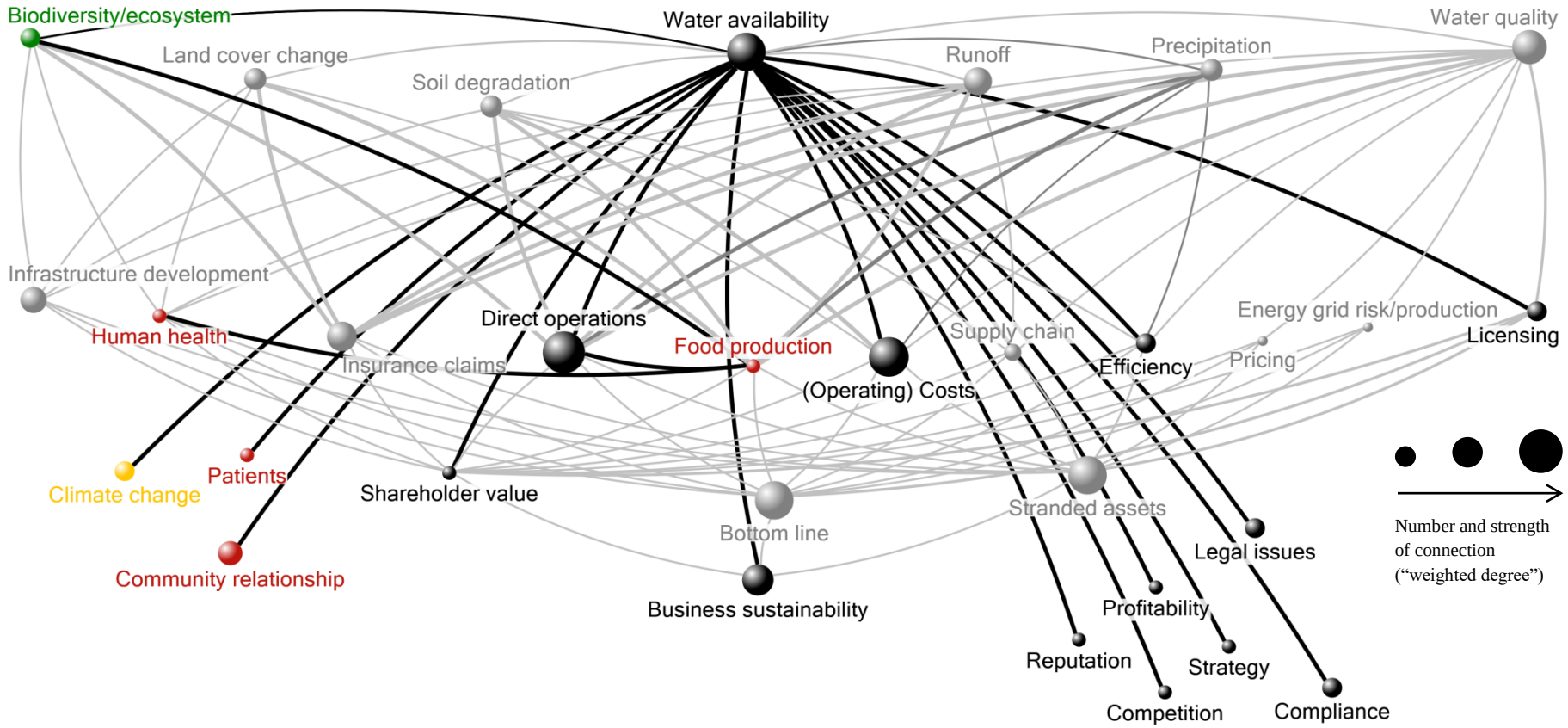

FIGURE 4. Similarity map of Risk Map 2 identifying which environmental, social and economic risks linked to water availability. Climate change, patients, community relationship, reputation, profitability, legal issues, strategy, competition, and compliance were risks not included in Risk Map 2, but linked to water risks in annual integrated/sustainability reports, and were added here. Green: environmental risk; red: social risk; black: economic risk, grey: areas not covered by annual integrated/sustainability reports.

The analyses with respect to environmental risk targets, monitoring, mitigation and adaptation, presence of risk assessment as well as risk reduction targets revealed that only 51 (21%) of all 239 reports had set environmental targets in place, 45 (19%) reported on target monitoring and most of these also covered the monitoring of these targets 69 (29%) on mitigation and/or adaptation measures. The presence of an environmental risk assessment (119, 50%) and risk reduction targets (101, 42%) were mentioned most frequently. Climate change and water were the most frequently reported topics (Figure 5). Environmental risk categories were found to be a predictor for the topics climate change (χ^2_4=57.19, p=1.13e^{-11}), water (χ^2_4=59.56, p=3.60e^{-12}), energy (χ^2_4=38.67, p=8.16e^{-08}), biodiversity (χ^2_4=15.34, p=0.004) and waste (χ^2_4=15.43, p=0.004; Figure 5).

The reports belonging to companies of the resources, basic industries and non-cyclical consumer goods groups reported most often on the categories identified (Figure 6). Reports of the resources group covered target setting (χ^2_5=36.35, p=8.09e^{-07}) and monitoring targets (χ^2_5=25.34, p=0.0001) best, while mitigation/adaptation measures were reported on most frequently by companies of the resources and basic industries group (χ^2_5=38.99, p=2.38e^{-07}). Reports belonging to the former two economic groups as well as the ones of non-cyclical consumer goods more frequently contained presence of risk assessment (χ^2_5=50.57, p=1.06e^{-09}), and the ones of resources and non-cyclical consumer goods included risk reduction reporting (χ^2_5=47.32, p=4.89e^{-09}; Figure 6) information. The year and GRI version were not found to have any influence on the reporting frequency of categories of the various economic groups.

Most of the 239 reports between 2008 and 2015 dealt mainly with climate change, energy and water. Companies of the resources group were found to report most on the topics climate change (χ^2_5=46.51, p=7.14e^{-09}), energy (χ^2_5=34.31, p=2.06e^{-06}) and pollution (χ^2_5=17.92, p=0.003), in addition both the resources and non-cyclical consumer goods group reported significantly better on water (χ^2_5=76.26, p=5.08e^{-15}).

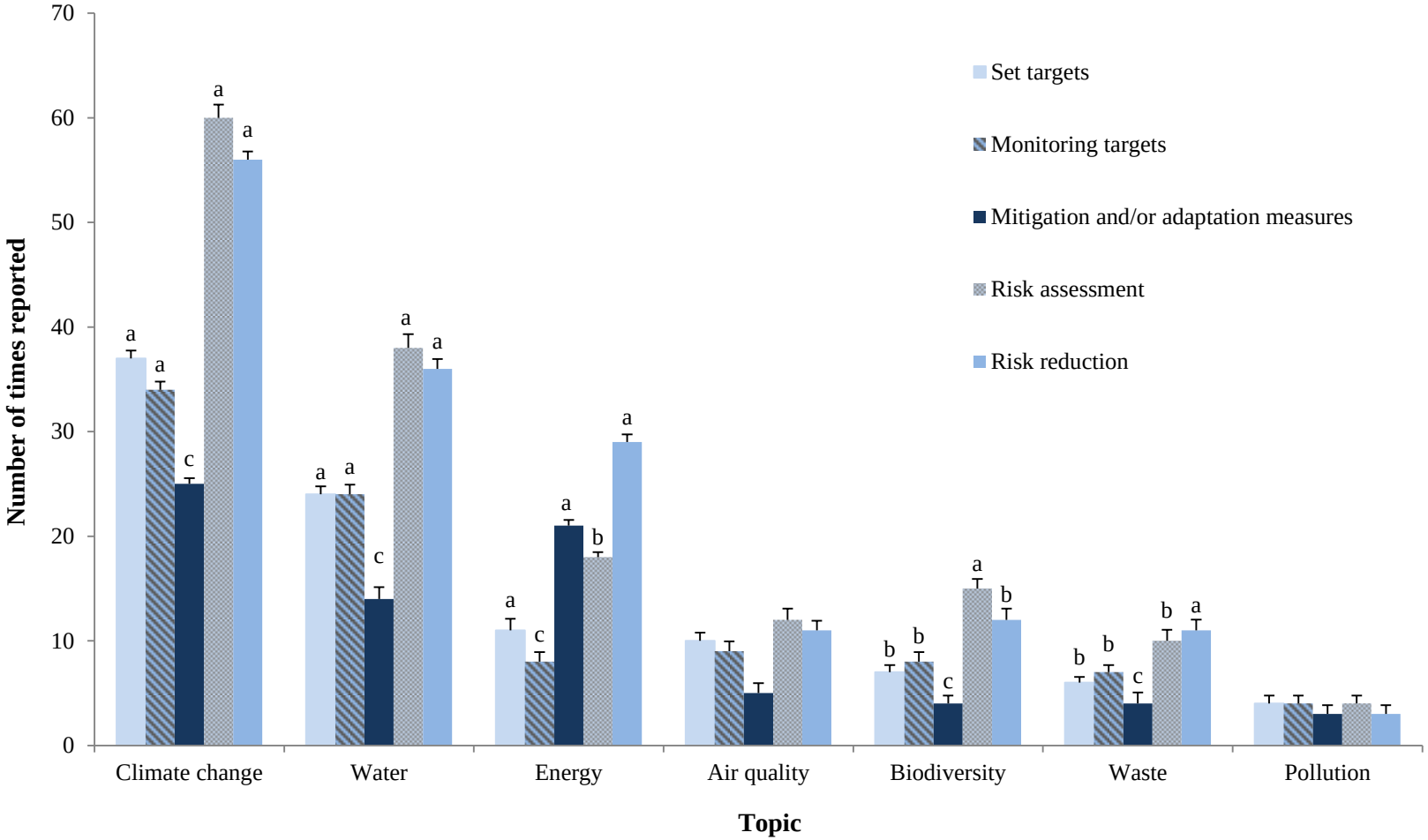

FIGURE 5. The number of times (+SE) various environmental risk topics were reported on between 2008 and 2015 (total number of reports: 239). a = different to all others, b = equal, c = smaller than everything else, where significant differences in the Waldχ^2 were found.

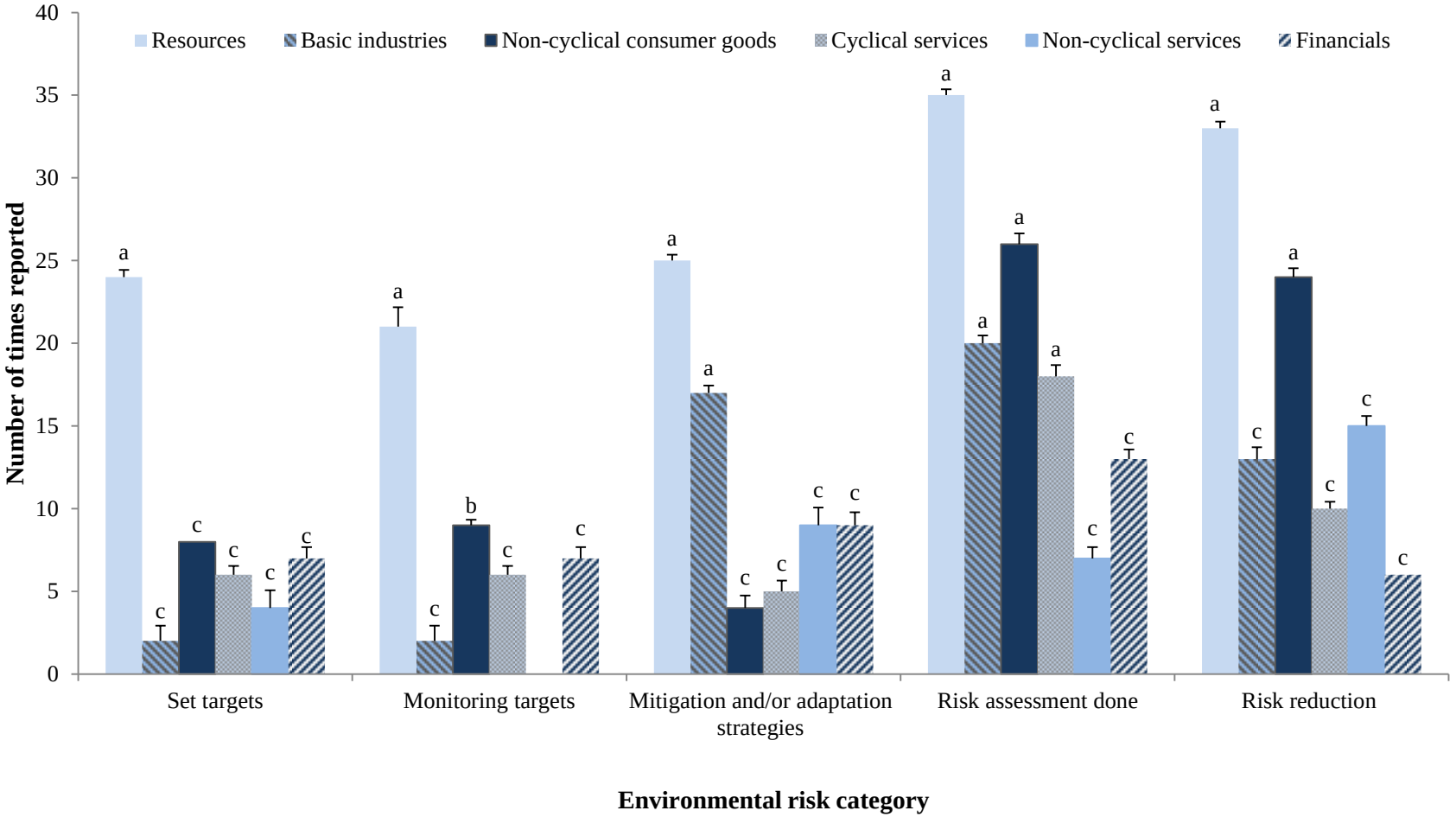

FIGURE 6. Assessment of the number of times (+SE) various environmental risk categories were covered in annual integrated/sustainability reports in the six different economic groups between 2008 and 2015 (total number of reports: 239). a = different to all others, b = equal, c = smaller than everything else, where significant differences in the Waldχ^2 were found.

The year and GRI version were not found to have any influence on risk reporting frequency of economic groups.

The number of reports covering target setting, monitoring of targets, mitigation/adaptation measures, risk assessment and risk reduction targets increased from 2008 to 2012. Between 2013 and 2015 the number of reports covering these categories did not increase (Figure 7). No significant differences were found between the category and year, except in the case of presence of risk assessment between 2009 and 2011-2015 (χ^2_1=7.05, p=0.008; Figure 7).

Seven of the 30 companies applied the new G4 guidelines in their annual integrated/sustainability report since 2013 (23%), 12 since 2014 (40%), and 16 since 2015. Significant differences were found between the reporting frequency of environmental risk categories and the GRI guidelines (G3.1, G4) for 2013, 2014 and 2015 (χ^2_1=26.35, p=2.84e^{-07}; Table 2).

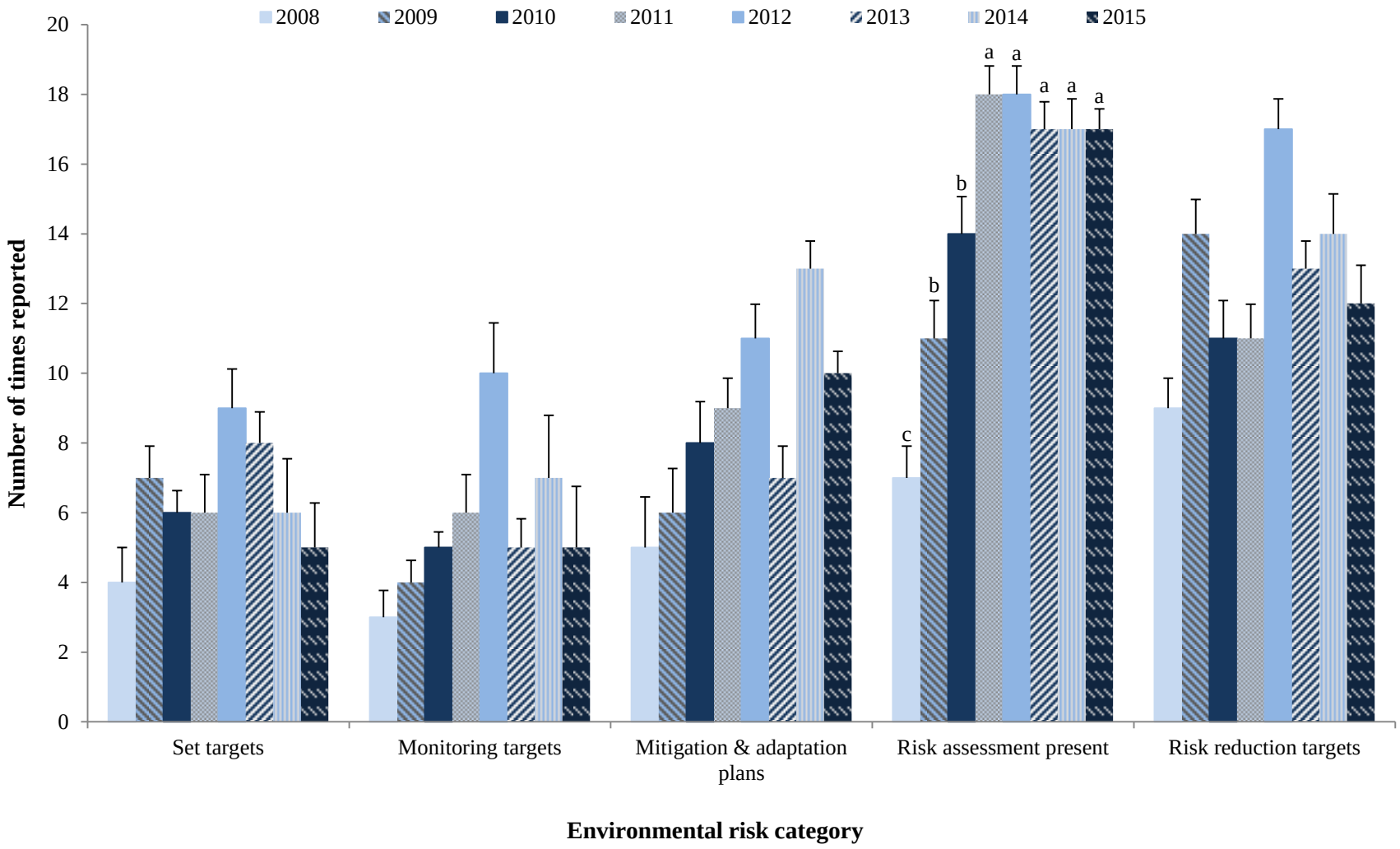

FIGURE 7. The number of times (+CI) various categories were reported per year (total number of reports: 239). a = different to all others, b = equal, c = smaller than everything else, where significant differences in the Kruskal-Wallis χ^2 were found.

Table 2. The reporting frequency of all risk categories combined and differentiated between GRI Version 3.1 and 4 for the years 2013, 2014 and 2015 (significant difference at * $p<0.05$).

	GRI 3.1			G4		
	2013	**2014**	**2015**	**2013**	**2014**	**2015**
Number of times reported (N)	36	30	18	23	33	37
Target setting	12 (52%)	8 (44%)	5 (36%)	5 (71%)	4 (33%)	5 (31%)
Monitoring targets	2 (8%)	2 (11%)	0	3 (43%)	5 (42%)	5 (31%)
Mitigation and adaptation plans	3 (13%)	6 (33%)	5 (36%)	4 (57%)	7 (58%)	6 (38%)
Risk assessment present	12 (52%)	8 (44%)	5 (36%)	5 (71%)	9 (75%)	12 (75%)
Risk reduction targets	7 (30%)	6 (33%)	3 (21%)	6 (86%)	8 (66%)	9 (56%)
Number of reports	23	18	14	7	12	16
		χ^2			**p-value**	
Linear mixed-effects model fit by maximum likelihood	2013	2014	2015	2013	2014	2015
	12.72*	6.79*	9.93*	0.0004	0.0091	0.0016

Interviews

The interviews revealed that water was identified as the most important strategic environmental risk for companies (7) in comparison to climate change, air quality, energy and waste (three times reported respectively). At four of the 10 companies, strategic environmental risks featured within the top 10 company risks. Four interviewees said that the step was not yet taken to include identified environmental risks in all other company risks. At one company environmental risks were least

important (financial services) while another stated that risks were sector-dependent (banks).

Differences were found in the departments dealing with environmental risk identification and the day-to-day management of those identified environmental risks (Figure 8). The vertical reporting lines were very similar across all companies. The escalation of risks usually ran from operational level (e.g. operational manager) to operational and group committees to the executive level and to the board. The horizontal reporting lines differed in the various companies. For example, in five companies the reporting of environmental risks followed an integrated approach, meaning the involvement of various departments and disciplines at the company and across all operations; at two companies the communication was very flexible. Two further companies were still working on effective communication on a horizontal basis and at one company communication was dealt with in only one specific department.

While the company's culture, codes of conduct, human resources and performance and reward systems were perceived by 7 interviewees to be supportive and improving at two, only one interviewee felt that these, although supportive, were not always translated from the top down. Monitoring processes addressing the company's ability to re-evaluate risks in response to internal and external changes were said to be effective (6) or improving (2). One company experienced practical difficulties while another stated this to be client-dependent. Also the communication to the board with respect to environmental risk monitoring was mostly said to be effective (8), although operational (1) and general management (1) were found to require improvement.

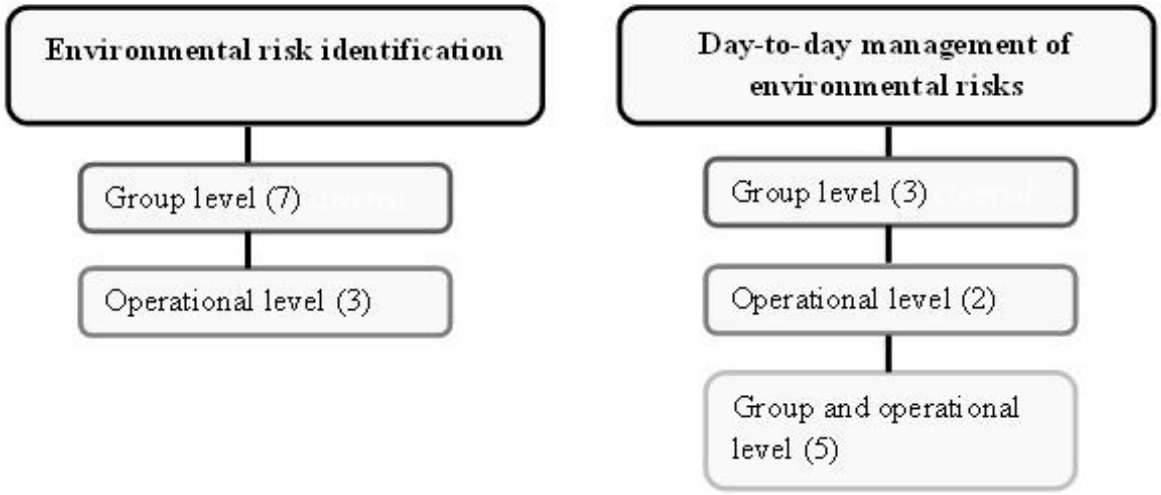

FIGURE 8. Environmental risks identification and management at different company levels.

Challenges with environmental risk management were linked to, among others, regulatory challenges and balancing different interest groups; strategies to overcome these were mainly linked to improvements in company systems, implementation, and staffing (Appendix 5).

5.4 Discussion

Water was the dominating environmental risk topic covered in interviews, water and climate change in annual, integrated and sustainability reports. Research by Giannakis and Papadopoulos (2016), who studied environmental risks in supply chain management of UK and French firms, found natural disasters, greenhouse gas emissions, pollution, non-compliance with sustainability laws and energy consumption to be the top environmental-related risks. Three of these five mentioned environmental risks were also identified in reports and interviews in this research. The only considerable difference is the emphasis on water and climate change risks

by South African firms. As environmental concerns such as droughts and water scarcity are encountered in geographic regions other than Europe (Giannakis and Papadopoulos 2016), and considering that South Africa has been predicted and shown to experience these (Christensen *et al.* 2013; Cubasch *et al.* 2013; Kirtman *et al.* 2013; Burkett *et al.* 2014; Cisneros *et al.* 2014), this research supports the findings that non-European regions encountering water- and climate change-related risks are reported/identified by corporates.

However, water risks were only mentioned in 20% of the reports between 2008 and 2015. The CDP's (2016b) report provided similar results for disclosing precipitation and water-related risks (21%), validating that most companies did not yet report strategically on this environmental risk. Large companies in Malaysia, a developing country experiencing water stress and restrictions similar to South Africa, were found to lack quality in water reporting too (Remali *et al.* 2016). Water crisis was the only environmental risks that featured in the South Africa Risks Report for 2016 (IRMSA 2016) at number 5. The Global Risks Perception Survey (GRPS) 2016 however identified extreme weather events and water crises as the top risks in terms of likelihood of occurrence and third most concerning in terms of impact (WEF 2017). Only four of the ten companies interviewed did environmental risks feature as a top 10 risk to the business. The results indicate that South African companies are not sufficiently addressing water-related risks in comparison to international findings.

Companies at which environmental risks featured significantly were more aware of the risks to the business viability that environmental issues pose. They reported to have had identified these many years ago and started managing them early on, and were thus at an advanced stage of natural resource management in comparison to other companies. Their reporting reflected this understanding, while the remaining reports made very linear links between water and other risks. . This as well as the report analyses suggest that risks such as the ones related to water and climate change are still not seen as critical factors for company sustainability and that an

understanding of the complexity and connectivity of risks and thus a systems approach to natural resource management was communicated in only few company reports. The similarity maps confirmed this by highlighting that the complexity of environmental risks was not addressed. This is not surprising when considering the findings of the PwC 2016 annual CEO survey (PwC 2016): in Africa, 80% of CEOs questioned were implementing changes to minimise their social and environmental impacts, 60% were concerned about climate change and environmental damage, yet only 20% considered the reduction of environmental impacts as a priority for their business to deliver. To reduce environmental risk exposure, the board and executive level are required to acknowledge their dependence on natural capital, prioritise environmental issues and quantify their risk exposure (PwC 2016). Research has shown that only a small minority of companies apply integrated thinking, practice effective decision-making to build environmental and social value and create long-term value for the company (CGMA 2016). For South Africa, other reasons for the low levels of reporting on water-related risks were linked to lower perceived water regulatory risk, water being an inexpensive resource, no common water accounting framework and an operational focus on risks (CDP 2016e).

The few company reports that addressed the environmental risk categories (target setting, monitoring targets, mitigation/adaptation strategies, and risk assessment present, and risk reduction targets) mainly belonged to the resources group. This may indicate that companies with greater dependence on natural resources understand the link between identified environmental issues and risk reduction strategies better, also given that the nature of their business requires greater compliance with government regulations (e.g. water use licencing, air emission standards) than for example general retailers or banks do (Cho *et al.* 2012). This also reflects findings in Kitsikopoulos *et al.* (submitted) showing companies from the resources group as the best performers in terms of environmental impact reporting quality. It must be taken into account that only between 30-50% of companies belonging to the resources group reported well on various environmental risks. This therefore indicates that although these

companies report most on environmental related risks, they do not report well on them. Rather some of them have a good reporting record, whereas others reported inconsistently on environmental risks or not at all.

Most concerning is that the reporting of those environmental risk categories has not improved since 2012. The CDP's (2016b) suggested that South African disclosing companies experience difficulties in maintaining pathways to reduce environmental risks. Their latest climate change risk report for South Africa (CDP 2016d) provided data showing that, although the number of companies having set targets increased between 2008 and 2016, climate change disclosure remained static from 2011 onwards. Many of the targets provided only a short-term focus and lacked ambition. This also applies to water risk management (CDP 2016a). Even though the understanding of water risk has improved, the water metric focus is still narrow and more rigorous targets are needed, especially considering that only 58% of set targets have been achieved (CDP 2016f). The reporting frequency of the five environmental risk categories was significantly higher in reports applying the G4 reporting guidelines between 2013 and 2015, suggesting that the G4 guidelines have encouraged better reporting on target monitoring, the presence of a risk assessment and risk reduction targets. With an increased sample size of G4 reports, further research could identify whether the patterns found here hold.

While most environmental risks were identified at group level, the management of the day-to-day environmental risks lies either at group level, operational level, or both. This concurred with findings from UK firms (Vivian *et al.* 2003). Whether a difference in company levels dealing with environmental risk identification and environmental risk management is positively or negatively affecting environmental risk management could not be determined here. Both at UK and South African companies, vertical reporting lines were found to be relatively flat structures. The horizontal reporting lines in contrast were variable. At most companies communication across many departments was present and could facilitate

collaboration and information exchange across the whole company (Kahn 1996), therefore aid environmental risk management performance. From the interviewees' points of view, companies that do involve interdepartmental communication of environmental risks have a good or very good understanding of environmental risks. The absence of such interdepartmental communication was related to a need for improved structures and support from within the company, or simply being a gradual process that requires a lot of time. Further research into such links would be insightful to understand in more detail where internal issues with environmental risk management may lie, especially that reported challenges in environmental risk management and strategies to improve these were found to be mainly related to internal company processes (staff resourcing, training, perceptions and understanding of environmental risks, balancing different interest groups, real-time monitoring/predictive systems).

This study identified that (1) important environmental risks to businesses, such as extreme weather events, failure of climate change mitigation and adaptation, and water crises, which pose in turn huge risks to businesses and society (UNEP 2016b), were absent in annual, integrated and sustainability reports; (2) the multi-system complexity (systems view) as demonstrated in risk interconnections map 1 and 2 is mostly lacking in reports; (3) a strategic focus was absent; (4) factors related to, for example, perception, understanding and staffing need addressing to improve corporate strategic environmental risk management. Few risk reduction targets in place were reported on, correlating with findings by the CDP (2016d). Furthermore, reports and management approaches do not seem to acknowledge the company's dependence on natural capital, adequately identify and evaluate environmental risks, prioritise environmental business risks or quantify and strategically manage them. A strategic approach to environmental risk management is necessary for integrated decision-making (IRCSA 2014), which leads to a systems-based approach to sustainable resource management (Smith 2011). Systems-based management approaches take the complexity and interconnectivity of the human and

environmental systems into account when managing natural capital (IPCC 2007; Rockström *et al*. 2009), allowing for more effective reduction strategies of risk related to resource degradation and climate change that companies and societies will face. The risk interconnections maps identified that such systems-based reporting approaches are mostly absent. The findings also highlight that the previously reported (Benson and Garmestani 2011; Whiteman *et al.* 2013; Sun *et al.* 2018) single-level focus is still present. The CDP (2016d; 2016e) has described sound water resource management and comprehensive risk assessments as vital to strengthening company resilience. A lack of addressing environmental risks strategically and in an integrative manner therefore risks environmental, economic and social wellbeing, enhanced corporate resilience, leaving society exposed to various climate and environmental risks, unable to predict changes and unable to transition to a sustainable future and persevere in this uncertain future. A more adaptable economy will suffer up to half as much annual output losses than a weaker one (Sondermann, *in press*).

5.5 Conclusion

In the presence of increasing resource degradation and resulting risks to the human and natural system such as water insecurity and climate change, societies and economies are left dealing with an uncertain future. Strategic environmental risk management and reporting, as well as systems-based views were rarely present at JSE-listed companies. This indicates that natural resource degradation is continuing, putting societies, economies and the environment at increased risk of being able to maintain their wellbeing, strengthen their resilience and their ability to endure ecological instability while the earth's system is becoming increasingly unstable and uncertain.

CHAPTER 6

Discussion

Human and natural systems are increasingly exposed to a more unpredictable and uncertain future due to changes to and over-exploitation of ecosystems (Folke *et al.* 2002; Walker *et al.* 2004; IPCC 2014b). Ongoing urbanisation, population increase, resource consumption and globalisation compromise the continued provision of ecosystem services for ecological, social and economic functioning (Biggs *et al.* 2012; Farley and Voinov 2016). Four of the nine global ecological thresholds identified in the Planetary Boundaries Framework have been crossed, thus increasing the likelihood of a shift from the current ecosystem state to a new, unknown one (Steffen *et al.* 2015; ESDN 2012). Ongoing environmental degradation is increasingly compromising the planet's ecological resilience, which may result in detrimental or even catastrophic consequences to environmental, economic and human wellbeing (IPCC 2007; Rockström *et al.* 2009). However, the level of severity of such consequences and the risks to be faced in this uncertain future can be reduced by society by enhancing their resilience to environmental change and disturbances (Adger 2000; IPCC 2007; Rockström *et al.* 2009).

Although external factors such as public, political and stakeholder pressures, as well as stock exchange listing requirements and reporting frameworks have improved corporate sustainability management and reporting (Vormedal and Ruud 2009; Skoudoulis *et al.* 2009; Levy *et al.* 2010; Whiteman *et al.* 2013; Maas *et al.* 2016), progress in creating sustainable societies has been slow (Skouloudis *et al.* 2010; Baumgartner 2011; Bouten *et al.* 2011; Jabbour *et al.* 2012; UN 2012; Alazzani and Wan-Hussin 2013; Comyns *et al.* 2013). Strategic, holistic, integrative and long-term approaches have been identified to be mostly absent from corporate sustainability

management (CRO 2013; Ntim *et al.* 2013; Engert *et al.* 2016). Instead of viewing ecological systems as dynamic in space and time, past policies and business practices related to natural resource use management have viewed these systems as stable, linear, predictable and single-layered (Gunderson 2000; Folke *et al.* 2002; Folke 2006; Benson and Garmestani 2011). To drive corporate sustainability forward, more strategic approaches are required that integrate environmental risk into corporate sustainability practices. Such an approach would incorporate the most recent ideas in sustainable development, which position businesses as part of the global, complex, interconnected social-ecological system rather than as separate entities disconnected from it and prioritising the financial bottom line (Aras and Crowther 2009; Sterk *et al.* 2017). Such reassessment of corporate sustainability practices would therefore enable corporations to contribute to reducing environmental degradation, manage associated risks and enhance their resilience. The aim of my PhD thesis was to advance our understanding of whether businesses address social-ecological system complexity as part of their business strategy and the risks associated with ecosystem degradation to strengthen resilience.

6.1 Environmental impact and risk reporting

Although environmental impact reporting preceded environmental risk reporting and conceptually does not incorporate a strategic focus, it is still a reflection of corporate's approach to natural resource use management (Fernandez-Feijoo *et al.* 2014). It should therefore give an indication of how well companies manage environmental issues and how sustainable they are. Yet environmental disclosure quality in corporate annual, integrated and sustainability reports was found to be average to poor (Chapter 2). Company reports highlighted few of the environmental aspects identified by the Millennium Ecosystem Assessment, Planetary Boundaries Framework and Intergovernmental Panel on Climate Change as highly important in the management and reduction of environmental degradation. These key indicators

are addressed in their simplest form by the GRI in the form of consumption, usage and time frame of environmental variables and do not include any level of complexity or long-term consideration. Yet only 35% of 179 reports addressed these indicators (Chapter 2). Disclosure quality was inconsistent within individual companies, between sectors as well as economic groups. Poor environmental impact reporting as identified in this study is in line with numerous other studies globally (see for example Skouloudis *et al.* 2010; Bouten *et al.* 2011; Alazzani and Wan-Hussin 2013; Comyns *et al.* 2013; Barkemeyer *et al.* 2015; Dietsche *et al.* 2017). This was related by other researchers to high costs involved in data collection which could result in the absence of complete datasets (Biddle and Koontz 2014) as well as to the alignment of company policy with environmental initiatives being time intensive (Skouloudis *et al.* 2010; Jabbour *et al.* 2012; Ramos *et al.* 2013; Maubane *et al.* 2014). However, interviews conducted with sustainability managers for this research indicated that reporting fatigue, resource and time constraints negatively affect the quality of environmental management and its reporting, and therefore their progress (Chapter 3). The effects of these factors on disclosure quality may have contributed to the lack of correlation between financial indicators ROCE, ROTA, P:E, ROS and environmental disclosure quality (Chapter 4). At the same time, it is important for companies to see a clear positive relationship between environmental and financial performance, as a lack of such a relationship may translate into a lack of motivation to engage in long-term environmental sustainability management (Song *et al.* 2017; Chapter 4).

The various risk categories (set environmental risk targets, target monitoring, mitigation and adaptation measures, risk assessment and risk reduction targets) were poorly addressed in reports between 2008 and 2015. This also applies to the environmental risk topics such as water, climate change and energy, which were covered in only 20-25% of the 239 reports (Chapter 5). Interviews with sustainability managers revealed that environmental risks only featured in the top ten business risk at four companies. Considering this finding, together with the fact that water crisis

was the only environmental risk that featured in the South Africa Risks Report for 2016 (IRMSA 2016), results suggest that water and climate change risks are still not seen as critical factors for company sustainability.

The reports of companies in the resources and basic industries group showed the highest quality of environmental disclosure and the highest frequency of risk category and topic coverage (Chapters 2 and 5). This grouping mainly comprises companies of high environmental impact, and their environmental reporting was of better quality compared with medium and low environmental impact companies. Companies with a more significant economic, social and environmental impact are subjected to greater levels of media coverage, stricter listing requirements and legislation (Cho *et al.* 2012; Hahn and Kühnen 2013; Hörisch *et al.* 2015; D'Amico *et al.* 2016); this could have positively influenced the disclosure quality of these companies.

6.2 Progress in sustainable business practice has slowed down

Of concern is the finding that disclosure quality of environmental impacts as well as coverage of environmental risks levelled out in 2011. Although legitimacy theory is one potential explanation for this trend, the continuous changes in the sustainable development concept driving changes in sustainability reporting and management frameworks, principles, guidelines and stock exchange listing requirements (for example <IR> Framework, King IV, GRI) should have driven companies to continuously adjust their reporting and management. This should have led to improvements in reporting. Although significant differences were found between G3.1 and G4 reporters between 2013 and 2015 (Chapter 5), the reporting frequency of risks and environmental risk categories was generally still low. The stagnating reporting frequency and quality could rather be linked to a still dominant short-term focus and lack of ambitious targets, as found by the CDP (2016a). This focus is not challenged by, for example, the GRI guidelines, which state that the "sustainability

report conveys disclosures on an organisation's impacts – be they positive or negative – on the environment, society and the economy." (GRI 2013, p. 3). A focus on risks to the company and long-term ambitious targets is absent. This is reflected in the limited reporting of the environmental risk categories' set targets, monitoring targets and mitigation/adaptation strategies between 2008 and 2015. Neither was there a long-term, holistic and strategic focus evident for either the GRI 3.1 or the G4; this suggests that the first-level assessment of environmental impacts and risks is not sufficient to guide companies in their management and reporting of corporate environmental sustainability management. While the GRI Standards will replace the G4 on 1 July 2018 – and includes long-term strategy, potential risks, opportunities and goals reporting – sustainability reporting is still based on impacts on the economy, the environment, and/or society (GRI 2016, p. 3). This reflects TBL reporting, rather than risks to businesses and the social-ecological system of which they form an integral part. The GRI Standards also do not reflect the recent developments in the sustainable development concept. Yet a focus on TBL reporting is insufficient considering the risks economies and societies are facing from climate change.

Even though the topics covered most frequently in reports and addressed by interviewees (energy, water, greenhouse gas emissions, climate change and waste) related to the environmental risks South Africa is facing, the coverage of the above topics may be linked to what best portrays company aims (Barkemeyer *et al.* 2015). Also, topic coverage may not be based on materiality (Barkemeyer *et al.* 2015) as research has shown continent and sector consistency and no country-level preferences (Barkemeyer *et al.* 2015; Chapter 3). The coverage was thus not Although the GRI reporting guidelines promote comparability, reports have become too static and uniform, while also not addressing multi-level and multi-system system complexity. This may also increase the risk of using the GRI guidelines as a tick-box-system, which cannot assist the company in driving sustainability, forward (de Colle *et al.* 2014). Reporting guidelines are rather meant to be used as a framework to guide a

company to identify business materiality, and to report and manage environmental impacts and risks accordingly.

Environmental sustainability reporting still appears to follow a “restoration” approach (Benson and Garmestani 2011, p. 394). This aims to maintain systems the way they were, not taking into consideration inevitable change and the need to have strategies in place to manage uncertainties regarding future events (White 2010). As Lozano (2013) pointed out, there is still a need to adjust targets and redefine the business strategy to attain sustainability. Considering the increasing severity of natural resource degradation and climate change, exposing social and human systems to their associated risks and uncertainties, it is concerning that environmental risk reporting has not improved. On the contrary, this research has shown that environmental risk reporting is stagnating. Even factors such as regulatory norms, an understanding of the importance of environmental issues, experienced staff, a sustainability committee and well-aligned internal processes and structures positively impact the management of company environmental sustainability could not further the progress in corporate sustainability – if company staff responsible for day-to-day corporate sustainability management are not sufficiently resourced, and have reporting fatigue, improvements in environmental management will be limited. It is also of concern that such limitations were reported to have existed for many years (Adams and McNicholas 2007), but have still not been addressed.

6.3 Systems-based approaches

Important environmental risks such as climate change, biodiversity and water crises identified by the global business community (WEF 2017), the MEA (2005), Planetary Boundaries Framework (Rockström *et al.* 2009; Steffen *et al.* 2015) and IPCC (see for example Cubasch *et al.* 2013; Hartmann *et al.* 2013; Kirtman *et al.* 2013; Burkett *et al.* 2014; Cisneros *et al.* 2014) were rarely addressed in reports between 2008 and

2015 (Chapter 5). A systems-based approach, emphasising the links between governance, strategy and sustainability as well as the linkages and interdependencies between the various capitals, was rarely present. The majority of annual, integrated and sustainability reports provided few and linear links as highlighted by the two risk interconnections maps, and risks were rarely connected to long-term strategic objectives. Interview responses also indicated that the majority of companies did not acknowledge their dependence on natural capital nor did they manage it strategically. Business conduct was thus still found to display a predominantly short-term, reactive and one-dimensional focus with few reduction targets in place as identified by previous research (Benson and Garmestani 2011; Whiteman *et al.* 2013; CDP 2016d; Sun *et al.* 2018). However, integrating strategic environmental risk management into corporate sustainability enables companies to identify and manage risks arising from environmental change and resource degradation (Baumgartner and Rauter 2017). It also allows companies to understand their role as part of the global social-ecological system. This understanding is necessary in building and maintaining resilience, thus to have the capacity to address change. Corporate sustainability could then be fostered. Improving corporate sustainability would improve adaptive capabilities, which essentially enhance resilience (IPCC 2007; Rockström *et al*. 2009; Smith 2011). As a strategic environmental risk focus was found to be mostly absent, progress in global sustainable development will continue to be slow unless changes to management practices are made in the short-term.

To change sustainability practices, increased prioritisation of strategic environmental risks is necessary, especially at executive and board level (PwC 2016). Environmental risks are not acknowledged as critical factors for corporate sustainability (IRMSA 2016; PwC 2016), a point also raised by interviewees during the present research (Chapter 5). The board and executive level of corporate structures have the authority to give environmental risks increased visibility and importance; they further have the capacity to alleviate the identified challenges related to staffing and management systems. It requires the board and executive levels to promote the shift in corporate

sustainability towards more holistic natural resource use management practices. Such a shift at the highest company levels would filter down to day-to-day management practices. Considering the scientific evidence of climate models and predictions around the consequences of further natural resource degradation and climate change, environmental risks certainly should be a priority at company level.

6.4 Conclusion and recommendations

Environmental sustainability has become increasingly embedded in governance and corporate bodies since public, stakeholder and political entities have grown in their demand for environmental concerns in business practices (Kolk 2003; McDonald 2004; Sneddon *et al.* 2006). Corporate firms were thus required to link financial and non-financial information more clearly and increase the transparency of their strategy, long-term performance and value-creation (Cheng *et al.* 2014; de Villiers *et al.* 2014; Burke and Clarke 2016). In response to global imperatives, the sustainable development concept has evolved from conceptualising the TBL to the six capitals model, towards applying governance, risk and most recently resilience theory (Xu and Marinova 2013; Xu *et al*. 2015). Corporate sustainability management is therefore meant to take social-ecological system dynamics into consideration.

Determining where businesses are on their path in understanding and applying the most recent developments applicable to sustainability is one of the biggest challenges in attaining corporate sustainability. Yet research findings in South Africa indicate that the shift in management practices from TBL to risk and resilience has generally not taken place. Environmental risks were seldom identified, not viewed as critical to company sustainability, and rarely were they managed strategically. Current corporate sustainability practices do not challenge the traditional financial (short-term, retrospective and linear) focus. The notion that such financially-focused business practices can be slightly adjusted to foster sustainable development is still

present. This is reflected in company management and reporting displaying short-term financial, retrospective and linear approaches and depicting the system as stable, predictable and that impacts can be controlled. Findings show that company approaches, reporting and management mostly still focus on the TBL concept, and that corporate sustainability is lagging three concept steps behind. A systems view and long-term approaches are not present. This has not progressed social sustainability, as findings by this research as well as by other research illustrate (Skouloudis *et al.* 2010; Baumgartner 2011; Bouten *et al.* 2011; Jabbour *et al.* 2012; UN 2012; Alazzani and Wan-Hussin 2013; Comyns *et al.* 2013). If companies had recognised that a reassessment of business practices is necessary to manage their activities sustainably, their role as part of and within this global system would have been reflected in their management and reporting. Their management and reports would have also reflected the risks resulting from business activities to the business itself, as well as overall environmental, social and economic health. In this case the positive influences on corporate sustainable management, such as regulatory norms, an understanding of the importance of environmental issues, experienced and well-resourced staff, a sustainability committee and well-aligned internal processes and structures, communication within the company and to the board, effective monitoring processes addressing the company's ability to re-evaluate risks, supportive company's culture, codes of conduct, human resources and performance and reward systems, would have translated into improved corporate sustainability. The aim of sustainable development (see Holling 2001) has not been achieved. This is worrying considering that a reassessment of corporate sustainability management are urgently necessary if businesses aim to reduce risk exposure resulting from ecosystem degradation, ensure sustained social, economic and environmental wellbeing, strengthen their resilience, and thus have the ability operate sustainably and recover from current and future disturbances.

While the GRI guidelines have been updated and are a suitable and internationally comparable financial reporting tool, and provide a global standard that is

internationally comparable, they have reduced system complexity. Reporting and management guidance have been simplified to a level at which they do not reflect system dynamics; neither do they allow for a long-term, multi-dimensional sustainability assessment of a company. The reporting guidelines still fundamentally apply the TBL approach and have not progressed to address the concept of interdependence and reliance on natural systems. The identified difficulties with understanding materiality could imply challenges in understanding how environmental issues affect the business and could also imply the use of the GRI guidelines as a tick-box-system. This reduces environmental and other sustainability indicators to mere data points, and disconnects these from the actual mode of functioning of social-ecological systems.

The current water crisis in Cape Town (Evans 2018) clearly highlights the economic effects of climate change, unsustainable natural resource use (Groenewald 2018) and the importance of being able to absorb and recover from such disturbances while maintaining business functionality. Despite "Day Zero" – when Cape Town will run out of water – is approaching fast (predicted for April 2018), corporations and households are not adhering to the governmental water conservation targets, and some are even questioning the reality of the water crisis (Gosling 2018; Maxmen 2018). While it is important that companies focus on the reduction of their water consumption, they should further aim to change their approach to water use management. Even during such a high risk situation resulting from the current water crisis threatening business operations, corporate sustainable management practices have not changed.

However, some companies have shown that strategic environmental risk management is indeed being practiced currently. The findings of the study show that long-term planning had been carried out and connections between the various capitals had been made. These few companies were aware of the risks that environmental degradation and climate change pose to their business and have set out to manage them

accordingly. Although few in numbers, it clearly demonstrates that the notion of financially-focused business practices can be replaced by systems-based views without jeopardising the bottom line. To the contrary, because of these changes, those businesses are enhancing their level of resilience and are maintaining their business functionality while exposed to uncertainty and risks resulting from resource degradation. To advance rethinking of and changes to business practices to reflect the recent changes in the sustainable development concept, it is recommended that:

- Companies engage in the concepts and theories included in the sustainable development concept to increase their understanding of system dynamics and their positioning and role within the system;
- Companies acknowledge their inevitable dependence on natural capital, and act as part of the social-ecological system. Every business decision therefore needs to be linked back to impacts on the environment and risks to the business arising from such impacts;
- Companies acknowledge that environmental degradation and climate change pose risks to business survival;
- environmental factors are given more weight and visibility, especially at board level and CEO;
- Environmental risks are included in the business strategy;
- the complex nature of the six capitals is acknowledged, understood and incorporated into business management;
- Increased efforts are made to include a long-term, forward-looking focus of the business strategy;
- The sustainability (or similar) committee is given more authority in managing environmental risks and in influencing the business strategy;
- Sufficient funding for teams and for the employment of qualified staff managing environmental impacts and risks is provided. This can reduce reporting fatigue, improve environmental risk management quality and counteract the negative effects of misaligned reporting frameworks, and tight submission deadlines;

- Comprehensive risk assessments are applied;
- Predictive systems and/or real-time monitoring systems are installed that allow for immediate actions. This can prevent environmental catastrophes or failing to comply to legal standards (for example water quality);
- Firms consider identifying business-specific thresholds, setting limits at which point their business is no longer viable. This may allow businesses to understand interconnectivity, complexity and non-linearity, as well as the consequences of crossing thresholds. It could simplify the identification of key management strategies to operate sustainably within those limits.

Corporate sustainability practices and management systems did not adequately address the most recent developments in sustainability by applying risk and resilience thinking. Businesses have also not reconsidered their position as part of a complex social-ecological system and the direct and indirect consequences of their actions on all actors. Business approaches and management still suggest a disconnect from the system, as well as short-term, linear and retrospective views. Sustainability can therefore not be fostered and resilience enhanced, which leaves business and society exposed to the increasing risks, uncertainties and dynamics associated with ecosystem degradation; thus we will be unable to build capacity to maintain social wellbeing.

Limitations of the study

Like all research, this study had a number of limitations that I wish to acknowledge. A limitation arises from interviews conducted to obtain a better understanding of environmental risk management as the response rate was relatively low. Extending the number of interviews would assist in confirming the patterns found here. Interviews were limited to sustainability managers and other staff managing the day-to-day sustainability matters at their respective company. Including board members and CEO in the interviews could have provided further insights into the extent of a change in thinking around the importance of natural capital, uncertainty, long-term

focus and risks to the business resulting from natural resource degradation. Further, the absence of any correlations between environmental disclosure quality and the financial performance indicators ROCE, ROTA and P:E as well as the moderate negative correlation between environmental disclosure quality and ROS could be strengthened by applying more advanced econometric analyses, as the use of simple correlation coefficients were found to increase the likelihood of finding a negative link between the two variables (Horváthová 2010).

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APPENDIX 1

Economic groups and examples of their type of company according to the FTSE Global Classification System (2002).

Economic group	Description
Resources	Companies engaged with mining, oil and gas
Basic Industries	Companies involved in chemical production, building and construction materials; constructors; owners of timber tracts and paper producers; steel traders, manufacturers and producers
Cyclical Consumer Goods	Manufacturers and distributors of automobiles, parts and vehicles; manufacturers, distributors and/or wholesalers of clothing, furnishing and leisure equipment
Non-cyclical Consumer Goods	Beverage manufacturers, distillers; processors and wholesalers of food; owners and operators of health maintenance organisations and other health care services and products; tobacco manufacturers and wholesalers; companies engaged with pharmaceuticals and household or personal products
Cyclical Services	Retailers of discount, super stores and warehouses, e-commerce, hardlines, multi department and soft goods; companies engaged with gambling, hotels, restaurants; media and entertainment; rail, road and freight
Financials	Companies engaged with banking, life and non-life insurance, investment and real estate

APPENDIX 2

GRI environmental indicator protocol set and maximum scores per *core* indicator to calculate environmental disclosure quality.

GRI environmental indicators		Aspect	Score	Total
EN1	Materials used by weight or volume	Materials	/12	/24
EN2	Percentage of materials used that are recycled input materials		/12	
EN3	Direct energy consumption by primary energy source	Energy	/20	/32
EN4	Indirect energy consumption by primary source		/12	
EN8	Total water withdrawal by source	Water	/8	/8
EN11	Location and size of land owned, leased, managed in, or adjacent to, protected areas and areas of high biodiversity value outside protected areas	Biodiversity	/8	/20
EN12	Description of significant impacts of activities, products, and services on biodiversity in protected areas and areas of high biodiversity value outside protected areas		/12	
EN16	Total direct and indirect greenhouse gas emissions by weight	Emissions, Effluents, and Waste	/16	/88
EN17	Other relevant indirect greenhouse gas emissions by weight		/12	
EN19	Emissions of ozone-depleting substances by weight		/8	
EN20	NOx, SOx, and other significant air emissions by type and weight		/12	
EN21	Total water discharge by quality and destination		/12	
EN22	Total weight of waste by type and disposal method		/12	
EN23	Total number and volume of significant spills		/16	
EN26	Initiatives to mitigate environmental impacts of products and services, and extent of impact mitigation	Products and Services	/8	/20
EN27	Percentage of products sold and their packaging materials that are reclaimed		/12	

	by category			
EN28	Monetary value of significant fines and total number of non-monetary sanctions for noncompliance with environmental laws and regulations	Compliance	/8	/8
Total				/200

APPENDIX 3

Interview questions for JSE-listed selected companies covering sustainability/environmental reporting and Section 9 guidelines in King III.

Interviewee´s particulars
Company: Interviewee: Position at company: Department:

1. Rank economic, social and environmental aspects according to the level of importance in your company (1 = most important; 3 = least important).

2. What motivates you/your company to report on environmental issues?

3. Does your company have a sustainability committee? Why / why not?

4. Do you consider the above as a vital part in improving environmental performance?

5. Which criteria are applied select new staff for the sustainability department?

6. King III Principle 9.1.1: A company should have controls to enable it to verify and safeguard the integrity of its integrated report. If any, what controls are present in your company to verify and safeguard the integrity of the integrated annual report?

7. King III Principle 9.1.5: Focus on substance over form. How does the company ensure substance over form?

8. King III Principle 9.3.3: The audit committee should oversee the provision of assurance over sustainability issues. Does the audit committee oversee the provision of assurance over sustainability issues?

9. Are there any issues related to the overall topic of this interview which have not been covered here but you would like to address?

APPENDIX 4

Interview questions for JSE-listed selected companies discussing environmental risk management strategies.

Interviewee´s particulars

Company: Interviewee:

Position at company: Department:

1. What are the top strategic environmental risks at your company? List a maximum of three for each category.

2. Where would they feature in a list of all company risks combined (e.g. top, middle, bottom)?

3. Who has responsibility for identifying environmental risks within the organisation?

4. Who has responsibility for management of day-to-day corporate environmental risk-related issues?

5. What are the reporting lines, vertical and horizontal, for addressing corporate environmental risks?

6. What are the connections and linkages between environmental risk management systems and other business risk management systems?

7. How well do the company's culture, codes of conduct, human resource policies, and performance and reward systems support environmental risk assessment and internal control system?

8. How effectively do monitoring processes address the company's ability to re-evaluate risks in response to changes, either internal or external? How effective are follow-up procedures to ensure action occurs in response to changes?

9. How effective is communication to the board on effectiveness of ongoing monitoring of environmental risk and internal control?

10. Where, in your opinion, lie the obstacles in environmental risk management?

11. What needs to be done/what strategies need to be put in place at company level to improve environmental risk management?

APPENDIX 5

Interview responses for environmental challenges and potential strategies to overcome these.

What are the challenges in environmental risk management?	What strategies need to be put in place at company level to improve environmental risk management?
Regulations: - Compliance - Conflicting requirements - Lack of understanding - Changing company processes due to new regulations	Increase/improve: - Accountability - Awareness of (1) environmental risks; (2) financial implications - Partnerships (e.g. communities) - Culture and perception to increase understanding of environmental risks - Implementation (e.g. licensing)
Market: - Conditions - Pricing	Systems: - Real-time monitoring - Predictive systems
Balancing: - Shareholder/stakeholder expectation and business affordability - Ecological and ethical issues and business sense	- Move away to some extent from target approach of government compliance - replace with value range (e.g. air quality)
Staff: - Resourcing - Lacks authority to manage environmental risks	Staff: - Increase capacity - Training
Understanding financial-ecological link	Align compliance and business targets
Capital availability	Government investment in sustainability
Quantification on balance sheet	Analysis of value chain
Uncertainty	

Complexity
Perception and resistance to environmental issues
Supply chain management