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UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

THIRSTY FOR CHANGE: WATER CHALLENGES AND OPPORTUNITIES IN SOUTH AFRICAN BUSINESSES

A dissertation submitted to the Faculty of Science, University of the Witwatersrand, Johannesburg, in fulfilment of the requirements for the degree of Master of Science.

by

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Supervised by Prof Coleen Vogel and Prof Barend Erasmus

Johannesburg, 2019

DECLARATION

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



(Signature of candidate)

29 day of August 2019 at 15:49

ABSTRACT

Water is a key element linked to challenges such as food security, economic development, energy generation and climate change. South Africa experienced its driest year on record in 2015, together with one of the largest cities, Cape Town, almost running out of water in 2018. The likelihood of increased drought in the future coupled to climate risks makes it imperative to attend to water security concerns within the country. The business sector needs to pay more attention to water issues given its reliance on water for operation. This study explores how South African companies that are dependent on water respond to water security concerns linked to increased demand and variability. Focusing on the potential of the CDP Water reporting process to promote improved water stewardship practices. A mixed methods approach is used including a detailed investigation of CDP Water report data and interviews. Companies are unique in their responses, their perception of water risk hence determines their responses to the risk. Many companies showed misalignments between their company strategy, governance and practice in water decision making that further calls into question their water stewardship in addressing water security concerns. Although water stewardship is highlighted as an opportunity for various companies, engagement in practices that promote stewardship is low. In the pursuit of water stewardship practices and improved water management, context becomes key. By companies conducting comprehensive river basin assessments, it assists in addressing and engaging water risks in a local context. Beyond CDP reports and interviews, an underlying outcome has emerged that calls for effective sustainability/ environmental strategic planning in environmental departments within companies. Communication becomes an essential tool even though creating a business case around risk is not unique to water. An emphasis is then needed at Board level on effective leadership within a company to transform the way they view their water related risks and turn them into opportunities. To bring these findings together, archetypes were created based on company 'water stewardship readiness.' The archetypes encompassed the likelihood of companies engaging in water stewardship practices as this is seen as one of the best ways forward for business to assist in securing water in the country. The notion of a water champion to tackle water related risks and lead opportunities brings to light the value of education and creating individuals, regardless of their field of interest, with the understanding and knowledge that resources such as water are limited. Environmental issues should be embedded within these individuals for appropriate decision making given the current state and future projections of not only water, but environmental concerns going forward.

DEDICATION

To my parents for your unconditional love and support, I am forever grateful for your investment in my education.

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LIST OF ACRONYMS

CDP	Carbon Disclosure Project
CEO	Chief Executive Officer
DWA/DWS	Department of Water and Sanitation
ERM	Environmental Resources Management
GRI	Global Reporting Initiative
IPCC	Intergovernmental Panel on Climate Change
MDG	Millennium Development Goals
NBI	National Business Initiative
NDP	National Development Plan
NWRS	National Water Resource Strategy
PCA	Principal Component Analysis
SDG	Sustainable Development Goals
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environmental Programme
UNGC	United Nations Global Compact
WMA	Water Management Area
WEF	World Economic Forum
WRF	Water Risk Filter
WRI	World Resources Institute
WWF	World Wide Fund for Nature

1. CHAPTER ONE – INTRODUCTION

1.1. Background

South Africa is a water scarce country (Percival & Homer-Dixon, 1998; NDP, 2011; Hedden & Cilliers, 2014; Wort, 2015). Periods of drought, (e.g. such as during 2015 which was confirmed as the driest year on record (de Jager, 2016; Allen *et al.*, 2018)), further exacerbate the ways in which water is used in South Africa. To add to this, future projections by the Intergovernmental Panel on Climate Change (IPCC) shows a greater possibility of drought over the southwestern parts of the country with a decrease in rainfall over the west coupled with heightened variability (Niang *et al.*, 2014).

The demand for South Africa's limited water resources is increasing with an increased competitiveness between the various water needs of different sectors. These demands mainly lie between the agricultural, industrial, energy, mining, commercial and domestic sectors (NWRS2, 2013). Consequently, water plays a crucial role in the country's economy with agriculture using almost 60% of supply (Muller, 2016). The second largest water user is the municipal sector. However, water withdrawal within this sector is expected to keep rising as the country's population increases (Hedden, 2016). In order to ensure the sustainable use of water, strategies need to be implemented to manage the accessible supply of water with its corresponding demand (Gleick, 1998; Hedden, 2016).

As "water ecosystems underpin functioning economies" (Pegram *et al.*, 2009; p.12), it is imperative to assess how the private sector in South Africa is dealing with water security concerns. Businesses in many cases may not be able to operate under water stressed conditions – "either because they rely on large volumes of water for their core functions or because they are not able to offer safe water and sanitation to employees for their time at work" (WWF, 2018b; p.2). Increasing water scarcity, driven by growing water demand and climate variability, is seen as a major risk to the global economy and a challenge for businesses (UNGC/UNEP, 2012; Hoekstra, 2014; Morgan & Orr, 2015).

1.2. The Complex Nature of Water

Water security, defined by the United Nations, is "the capacity of a population to safeguard sustainable access to adequate quantities of acceptable quality water for sustaining livelihoods, human well-being, and socio-economic development, for ensuring protection against water-borne pollution and water-related disasters, and for preserving ecosystems in a climate of peace and political stability" (UN-Water, 2013; p.1). According to the National Water Act for South Africa in 1998, water security is simply explained as "some for all and forever" (also see NWA, 1998; Mackay, 2003; p.53; MacKay *et al.*, 2003; p.353). Although definitions exist, there is a diversity of explanations and approaches for the concept of water security, depending on the subject area (Allouche *et al.*, 2011; Cook & Bakker, 2012).

Since the 1990s, the notion of water security was established and has developed considerably ever since (Cook & Bakker, 2012). In a comprehensive review of this concept, it was found that there is an increase in the use of the term across disciplines. Interestingly, the top five most cited articles that included the term 'water security' were all found in different fields of research (Cook & Bakker, 2012).

Water security thus needs to be viewed as a complex system challenge, with an emphasis on the effects water scarcity has across sectors, environments and communities. Natural and social systems are revealed to be complex within themselves, thereby adding to the interactions of complexity in already inter-twined systems (Pollard & Du Toit, 2008). Water, a critical interconnecting sub-system of the environmental system, is no different. Pollard and Du Toit (2008) summarise the fundamental characteristics of complex systems with examples related to water (Table 1). Managing water in such complex, inter-twined systems, requires interactions between different stakeholders at different levels of governance. The management of water resources in any of the interfaces of the system in a sustainable manner can prove challenging for the whole system. Berger *et al.* (2007; p.130) emphasise the wicked complexity inherent in water systems: "This is due to the fact that the scale of management implied by hydrological characteristics often comprises many layers of social, political, and economic institutions."

Table 1: Characteristics of complex systems (Source: Pollard & Du Toit, 2008)

Attribute	Example
Socio-ecological systems are **heterogeneous**, **dynamic** and in a state of **flux**. Variability is essential and not a 'management inconvenience or problem'.	Rainfall may vary around an 'average' of 500 mm per year – from 200 mm in a dry year to 800 mm in a wet year. This brings about different effects each year and cumulatively.
Systems have **multiple drivers**, many of which are non-linear in their effects and which operate at different scales. Hence out-comes are usually not entirely predictable. Also some of these drivers may relate to other 'sub-systems' such as a political or global drivers.	A reduction in base flows may reflect increased abstraction, the impacts of a weir and a political decision to expand agriculture, such as biofuels which are seen as a way to improve our foreign exchange
Components of systems are independent and interacting and understanding the linkages is important. In particular **feedback loops** are an important attribute of complex systems.	For example, a reinforcing loop is evident when wetland health improves, causing an increase in the water table which causes a further improvement in wetland health (Pollard and Perret, 2007)
Multiple drivers and feedback loops often mean uncertainty because we **can't predict exact outcomes**, Moreover they can lead to **unexpected outcomes**	The global drive to reduce dependence on fossil fuels (viewed as a favourable position for sustainability) has increased biofuel initiatives which are impacting on water resources and on food availability.
Complex systems display **lags**	We are unlikely to see immediate benefits from the policy to determine environmental flows because of the complex socio-economic and political arrangements needed to achieve this
Complex systems are not necessarily complicated; in fact, they often only have a **basic set of drivers and responses**.	For example, fire, rainfall and fire management may be the key drivers of savannah eco-systems.

Solving complex systems such as water security requires approaches that can deal with such interactions. One such method is a transdisciplinary approach (Wiek & Walter, 2009; Rich-Tolsma & Assenza, 2013). One of the earliest definition of transdisciplinary was defined by Apostel in 1972 as "establishing a common system of axioms for a set of disciplines" (Apostel, 1972; p.24). This can be interpreted as a procedure whereby different disciplines and knowledge contributors (for example, with regards to water the role of business, civic society, government agencies, water related industries and other knowledge holders within society) work together in achieving a common goal by integrating their expertise.

In a study by Sershen *et al.* (2016), one of the challenges and developments explored within the South African context was water security and governance. Highlighting a transdisciplinary approach to ensure water security, it was stressed that different stakeholders have different perceptions around water related issues and these all need to be included. Additionally, a transparent and continuous conversation with all stakeholders is crucial in safeguarding water and essential to creating water stewards.

The complex nature of water therefore requires an integrative, multi-scaler systems approach. With a plethora of global and regional agreements and frameworks, the water

challenge remains local. The interconnectedness of water is emphasised through the impact on society, the environment and the economy as explored in the section below.

1.2.1. Water, a local challenge needing integrative systems approaches

The urgency behind securing water resulted in the inclusion of water access and sanitation in the Millennium Development Goals set by the United Nations, with leaders from 189 countries in the year 2000 with targets set for 2015. One of the most compelling results found that "water scarcity affects more than 40 per cent of the global population and is projected to rise" (MDG, 2015; p.55). Although some targets were met, many were improved on and expanded into the new set of Sustainable Development Goals (SDGs) established during the Rio+20 Conference in 2012 (Sachs, 2012). These SDGs have 17 goals for the 2030 development agenda and this study will focus on goal six which is to "ensure availability and sustainable management of water and sanitation for all" (UNDP, 2016; p.4).

Since 2012, the global water crisis has been amongst the top five global risks according to the World Economic Forum (WEF). The year 2018 was no different, ranking the water crisis as the fifth most impactful risk. Over the first three years, the water crisis was categorised as an environmental risk, however, in 2015 it was seen as the top most global risk in terms of impact and was then re-categorised as a societal risk. Here the water crisis is defined as "a significant decline in the available quality and quantity of fresh water, resulting in harmful effects on human health and/or economic activity" (WEF, 2018; p.61). Although the WEF's definition focuses on water deficiency, Kammeyer (2018) highlights that the water crisis is not restricted to scarcity and pollution. Rather as Shulte (2018a, online) mentions, physical water risks can diverge from a number of issues including having "too little water, too much water or water that is unfit for use."

The Global Risks Report (2018) additionally emphasises the complexity of water through the interconnectedness between environmental risks and their strong links to the water crisis. Immense weight is placed on the strength of connection with the failure of climate change mitigation and adaptation. This is followed by strong connections with extreme weather events, man-made environmental disasters, natural disasters, biodiversity loss and ecosystem collapse. Additional prominent links to the water crisis from societal risks

included the food crisis and the failure of urban planning with the geopolitical risk of state collapse or crisis and the economic risk of energy price shock and failure of critical infrastructure (WEF, 2018). Pegram *et al.,* (2009; p.12) stress the association of water with society, "People live in and around freshwater systems, so ecosystems are highly interconnected with human activities and are quite vulnerable to change." The systemic challenge stems from the interwoven connectedness of these risks with each other.

The costs of water risks from a wider systems perspective is also daunting. In the wake of climate change and its effects on water variability, "water insecurity is a US$500 billion annual drag on global economic development – excluding environmental and other non-monetized impacts" (UNDP, 2016; p.5). The Global Water Partnership and the Organisation for Economic Co-operation and Development state that economic prospects are heightened when water is easily obtainable - an unreliable source of water in contrast inhibits growth (Sadoff *et al.,* 2015). To any economy, these effects can be detrimental. The SDGs therefore appeal to businesses as a fundamental driver of sustainable development. These complex interconnections between water as a resource and economies across scales further suggests the need for a transdisciplinary approach with businesses to work with the government and other stakeholder/actor agencies to ensure a sustainable water supply (CDP, 2016).

1.3. The South African Context

Bearing in mind that the water crisis was the fifth most impactful risk according to the World Economic Forum, for South Africa, this context is not that different. South Africa is a water scarce country and demand for its limited water resources is increasing with an increased competitiveness between the various water needs of different sectors. Water risks links to the range of related risks highlighted by the Global Risks Report, such as the food crisis the failure of urban planning, the risk of state collapse or crisis and failure of critical infrastructure to name a few. These risks are not unique to South Africa, but are all amplified by the lack of water.

Having given a brief overview of water, water risks and the cascading and ripple effects across sectors at varying scales, attention now turns to the South African context. As in the

global context presented above, the inter-linkages and dependencies between biophysical and socio-economic stressors, in the local context are key to understand.

From a biophysical view a number of factors shape the 'water risk' context in which businesses have to try and operate. Climate change is one key overarching concern. Extensive evidence has been observed about the processes and impacts associated with the changing global climate (IPCC, 2014b). At present, "climate change is being experienced as increasing temporal and spatial variability in temperature, precipitation, and winds, particularly the incidence and magnitude of extreme events" around the world (Vermeulen *et al.*, 2012; p.196). The South African Weather Service, for example, reported 2015 as the driest year on record since 1992 (de Jager, 2016). According to water stress projections conducted by Aqueduct in 2013, South Africa as a whole has a 'high' level of water stress (Fig. 1). Around the world 37 countries face 'extremely high' levels of water stress (Gassert *et al.*, 2013).

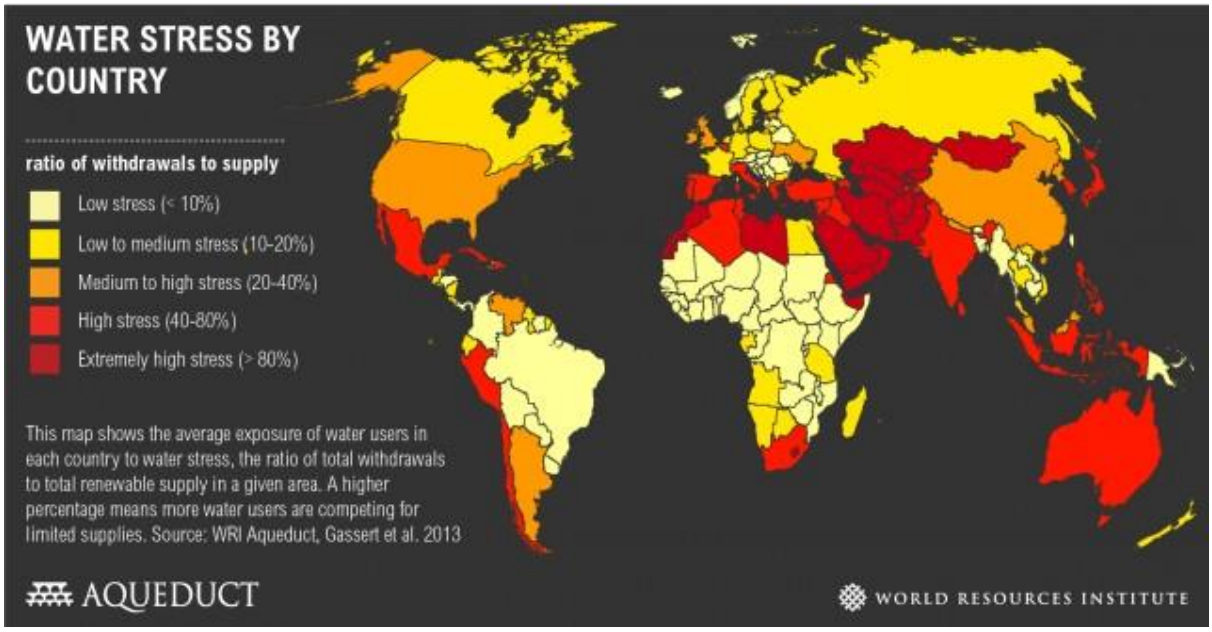


Figure 1: Water stress by country (Gassert et al., 2013)

At the provincial level, based on WRI Aqueduct 2014 data, South Africa's water stress can be broken down into low to medium, medium to high and high overall water risk with small areas in the Western Cape experiencing extremely high water risk (Fig. 2). The greater part of South Africa is covered by a medium to high risk with portions of low to medium water risk. A high water risk, however, covers crucial cities in the country

including the Western Cape, a large portion of the Northern Cape, the majority of North West and Gauteng and fragments of Limpopo.

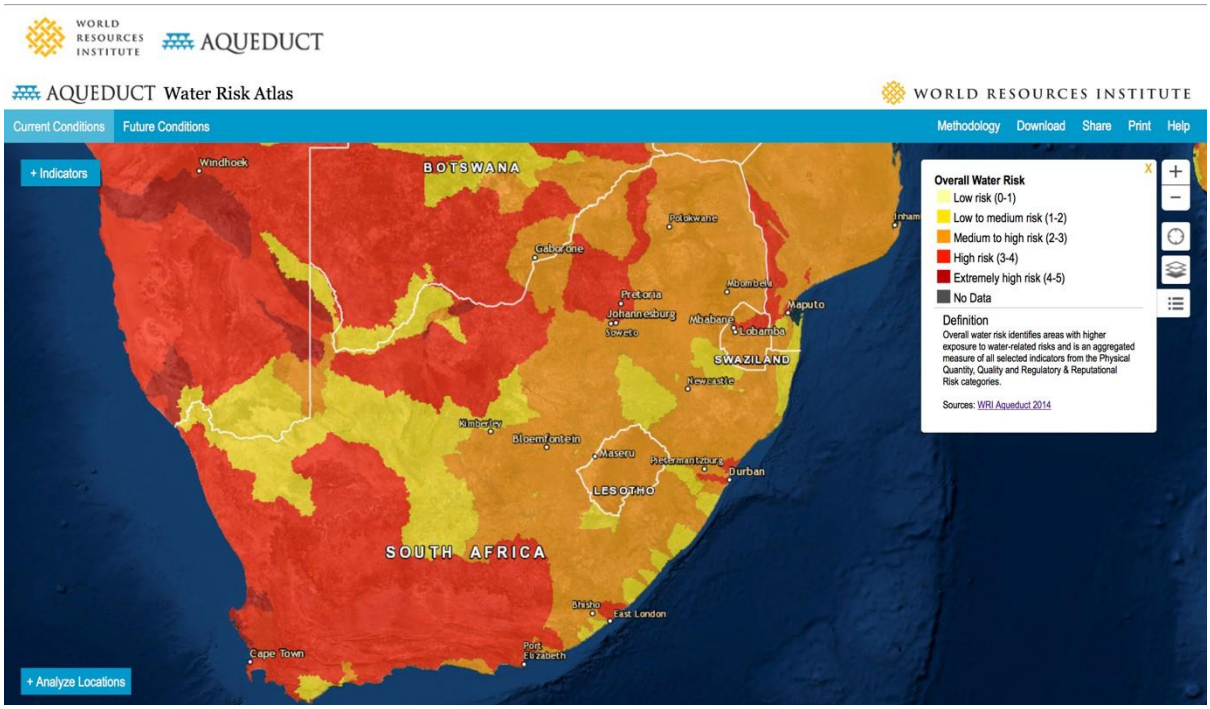


Figure 2: Using AQUEDUCT to visualise South Africa's water stress regions (Source: Aqueduct, 2018)

Five provinces were declared drought disaster areas in 2015 (Ngoepe, 2015). This increased to eight in June 2016 with Gauteng recorded as the only province not impacted as intensely (Essop, 2016). At the beginning of 2017, South Africa continued to operate under drought conditions despite a rise in water levels. The Vaal Dam rose to 90 % capacity from as little as 26% according to the Department of Water and Sanitation (Bega, 2017). However according to Sputnik Ratau from the Department, drought conditions were anticipated to continue for no less than the upcoming two years (Modise, 2017). On the 13th of March 2017 water restrictions in Gauteng were lifted as the Vaal Dam approached 100% capacity, which was the highest level the dam has reached in six years (Lindeque, 2017; Rahlaga, 2017). In this case, dam level increase was as a result of intense rainfall in Gauteng and not necessarily water restrictions. Many provinces in South Africa were unfortunately not as fortunate.

The City of Cape Town in the Western Cape for example implemented Level 6B water restrictions from February the 1st 2018. The seriousness of a lack of water compelled the City into creating two new water restriction levels (Donnenfeld *et al.,* 2018). The

fundamental restriction was a daily limit of 50 litres of water per person (City of Cape Town, 2018). This limit was decreased by 37 litres (from 87 litres) in January 2018 as dam levels dropped to 32% (Palm and Smith, 2018). This brought about the likelihood of a 'Day Zero' characterised by the day the City's taps were expected to run dry. It was calculated "based on knowing how much water is in the big six dams that feed Cape Town and the Western Cape Water Supply System, and knowing how much water is being used by the city's residents, by agriculture and what is evaporating out of the dam," (WWF, 2018; p.1). The expected Day Zero date was set for the 21st of April 2018 and entailed the installation of 200 points of distribution where residents could collect their allocated 25 litres of water per person among other plans (Jacobs, 2018; Walton, 2018; WWF, 2018). Day Zero has since had multiple push backs and is still being planned with a possible date in 2019 (Evans, 2018; Gosling, 2018; Yates, 2018).

Although many have questioned the seriousness and integrity of Day Zero (Jadwat, 2018), the WWF stated that the drought was real and that Cape Town was still at risk of water shortages (Evans, 2018). In the beginning of April 2018, dam levels together reached a maximum of 21,9%. In order for dams to recover, the province requires at least three consecutive years of average rainfall (between 450 and 550ml) every winter (Winter cited in Palm, 2018).

1.3.1. What do such periods of water stress, in part induced by climate stress, mean for business operations?

In 2017, the National Business Initiative (NBI) released an adaptation case studies report titled *A New Climate of Risk: How South African Businesses are Adapting to Climate Change.* The report highlights some of the central climate change impacts that require adaptation responses. These included "water shortages and drought, an increased frequency and severity of floods, an increased frequency of extreme weather events, rising food insecurity, public health problems and damage to infrastructure and ecosystems" (NBI, 2017a; p.vi). As a result, water risk features high on climate change impacts experienced by business.

According to McNulty, a principal consultant from Environmental Resources Management (ERM), water security risk has become a prominent issue on the corporate risk committee

agenda. The interest in water issues has increased as more companies want to understand water risk and opportunities (Star Workplace Reporters, 2016). In relation to water related business risks, the CEO Water Mandate recognises two sources of risk, risk due to the company operations and risk due to the river basin (Fig. 3). The effect of risk is commonly categorised into three different types, physical, regulatory and reputational.

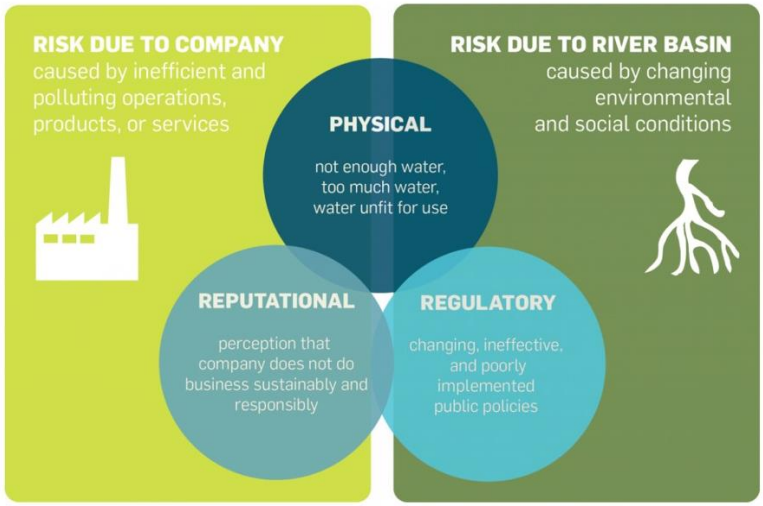


Figure 3: Water related business risks (Source: Schulte, 2018a)

The interlinkages between these three spheres are explained by Orr *et al.*, (2011; p.12), "…where water is becoming increasingly scarce, regulation is more likely to become stricter and the public will be more apprehensive about a business's relationship to water where communities do not have access to sufficient amounts of water that fulfil their basic needs and expectations." Pegram and Williams (2009) shared a similar consensus and illustrated this interaction between the different types of risks (Fig. 4).

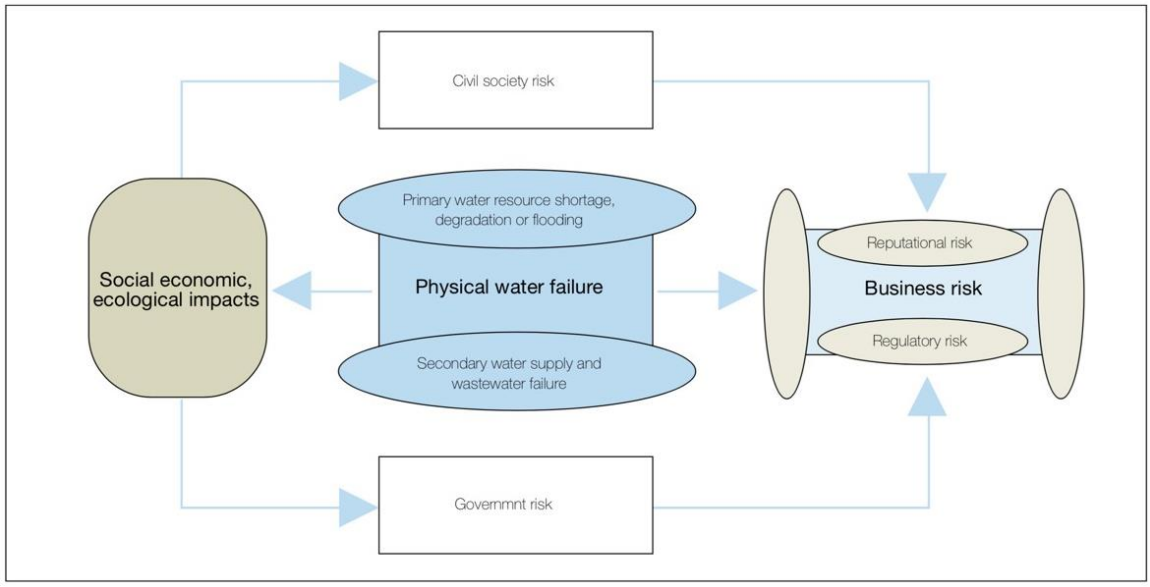


Figure 4: The interaction between different types of risk (Source: Pegram & Williams, 2009)

Given these complex interacting factors, the responsibility lies with trying to find effective and flexible responses to such changing environments. These vary between resilient approaches (Linnenluecke *et al.*, 2008; Nottingham & Yeo, 2017) in addition to a greater emphasis on water governance and more effective decision making in complex, uncertain contexts (Camillus, 1997; Adger, 2001; Dow & Carbone, 2007; Ziervogel *et al.*, 2014; Edwards *et al.*, 2017). In the next section an overview of some of the current discourse into possible response options taken from an adaptation, water risk and governance perspective are considered.

1.4. Resilience Consists of Adaptation, Water Risk and Governance and Decision Making

Risk, particularly related to water, forms part of three spheres that when managed correctly, essentially has the ability to create a more resilient business. Defined by the IPCC, adaptation[1] is "The process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects," (IPCC, 2014a; p.118). One of the key

[1] Within this study adaptation refers to whether current practices taken up by companies are preparing their business to become more adaptive.

approaches for dealing with risks, including water risks, lies in successful adaptation responses (Jones & Preston, 2011).

Adaptation, according to Adger (2001) is more often appropriate at local scales with a collective action through personal decisions and behaviours rather than global scale initiatives. Climate change, however, is a "challenge to structures of governance at all spatial and temporal scales," particularly involving decision making of natural resources (Adger, 2001; p.921). Ziervogel *et al.*, (2014; p.615) state that "climate change adaptation requires forward looking decision making that marries scientific diagnoses and technical innovation with social organization and political debate around competing value systems."

Dow and Carbone (2007) concur and share the importance of understanding climate information and the need to bring this into decision making in order to build adaptive management systems that are able to cope with the uncertainty of climate change and variability. The challenge of uncertainty according to Camillus (1997; p. 2) involves a change in focus of "strategic planning and management in organizations from an attempt to adapt to a predictable future to flexible and speedy responses to a changing present." By combining adaptation measures with effective governance and decision making, the existing risk from climate variability can be lessened (Adger, 2001). As a consequence, climate change adaptation requires robust decision making for its uncertainty and unpredictability (Edwards *et al.,* 2017). By overlapping the three spheres of climate change adaptation, risk and governance and decision making, a business becomes resilient (Fig. 5).

The three circles of risk, climate change adaptation and governance and decision making (Fig. 5) loosely speak to archetypes of companies who have distinct approaches to the management of water. The intention of bringing these intersections together to create a robust approach is explored through the research of this study.

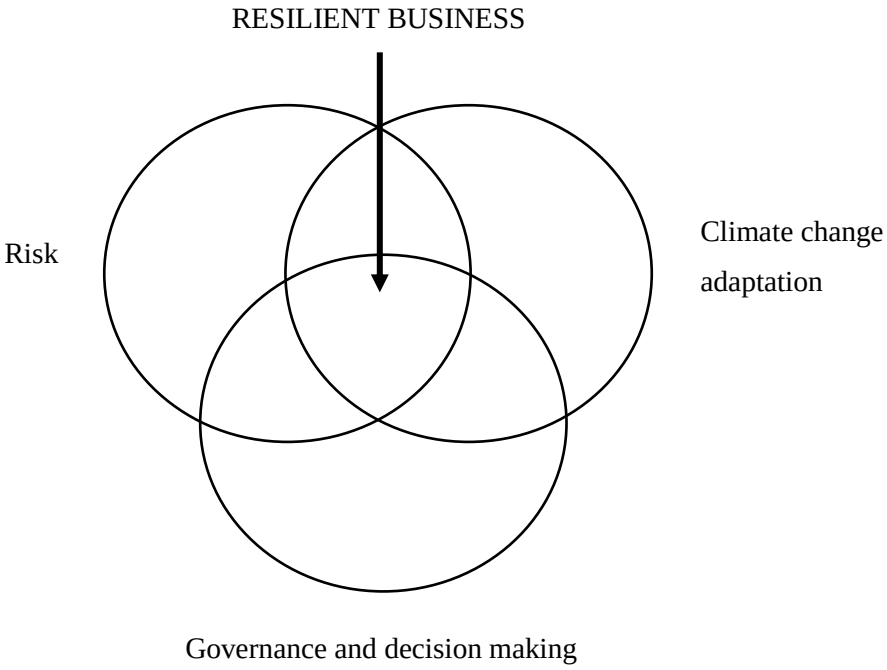


Figure 5: Overlap between climate adaptation, governance and decision making and risk, ideally creating a resilient business

Linnenluecke *et al.*, (2008) agrees that by foreseeing changes in climate and weather patterns a company can enhance their capability not solely for adaptation, but also for resilience. Assessing vulnerabilities in a company context are important for building resilience and reducing impacts to climate and other related stresses (Gitz & Meybeck, 2012). Resilience according to the IPCC (2014a; p.127) is defined as "the capacity of social, economic and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity and structure, while also maintaining the capacity for adaptation, learning and transformation."

Specifically, climate resilience refers to the "outcomes of evolutionary processes of managing change in order to reduce disruptions and enhance opportunities," (Denton *et al.*, 2014; p.1108). According to Nottingham and Yeo (2017) this 'paradigm shift' requires building a mindset, in business, of climate resilience by moving from a corporate social responsibility focus to an environmental risk management one, and lastly one of climate risk and strategy (Fig. 6). Nottingham and Yeo (2017; p.3) recommended the following steps for companies to better understand how climate resilient they are, "(1) Assess climate vulnerability of operations and facilities, (2) embed climate risks into enterprise risk

management programs, and (3) undertake scenario analysis to enhance decision making around risks and opportunities."

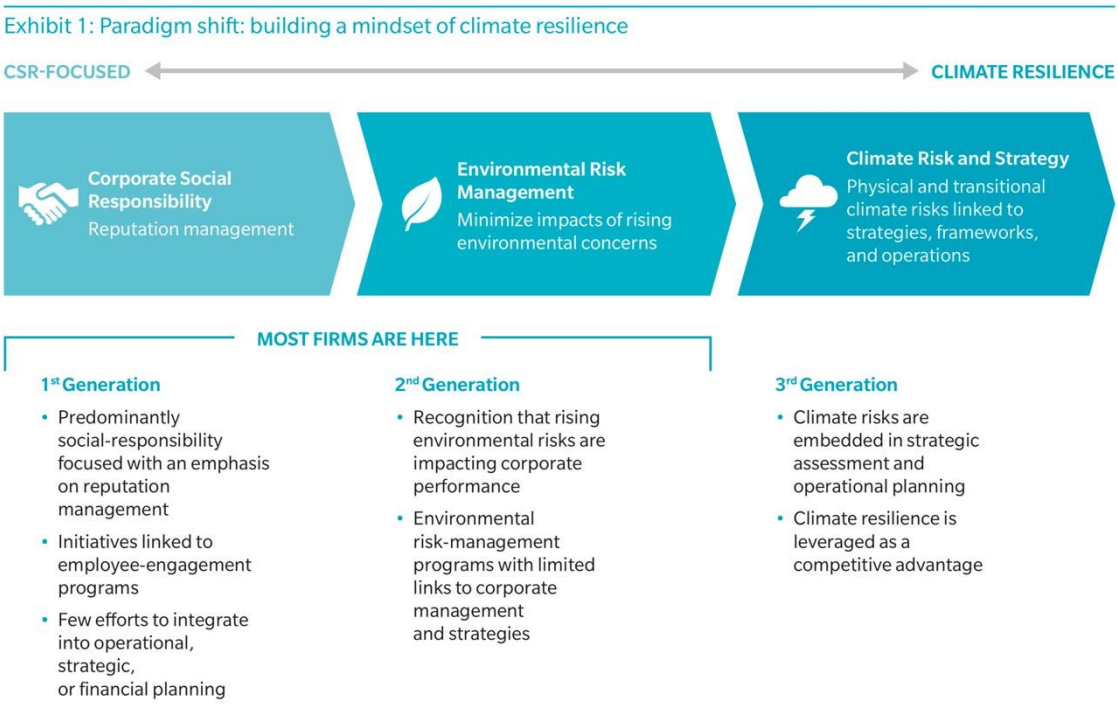


Figure 6: Towards climate resilience (Source: Nottingham and Yeo, 2017)

1.5. Managing Water - Different Takes on Managing Water

Conventional water management approaches generally pay attention to efficient productivity (in terms of yield or output) and pollution avoidance within the company. The emphasis is on effective water expenditure with limited water risk mitigation (the focus here lies solely with company related risk, not extending into the basin). This approach leaves businesses vulnerable to the risks they face from the uncertainty of the economy, environment and social forces that stem beyond the catchment (Morgan & Orr, 2015). For many companies water poses a direct and immediate operational risk and as a result can also result in a company developing reputational risk (Orr *et al.*, 2009; Morgan & Orr, 2015).

Corporate water risk according to WWF is the physical, regulatory and reputational risks that a company faces due to the nature of their activities at a basin level instead of at a company level (Fig. 4; Orr *et al.*, 2009; Pegram, 2010; Morgan & Orr, 2015). Basin-

related risks are associated with the location of the facility, consequently looking at the risks greater than the facility's performance (Morgan & Orr, 2015). These water-related challenges are dependent on each individual company's operation and supply chain (Pegram, 2010). Water within itself is a "multifaceted resource" and more so "is highly variable across time and space," (Mehta, 2014; p.60). Thus risks associated with water are related to how water is valued within the company depending on both the key function of the company as well the location of operations.

A more mature water management response recently being explored is water stewardship. According to the WWF, water stewardship is the "use of water that is socially equitable, environmentally sustainable and economically beneficial, achieved through a stakeholder-inclusive process that involves site and catchment-based actions" (Morgan & Orr, 2015; p.42). The idea is for business to view water as a sustainable, shared, public resource while also understanding the risks they face from water scarcity and pollution. Consequently, water stewardship is a systemic approach to the management of water. It involves viewing the resource as more than a supply for the business, but rather as an integral part of the environment, society and economy as a whole at various scales, echoing the section at the outset that calls for systems view of resource management. As a result, taking into account the sustainable use of water across the entire value chain (Hoekstra, 2014; Morgan & Orr, 2015). As a result, viewing and assessing water in this manner, water stewardship becomes a form of water risk mitigation (Morgan & Orr, 2015).

Water stewardship is at the forefront of the CEO Water Mandate (guided by the UN Global Compact initiative). This initiative prepares and advises business leaders on water, sanitation and the SDG. The CEO Water Mandate mentions five core actions of effective corporate water stewards. This includes: "(1) Provide water, sanitation, and hygiene for all employees, (2) drive efficiency and reduce pollution in their operations, (3) facilitate improved water performance in their value chain, (4) advance collective action and sustainable water management in river basins and (5) achieve continuous dialogue with stakeholders" (Schulte, 2018b, online).

Considering water stewardship in light of Nottingham and Yeo's (2017) climate resilience mindset (Fig. 6) then questions if viewing water as a systems challenge, makes it more resilient. This view may not be the case. Water in this manner may become unmanageable

as mitigation measures outside of the company are not within the company's control. If this is the case, 'managing water' then becomes a matter of influencing and not solely management. However, this in itself is a risk due to limited control. Risk, specifically related to water, therefore is not viewed in a narrow sense but rather with an intersection of adaptation and governance and decision making (Fig. 5).

1.6. CDP Water and its Role in Assessing Responses to Water Security Concerns

Thus in order to become 'resilient' to a range of stresses not least climate stress, companies need to increase their systemic understanding of the complex, interacting stresses they face. Water and its use has as a result been identified as a key lens through which to view systemic risk reduction to periods of stress brought about either through climate, socio-political stress or a mixture of both. One process to enable a more integrated and systemic overview is the CDP process. CDP originally began as the Carbon Disclosure Project, with a focus on carbon, but has since recognised the importance of climate, water and forests, thus expanding their area of interest. Through this expansion the disclosure system is now known as CDP.

CDP is a process that enables one to audit how business is using and managing water. CDP is a non-profit organisation that tracks disclosure globally for investors, companies and cities to assist in managing their environmental impacts (CDP, 2017a). The CDP Water Disclosure reports follow the same procedure of the CDP Carbon report set out since 2003 (CDP, 2010).

The CDP Water survey asks "companies to systematically report data relating to their water use, water-related risks and opportunities and governance of water" (CDP, 2016; p. 8). The first questionnaires on water were sent out in 2010 to sectors which are intensive water users or exposed to water-related risks (CDP, 2010). The CDP's water program has since grown, allowing for a larger number of investors (CDP, 2015) to recognise the leaders in water management. Reporting on water through the CDP is voluntary, and companies who agree are asked to answer these questions through an Online Response System (ORS) which is available through the CDP website.

The 2014 CDP Global Water Report, for example, found that 53% of companies which reported to them mentioned water as a central risk to their business (CDP, 2014). Water risks, such as shortages and pollution directly affect a company's operation and supply chain (Hoekstra, 2014). How vulnerable a company is to these risks is determined by their commitment to implement appropriate risk management and adaptation strategies (Edwards *et al.,* 2017).

The CDP tracks five key areas which all improved from 2015 to 2016. This included transparency, measuring and monitoring, risk assessment and management, targets and goals and engagement and response (CDP, 2016). Although there has been an increase in these areas, transparency for example is provided by less than 50% of companies and "more than a third of companies are still not measuring and monitoring water use" by 2016 (CDP, 2016; p.12). This indicates that even though progress has been made over the years, there is still room for improvement.

1.7. Rationale of the Study

As indicated above, water is a key element of the broader systemic challenges facing the world, including food security, economic development, energy generation and climate change (Pegram *et al.,* 2013). In order to begin to effectively address any of these challenges to safeguard water, it is essential to understand water risk exposure. Unlike other natural resources that can be measured to the same quantity regardless of location (e.g. carbon in South Africa vs. carbon in Australia), water is unique (Pegram, 2010). The basis of water risk exposure is dependent on a number of factors, but one of the primary influences being the biophysical location of the river basin from which water is obtained. In addition to the geographical location, the social actors within the river basin who make use of the water also influence and in turn are influenced by each other's use and management of that water (WWF, 2015). In light of this, the CEO Water Mandate under the UN Global Compact suggests a 'shared action' response to address the experience of 'shared risks' (Morrison *et al.,* 2010). Because business relies on water, both directly and indirectly, business thus becomes a key actor playing an important role in tackling widespread water security (Schulte *et al.,* 2014). Very little, particular in the South African context, is known about such issues. More particularly from the viewpoint of current

metrics and measures to understand business management of water risks and how such measures are being viewed against a changing climate.

1.8. Aim, Objectives and Key Questions

Given the context articulated above, the aim in this research is to assess how large companies respond to water security, in the context of increased water demand and climate variability. The companies chosen are those which voluntarily complete the CDP Water survey, providing an indication of a willingness and intent to begin thinking about water risks in light of climate stresses. The completed CDP responses are those undertaken since the launch of CDP and span the period from 2010 to 2016. With this set of company responses, more targeted and detailed follow-up questions and interviews are also undertaken.

The central objectives (in italics) are outlined below including key questions.

Broad overarching objective:

1. *To gain a basic understanding of what companies experience currently, and what they may have in place, in terms of water risk management, water governance and water decision making with reference to climate as a major stress factor.*

    a. How does the weather and climate currently affect a company's ability to perform their daily functions/operations?
    b. Are companies exposed to water risk and how is it perceived and assessed?
    c. Do companies take climate variability into account when planning and is adapting to this variability seen as a key risk and/or an opportunity?
    d. Within a company, who governs water issues and how are governance decisions made?

More detailed nested, subset of objectives and questions:

2. *To investigate how a company is responding to water security concerns – both abundance and shortage.*

a. How important is water quality and quantity to the company? As a result, what responses and interventions are put in place?
b. Using water restrictions as a tool to assess if current practices are preparing companies to be more adaptive.
c. Are water management goals and targets set to improve efficiency?

3. *To assess if CDP reporting, coupled with the acknowledgement of threats to water security (e.g. climate variability), has the potential to transform the way CEOs see their company's water related risks and opportunities.*

a. Does water present opportunities for companies and if so, what type of opportunities?
b. What role does CDP play in understanding and addressing water related risks and opportunities?
c. Can business be used to influence government and society responses to water risk? What are the risks and benefits of collaborating this way?

1.9. Conclusion

In the next chapter, the research methods for the above aim and objectives are explored (Chapter 2). An explanation of a mixed methods approach as the study's research design is given through the use of CDP Water report data and interviews. This is followed by insight into both methods of data collection and analysis, the findings of which is presented in the results chapter (Chapter 3). Together the development of a narrative is formed with the support of Principal Component Analysis (PCA) to essentially create archetypes of company responses to 'water stewardship readiness' within the discussion chapter of the thesis (Chapter 4). Lastly the thesis closes with a conclusion chapter (Chapter 5).

2. CHAPTER TWO – RESEARCH DESIGN AND METHODOLOGY

2.1. Introduction

In this chapter an outline of the research methods used to conduct the study is given. A mixed methods approach is used by means of CDP Water report data as well as interviews. Background is first given on CDP Water reporting which frames the data collection process, followed by questions and data developed from the reports to address the research objectives. Questions and further details on how data collection, presentation and analysis were derived are lastly provided. As interviews followed CDP Water data analysis, this chapter also provides information on the participants interviewed and their process of selection while also providing information on ethical considerations. Finally, the methods used to analyse the interview data are described.

2.2. Research Questions

Using the CDP Water reports and interviews, large company responses to water security, in the context of increased water demand and climate variability, are assessed. These responses are explored through three objectives. First, a basic understanding of what companies experience and have in place in terms of climate change adaptation, water risk and governance and decision making is probed. Secondly, through investigating how a company is responding to water security concerns (both abundance and shortage of water), insights into possible avenues for enhanced climate change adaptation are interrogated. Lastly, CDP reporting, coupled with the acknowledgement of threats to water security (e.g. climate variability), is used to examine the potential to transform the way CEO see their company's water related risks and opportunities.

While CDP reports have given a quantitative approach to answering the studies objectives, interviews allowed for thicker and richer insight and a more interpretive approach revealing some of the 'back' story and perceptions behind companies' experiences.

2.3. Mixed Methods Approach

A mixed methods approach is used. This design incorporates gathering, assessing and essentially 'mixing' both quantitative and qualitative data. The two methods differ in a

number of ways; quantitative data are usually based on hypothesis testing, sampling is random or probabilistic which gives rise to numeric or categoric data that is analysed in a formalised manner (Trochim & Donnelly, 2001; Johnson & Onwuegbuzie, 2004). Qualitative data, by contrast, are more explorative and conceptual with purposive sampling that provides a narrative through audio or visual data which is analysed in an interpretive fashion (Trochim & Donnelly, 2001; Johnson & Onwuegbuzie, 2004).

The process of triangulation can increase the reliability of the findings by using the collection of different kinds of information supporting the same topic (Jick, 1979). Quantitative methods make use of numbers while qualitative methods are used to better understand social drivers of causation (Tuli, 2010; Yilmaz, 2013). A mixed methods approach research design was chosen as quantitative or qualitative methods alone were not sufficient in encapsulating developments and experiences behind company responses to water security concerns.

The quantitative data approach tends towards a more positivist paradigm where there is an objective truth (Guba, 1990). Information gathered through interviews by contrast portrayed the stories (narratives) of what companies have experienced in terms of water security. The qualitative data method is aligned with more of a constructivist paradigm where reality is understood as being socially constructed and is based on a variety of social constructs including perception (Guba, 1990). Together a pragmatic approach is taken, attempting to bring together "multiple viewpoints, perspectives, positions, and standpoints" (Johnson *et al.*, 2007; p.113).

2.4. CDP Water Reporting

The CDP Water survey asks "companies to systematically report data relating to their water use, water-related risks and opportunities and governance of water" (CDP, 2016; p. 8). The first questionnaires on water were sent out in 2010 to sectors who are "water intensive or are particularly exposed to water-related risks" (CDP, 2010; p.2). The CDP's water program has since grown allowing for a larger number of investors to recognise the leaders in water management (CDP, 2015). Reporting on water through the CDP is voluntary, and companies who agree are asked to answer these questions through an Online Response System (ORS) which is available through the CDP website.

From 2010 to 2016 a total of 44 companies, with access to river basins based in South Africa, completed the CDP Water Report. During this time period new companies joined the survey and some companies left, thus the number of companies reporting each year varied. In addition to varying company numbers, one company may have multiple operations around the country which makes use of different river basins. Within CDP Water reports companies are asked to mention the river basin they are referring to thus increasing the number of responses per question in many instances.

As companies changed over this time period, the questions in the survey have also improved, through additions of new questions, updating old questions and removal of what may have become irrelevant requests. This brought about a format change of the survey resulting in CDP conducting a data mapping process to track similar questions and in turn link the data they provide for the requested time period. For example, question 4.1 in the 2016 survey- *Does water present strategic, operational or market opportunities that substantively benefit/have the potential to benefit your organization,* is the same for 2015 and 2014 but is presented as 5.1 from 2013 to 2011 and 11.1 in 2010. Thus while the sequencing of questions may have changed, essential themes being probed remained similar throughout the reporting period under investigation.

By 2016, the CDP Water survey followed five strategic topics to assess the development of sustainable water management, these included transparency, measuring and monitoring, risk assessment and management, targets and goals and engagement and response (CDP, 2016). In 2017 these were updated to six key areas including transparency, governance, measuring and monitoring, risk assessment, targets and goals and supply chain engagement (CDP, 2017a). These focus areas were incorporated into answering questions under the four themes in this study namely climate change adaptation, water risk, governance and decision making and water stewardship.

2.4.1. Data analysis

2.4.1.1. Data

Data analysis from CDP reporting on water began from the beginning of the CDP Water data collection in 2010 until 2016 for all companies that make use of water from river basins based in South Africa. The following questions as used in the CDP (refer to 2nd

column in Table 2), were designed to give insight into how companies are responding to water security concerns (refer to the 3rd column in Table 2).

Table 2: Questions within the CDP Water survey analysed to answer research questions (CDP, 2017d)

Question no.	Question	Purpose
Climate change adaptation		
W1.1	*Please rate the importance (current and future) of water quality and water quantity to the success of your organization.* *(p.2)*	The importance of water should define the company's approach to dealing with water risk.
W1.2 a, b and c	*For your total operations, please detail which of the following water aspects are regularly measured and monitored and provide an explanation as to why or why not.* *(p.2)*	Assessing quantity data (mega litres/year) for water withdrawals, discharges and consumption levels allows for comparing how levels have changed.
Water risk		
W3.2 a to g	*Please provide details as to how your organization defines substantive change in your business, operations, revenue or expenditure from water risk.* *(p.7)*	Evaluate how a company frames water risk.
W3.1	*Is your organization exposed to water risks, either current and/or future, that could generate a substantive change in your business, operations, revenue or expenditure?* *(p.7)*	Provides categorical data on a company's exposure to water risk.
W2.5	*Please select the methods used to assess water risks.* *(p.5)*	Description of how a company assesses their water risk.
W4.1 a, b and c	*Does water present strategic, operational or market opportunities that substantively benefit/have the potential to benefit your organization?* *(p.10)*	Data available in 2016 describes the type of water risk and potential impacts involved. Review how water risk is assessed and whether water presents opportunities for the company.
W1.4 a and b	*Has your organization experienced any detrimental impacts related to water in the reporting year?* *(pg. 4)*	Insight into the types of risks companies experience and specifically whether or not companies see the drought or water restriction as a detrimental impact

		experienced by their company.
Governance and decision making		
W6.1	*Who has the highest level of direct responsibility for water within your organization and how frequently are they briefed?* *(p.13)*	To evaluate governance within the company.
W6.2 a, b and c	*Is water management integrated into your business strategy?* *(p.13)*	
W6.3 a	*Does your organization have a water policy that sets out clear goals and guidelines for action?* *(p.13)*	
W7.1a	*Please describe the penalties, fines and/or enforcement orders for breaches of abstraction licenses, discharge consents or other water and wastewater related regulations and your plans for resolving them.* *(p.15)*	Insight into how companies manage water through reviewing if companies are subject to any fines or penalties.
W8.1a	*Please complete the following table with information on quantitative targets (ongoing or reached completion during the reporting year) and an indication of progress made.* *(p.16)*	Aids in assessing whether or not companies take initiative in saving water and whether these are meaningful and achievable.
Water stewardship		
W1.4	*Has your organization experienced any detrimental impacts related to water in the reporting year?* *(pg. 4)*	Assesses what physical impact drivers and potential impacts companies would experience to result in a water stewardship response strategy.
W3.2c	*Please provide details as to how your organization defines substantive change in your business, operations, revenue or expenditure from water risk.* *(p.8)*	The potential impacts a company's direct operations may experience that resulted in water stewardship as a response.
W6.2a	*Please choose the option(s) that best explains how water has positively influenced your business strategy?* *(p.13)*	Whether water stewardship has a positive influence on a company's business strategy.
W8.1a	*Please complete the following table with information on quantitative targets (ongoing*	Assesses water stewardship as a motivation for the goals and targets company's set.

	or reached completion during the reporting year) and an indication of progress made. (p.16)	

2.4.1.2. Water Management Areas (WMA)

Many of the companies who have a basis in South Africa are also found elsewhere around the world. As a starting point, data for all questions were first filtered to represent companies whose operations make use of water from river basins within South Africa. The first request within the survey is for companies to state the river basin each operation uses in order to address the inherent water risks and opportunities they face as a consequence. The value placed on river basin location resulted in this being the first distinction of comparison for analysis.

Consequently, all river basins were then grouped into nine Water Management Areas (WMAs) for each question. As of September 2016, the South African government released a gazette for the new nine WMAs for the country. These are Limpopo, Olifants, Inkomati-Usuthu, Pongola-Mtamvuna, Vaal, Orange, Mzimvubu-Tsitsikamma, Breede-Gouritz and the Berg-Olifants (Fig, 7; DWA, 2016). Conducted from the CDP Water data, when reporting, besides specifically using one of the WMAs, 19% of companies stated the use of ‘all river basins within South Africa’ and 4% were either recorded as ‘not known/other/blank’ (Fig. 8).

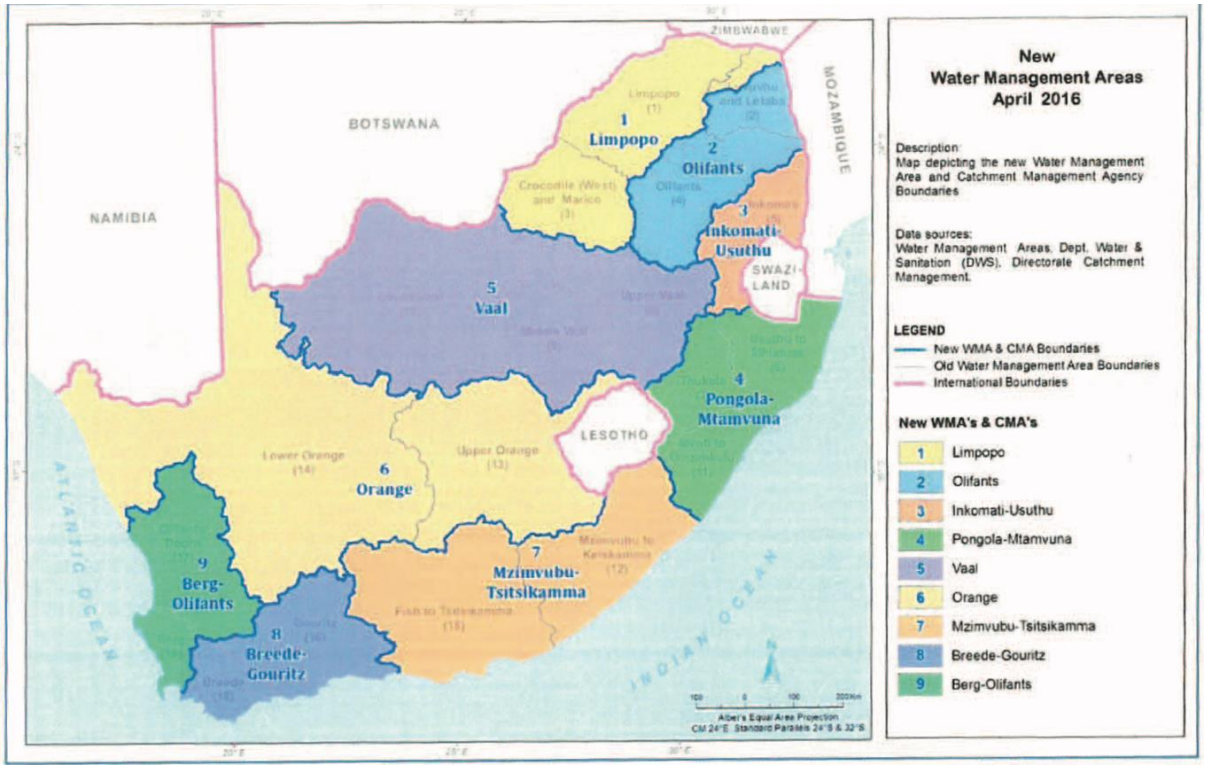


Figure 7: New Water Management Areas for South Africa (Source: DWA, 2016)

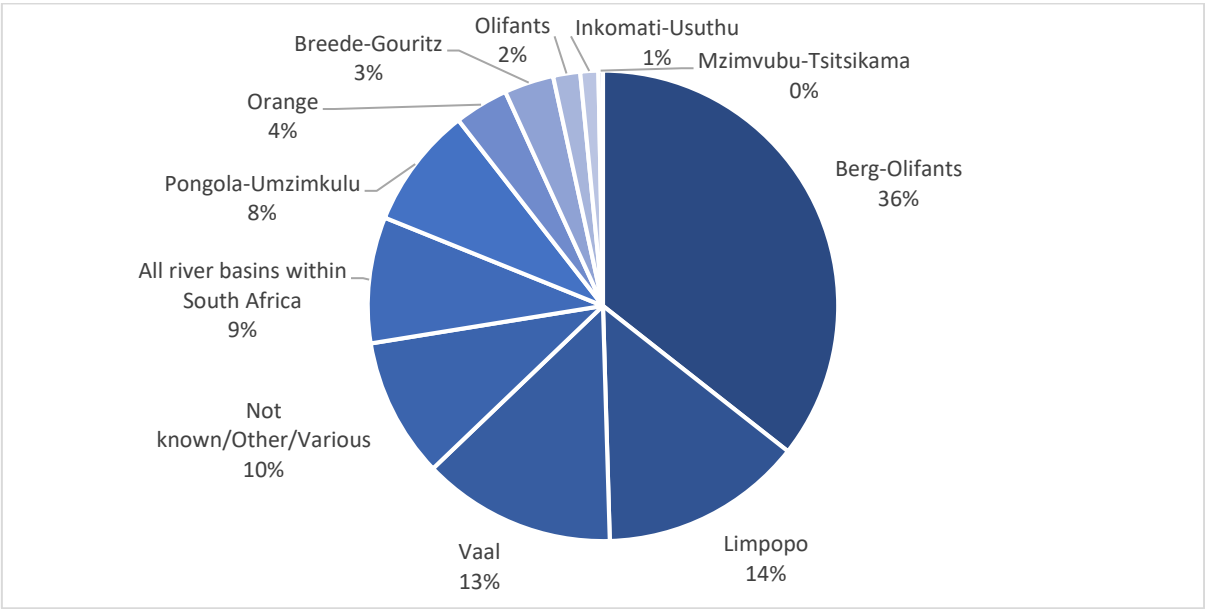


Figure 8: Water Management Areas used by companies who conducted the CDP Water survey over 2010 to 2016

2.4.1.3. Sectors

Where applicable questions were also analysed by sector (Fig. 9). There is an unequal representation of sectors as the CDP Water survey initially started off by targeting water intensive companies. Almost half of the companies come from the traditional water users

in the materials (27%) and industrial sectors (21%). All companies were spread across eight sectors and 24 different industries (Table 3). The eight sectors to which companies belong to include consumer discretionary, consumer staples, energy, financials, health care, industrials, materials and utilities.

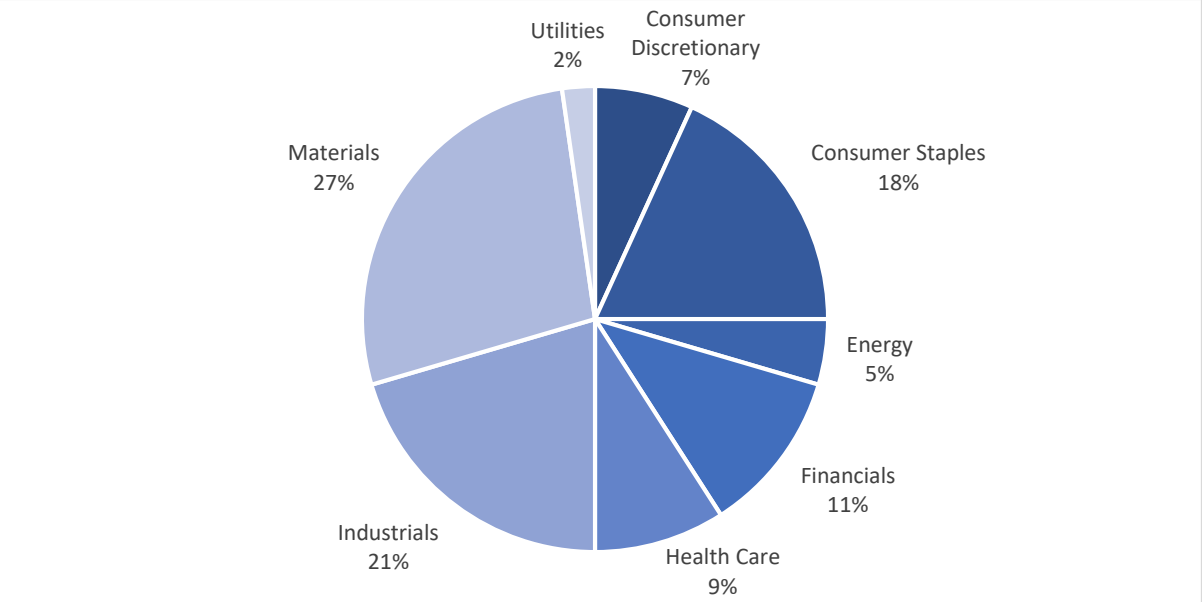


Figure 9: The percentage of companies belonging to eight different sectors who conducted the CDP Water survey over the years 2010 to 2016

Table 3: Summary data of the eight sectors, their corresponding industries and the number of companies that belong to each of them (Summarised using the CDP Water data set).

Sectors and industries within them
Consumer Discretionary
Hotels, Restaurants & Leisure, and Tourism Services
Retailing
Textiles, Apparel, Footwear and Luxury Goods
Consumer Staples
Food & Beverage Processing
Food & Staples Retailing
Energy
Mining - Coal
Oil & Gas
Financials
Banks, Diverse Financials, Insurance
Real Estate
Health Care
Healthcare Providers & Services, and Healthcare Technology
Pharmaceuticals, Biotechnology & Life Sciences

Industrials
Air Freight Transportation and Logistics
Construction & Engineering
Food & Staples Retailing
Hotels, Restaurants & Leisure, and Tourism Services
Technology Hardware & Equipment
Telecommunication Services
Trading Companies & Distributors and Commercial Services & Supplies
Water Transportation - Water Transportation
Materials
Chemicals
Mining - Iron, Aluminum, Other Metals
Mining - Other (Precious Metals and Gems)
Utilities
Electric Utilities & Independent Power Producers & Energy Traders (including fossil, alternative and nuclear energy)

2.5. Interviews

Once results were obtained through data analysis, interviews were then conducted to probe findings highlighted within the reports as well as to explore experiences and then practices that were not found within reports. In-depth, key informant interviews were used as the best way to acquire an insiders' perspective of dealing with water security concerns. Interviews were conducted between November 2017 and April 2018.

2.5.1. Participants

Interviews helped develop a more holistic narrative that more suitably informed how South African companies are tackling this period of climate variability and increasing water demand. This brought about in-depth, qualitative insights that could not be achieved with a more rigid instrument design, such as a closed-ended questionnaire. To best encapsulate these practices and experiences, interviews were conducted with the heads of sustainability, environmental or water departments.

With the advice of McNamara, the Programme Manager for Climate and Water at the National Business Initiative, six companies were identified and selected for interviews (Table 4). In order to obtain a variety of perspectives, companies were selected based on a range of different sectors (i.e. dependent on the role water plays in their company), in addition to a company's scoring of CDP activities (i.e. environmental awareness) as well as their experience of CDP reporting (e.g. new to reporting).

Participants from the following sector agreed to be interviewed for the study:

Table 4: Sectors to which interviewed participants belong

Participant	Sector
A	Materials – Chemicals
B	Consumer Discretionary
C	Energy
D	Industrials
E	Materials – Mining
F	Consumer Staples

Three interviews were also conducted with sustainability, water and environmental specialists to gain a more inclusive understanding and context of the role water plays within the business sustainability space (Table 5). These three participants were chosen as they give insight into a wider landscape and provide an overview of water and sustainability practices of South African companies. This included the advantages and disadvantages of CDP reporting and voluntary reporting as a whole, current water trends such as the opportunity for water stewardship as well as how companies outside of CDP deal with water issues (e.g. the case of Day Zero in Cape Town).

Participants with the following speciality agreed to be interviewed for the study:

Table 5: Specialist interviewed participants

Participant	Specialist
G	Sustainability
H	Water
I	Environmental

2.5.2. Ethical considerations

As human subjects were involved in the study, ethical clearance was required. The process involved stating how participants would be protected and how information would be safeguarded and represented. Ethical considerations were highly prioritised with informed consent as a prerequisite for involvement in the study. In addition, the questions used in interviews were verified to ensure participants were not exposed to any potential risks. Once all these data were presented the study was ethically approved (Appendix A). Following ethical procedures participants were first briefed about the study and given reason for their inclusion. Futhermore, any questions participants had were answered. Once participants understood that their participation was voluntary and that they would remain anonymous and their interview would be audio recorded, consent was provided and accepted.

2.5.3. Data analysis

As the ethical considerations state, interviews were recorded when consent was given. Once interviews were conducted, they were transcribed, managed and analysed with the assistance of NVivo (11). NVivo is a data management tool that facilitates the process of data analysis (Richards, 1999; Smyth, 2006; Zamawe, 2015). The software aids in building linkages that organized the views of companies (Richards, 1999; Smyth, 2006) in a subjective manner than would have been obtained using more personal inferences. This was done by creating a hierarchy of codes, first from the broad based themes of this study (climate change adaptation, water risk, governance and decision making and water stewardship), followed by identifying sub-themes or categories and lastly creating nodes.

Codes are represented by the term ‘node’ within NVivo, these are either a word or abbreviation that is used to establish the meaning of text within a transcript (NVivo, 2017). The process of coding is time saving, allowing for efficient and ‘objective’ analysing of data as the technique consolidates responses into practical sizes for review. This assists in searching for similar topics across respondents (Richards, 1999; Smyth, 2006; Zamawe, 2015). In addition, the codes created also allowed for emergent ideas to arise from the interviews themselves.

2.6. Building a Narrative

Developing a narrative began with NVivo through the formation of themes during data analysis. As a range of themes were presented across interviews, interactive diagrams were used to help make sense of the data. These mind maps were used to establish relationships through high level analysis of how ideas link together on the basis of quotes. Relationships, for example, indicated if respondents from different companies either shared the same sentiment around a certain issue or how views themselves overlapped. This assisted analysis as views, experiences and practices that were similar, different and new were all highlighted. This approach set up the beginning of building a narrative.

2.6.1. Principal Component Analysis (PCA)

Focal findings within the CDP Water survey data and highlights from interviews gathered through NVivo were then used to run Principal Component Analysis (PCA) in XLSTAT. PCA is a multi-variate statistic method which essentially summarises a multi-dimensional dataset. The purpose of this method is to reduce dimensions within the data while maintaining variability. As Jolliffe (2011; p.1) explains, "The central idea of principal component analysis (PCA) is to reduce the dimensionality of a data set consisting of a large number of interrelated variables, while retaining as much as possible of the variation present in the data set. This is achieved by transforming to a new set of variables, the principal components (PCs), which are uncorrelated, and which are ordered so that the first few retain most of the variation present in all of the original variables". These components can then be plotted in order to diagrammatically establish associations between components, both positive and negative, and reveal whether they can be grouped or not (Ringnér, 2008).

As PCA is used on quantitative data, the qualitative CDP data were converted into binary data for the appropriate questions to fit this statistics requirements. This was done using 2016 data only in an attempt to remove an institutional learning curve to deal with CDP and as recent responses were amplified as a consequence of the 2015 drought. The use of PCA assisted in supporting a narrative by bringing different results together that were previously viewed in isolation. PCA was conducted for physical impact drivers, impacts, governance and decision making, response strategies and water stewardship responses.

2.6.2. Archetypes

Through the use of PCA and bringing different results together, archetypes were created. Archetypes are typical examples of something and are ways of depicting dominant factors by virtue of a single representation. In this case here, for example, referring to the grouping of companies who experience and thus respond to water risk in a similar way (e.g. a reactive response to drought rather than a more proactive response) would be classified as forming one archetype. This assisted in linking companies across sectors and river basins to assess if similarities do exist or if companies respond in more unique ways, which in itself may be an archetype.

The development of archetypes is more than simply a data reduction exercise. Instead it demonstrates that in spite of a wide variety of sectors, companies and levels of skills, there are still certain ways in which uncertainty and complexity is being dealt with revealing some adaptation patterns of response.

In relation to this study, reactions converge around three archetypes for companies with characteristic approaches and response groupings; namely ostrich, chicken and owl. These clusters are brought together based on 'water stewardship readiness' within the discussion chapter of the thesis (Chapter 4). This encompasses the likelihood of companies engaging in water stewardship practices as this is seen as one of the best ways forward for business to assist in securing water in the country.

2.7. Short-comings

Addressing CDP Water reporting first, one of the short-comings of using this tool involved assessing predominantly water intensive companies. Extending the report to companies where water is not core to business operations could embrace a wider perspective of water related risk and opportunities. Additionally, within the CDP Climate Change reporting there is an effect of learning from responses year on year which eventually resulted in many companies scoring higher each year. This questions the real effect on carbon emissions. A similar reservation can be made around CDP Water reporting. Thus questioning if companies are truly reporting their water practices rather than taking a 'tick box' approach to achieve a higher score. A 'tick box' approach to reporting is considered to be a compliance driven exercise rather than internalising the questions asked in reports and using it as a driver for change within the company. This is not, however, unique to

CDP. Nonetheless, at present the CDP survey is considered the best reporting metric for the study.

Although interviews were conducted with specifically identified companies, a wider range of interactions may have brought about a more comprehensive narrative around water security concerns within South African companies (e.g. from a labour or labour union perspective). Additionally, interviews with companies who do not complete CDP could encompass an inclusive overview and different viewpoints on water risk. If data access permitted, comparisons between South African companies with others around the world could also bring about an understanding of risk across borders to assess how South African companies compare. Such dimensions, while all interesting, fell outside the time frames and focus of this Masters research and could be probed for other research purposes.

2.8. Conclusion

This chapter focussed on the methodology that was used in this study. An explanation of a mixed method approach as a method for data collection and analysis was given, presenting both CDP Water and interview data. CDP Water data was primarily analysed according to river basins and sectors. In an attempt to build a narrative, the use of Principal Component Analysis (PCA) was used on CDP Water data coupled with interviews which was explored using the tool NVivo. To bring this information together, archetypes were created to link common experiences and responses together.

In the next chapter (Chapter 3) the findings generated through the methods mentioned in this chapter are explored. Due to the complexity of researching the use of water by companies coupled with the role they play in addressing water security concerns in the country, the results chapter is presented under the three objectives of this study (see Chapter 1, section 1.8).

3. CHAPTER THREE – RESULTS

3.1. Introduction

In this chapter the results accumulated through the CDP Water survey conducted over 2010 to 2016, as well as interviews from six companies and three water, environmental and sustainability specialists are presented. Although a variety of questions within the CDP Water survey was analysed, the data presented best address the defined objectives and in turn the aim of the study.

The complexity of researching the role of companies and how they view water and its use in their business practice cannot be underestimated. The unique context of each company, their locations with reference to water sources, their management systems and over-arching understanding of risk management and design are key. The results captured below (under the three objectives of this study described in point form) all illustrate some of this complexity and nuance, including perceptions of weather and climate risk, water risk exposure, opportunities and decision making around water issues.

In light of the complex water system, results are presented under the three objectives of this study. Each objective builds on one another:

- Background is first given to the affects and drivers behind what companies experience and as a result, what their risks, decision making and planning around water issues are (3.2.).
- Within the above context, companies responses to water security concerns are addressed through various avenues of interventions, management actions and the example of adaptation measures through the implementation of water restrictions (3.3.).
- Lastly, building on these practices and experiences, the role of the CDP Water survey as a water ‘management’ tool is evaluated (3.4.).

Owing to the inclusion of numerous findings within each objective, a summary is presented after each, highlighting key outcomes within the section.

The CDP Water survey was the chief source of data collection. Companies reporting to this program are encouraged to reveal their water practices and urged to lessen their impact on nature through the influence of investors and customers. CDP Water surveys ask a range of questions spanning from company's exposure to water risk, the impacts they encounter, their responses, their governance and decision making around water related issues and the opportunities that arise to name a few. The data explored covered the period 2010 to 2016 with around 40 companies completing the survey. In addition, interviews were conducted to probe findings and experiences that were not highlighted within the survey. To provide a range of insights, companies interviewed come from different sectors and were also scored differently according to CDP activities (such as environmental awareness) and having varied reporting experience.

Depending on the information extracted from the CDP survey, data are explored through three avenues, by sector, by river basin and by company. Firstly, the CDP Water survey initially began by targeting water intensive companies (Fig. 9). Consequently, almost half of the companies come from the traditional water users in the materials (27%) and industrial sectors (21%).

Secondly, the CDP Water survey allows each company to respond to questions based on the location of each operation. Accordingly, one company may experience a range of risks depending on the location of their different operations. Each risk is as a result of different impact drivers (e.g. drought, flooding, inadequate infrastructure) resulting in various impacts and consequential responses. In addition to reporting sector responses, the importance placed on river basins allows for outlining total responses of companies using the same river basin in South Africa. In an attempt to use both sectors and river basins as avenues to explore data, results revealed that no trends in CDP responses were found for the majority of questions used in analysis. In many cases this resulted in probing data at a company level.

Thus to further assess company responses, a Principal Component Analysis (PCA) is used (PCA described in Chapter 2). PCA is a multi-variate statistic method which in essence summarises a multi-dimensional dataset. "PCA calculates an uncorrelated set of variables (factors or pc's). These factors are ordered so that the first few retain most of the variation present in all of the original variables," (Hintze & Utah, 2007; p.1). It is acknowledged

that a great deal of variability exists within the PCA findings, and to account for ~75% of cumulative variability, more than four factors are required for an explanation. Hence, companies have diverse strategies and perceive risk (and hence respond) in an incoherent manner. The variety of responses is explored in this chapter. To account for this variability, interpretations are made on the first three factors to ensure that conclusions are based on analyses that account for at least 50% of the variability in the data set. Furthermore, PCA was conducted using 2016 data only, in an attempt to remove an institutional learning curve to deal with CDP and as recent responses are amplified due to the 2015 drought. This was done for physical impact drivers, impacts, governance and decision making, response strategies and water stewardship responses.

3.2. Company Background

In the first section, what companies experience and have in place in terms of climate change adaptation, water risk and water governance and decision making is examined. These aspects were first explored through the lens of extreme weather events. At the time of writing and doing this research a severe drought was playing itself out in many parts of the country (see details of drought in Chapter 1). Elsewhere in the country, some catchments had also experienced floods. These climate experiences helped to surface whether companies were exposed to water risks or not. Water risk was then investigated through the different river basins that companies belong to, the drivers behind the impacts they experience and their consequential impacts. Owing to the multitude of encounters companies face, the opportunity for adapting and including climate variability into planning is also considered. Stressing the importance of planning, decision making around water issues are investigated. Lastly, as an assessment of the knock-on effects of decision making, through assessing how financial reporting metrics could be affected by water related risks, is reviewed.

3.2.1. The effects of extreme weather events

Companies have started noting visible changes in their operations due to the effects of extreme weather events. All companies interviewed experienced process disruptions due to extreme weather effects, such as thunderstorms, drought and flooding. Companies have suffered from low yields or outputs as well as a decrease in the quality of produce specifically during prolonged periods of decreased rainfall. Furthermore, operational

impacts were experienced particularly due to the reliance on water for processes. For example, a material company (Participant A) mentioned that "*Two years ago when we had that drought, we didn't have a lot of product like out-take… we had a lot of raw materials that were sitting, and nothing was going out*[2]". In addition, extreme weather events impacted on the selling of produce, both with the quality of produce as well as the ability of customers reaching stores to purchase products.

Specifically related to water, one company mentioned how they have experienced an increase in temperature resulting in a decline in dam levels coupled with the impact of rain not filling the dams. An energy company (Participant C) mentioned that the "*Vaal dam was at 26% and you know a week of rainfall took that level up to 104% so you know you just see the impact nature has on making sure that there's enough water in the system and also the lack of rainfall impacts in terms of risk of supply to [our] operation*". Other companies highlighted their need to start adapting by finding new system thresholds particularly for machinery to deal with stronger winds, increased lightning strikes and an increased occurrence of floods to name a few. Others who are reliant on agricultural output stressed the need for either crop migration or a change in irrigation periods due to the variation in season changes. From the view of a consumer staples company (Participant F), "*season plays a huge role in terms of if it's dry or if it's raining in that period, you don't have to irrigate any further but if it's not, and if it's dry, you irrigate based on your soil moisture content*". Understanding what companies experience is therefore important for analysing how they respond. Background into how the weather and climate affects a company's ability to perform daily functions or operations is first addressed. These events are expected to influence how a company reacts to risk.

In the section that follows various aspects of water risk are explored. Firstly, recognising company's perception of water risk followed by if they had experienced any detrimental impacts related to water risk during 2012 to 2016. Subsumed in the section on water risk are various influences that configure that risk, in this section specifically the location of companies in catchments, the impacts drivers and the impacts felt are dealt with.

[2] Respondents inputs have been inserted in italics for ease of reference and all respondents have been assigned an alphabetical letter to comply with ethical concerns.

3.2.2. Dealing with water risk

Kosovac *et al.,* (2017; p.2) highlight the importance of risk perception, stating that "Perceptions of risk, rather than whether a risk is seen as true or not, is what ultimately drives decision-making." Consequently how risks are evaluated is usually steered by perception. To gain an improved understanding of how perceptions may have influenced decisions about water management, interviewees were asked how water risk specifically is perceived within their company. Most companies responded in a similar manner stating that extreme events and impacts on water is "*something [that] will prevent us from operating*," (Participant E) additionally, it undermines the "*ability to function as a core business is designed to do*," (Participant B).

Water risk and in particular water risk for a company's operations is given a high priority. One company (Participant C), for example, emphasised the priority of water by mentioning that besides water risk being ranked amongst the top five risks by the World Economic Forum, "*we're in a water scarce country*". For a consumer staples company (Participant F) water risk was recognised as a priority early on, "*water has been identified previously for about three to four years ago already as a risk to the business in terms of the supply side*." Others phrased the perception of water risk as, "*a direct impact on our bottom line, as simple as that*," (Participant D).

To put perception into perspective, exposure to water risk was analysed as "*The first challenge for any business is to understand its own exposure to water-related risks*," (Pegram, 2010; p.13). The responses under water risk exposure encompass any detrimental impacts experienced by the organisation. Between 2012 and 2016, 62% of companies said that their organisation experienced detrimental impacts related to water during their reporting year (Table 6). Only 37% of all companies said they have not experienced any detrimental impacts and one company in 2015 said they did not know (3%). Almost 60% of these companies came from the industrial (35%) and materials (22%) sectors. The year 2014 was the only time period where the percentage of companies who did not experience detrimental impacts related to water was higher (56%) than those who did (44%).

Table 6: Companies who experienced detrimental impacts related to water between 2012 to 2016

%	2012	2013	2014	2015	2016	Total (2012-2016)
No	35	33	56	28	33	37
Yes	65	67	44	69	67	62
Don't know				3		1

In the following section the causes or 'drivers' of periods of water stress (either actual or perceived) and the impacts or outcomes of such periods of water stress are examined. These drivers were surveyed by first observing the spread of company operations across river basins.

3.2.2.1. River basins – Water Management Areas in South Africa

Within the CDP Water survey, companies were asked to report on inherent water risks that could generate a substantive change in their business operations. The first request asked companies to state the river basin with which they derive their water and subsequently answer questions including risk drivers, potential impact, timeframe, likelihood, magnitude of potential financial impacts and response strategies. As a result river basins are classified into their respective Water Management Areas (WMAs). There are nine WMA that extend across South Africa (Fig. 1). These comprise of the Berg - Olifants, Breede - Gouritz, Inkomati - Usuthu, Limpopo, Mzimvubu - Tsitsikamma, Olifants, Orange, Pongola – Umzimkulu and the Vaal (DWA, 2016). When reporting, besides specifically using one of the WMAs, 19% of companies stated the use of 'all river basins within South Africa' and 4% were recorded as 'not known/other/blank' (Fig. 11).

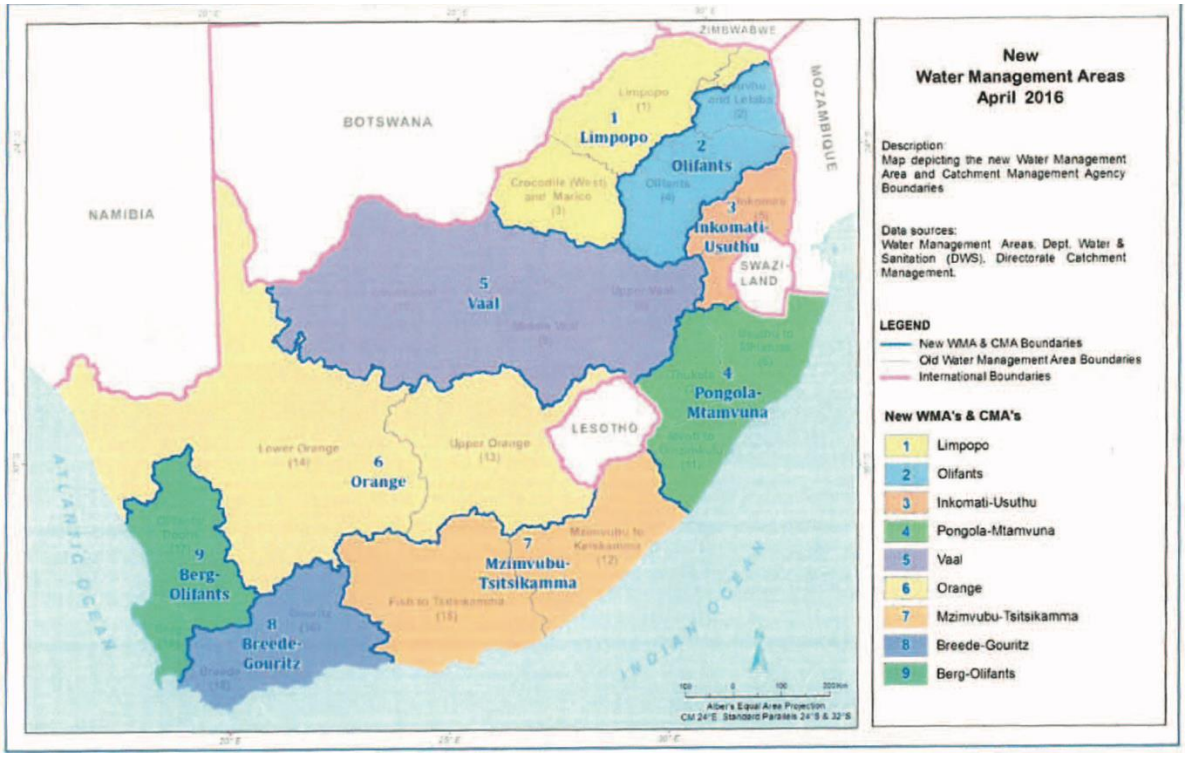


Figure 10: New Water Management Areas for South Africa (DWA, 2016)

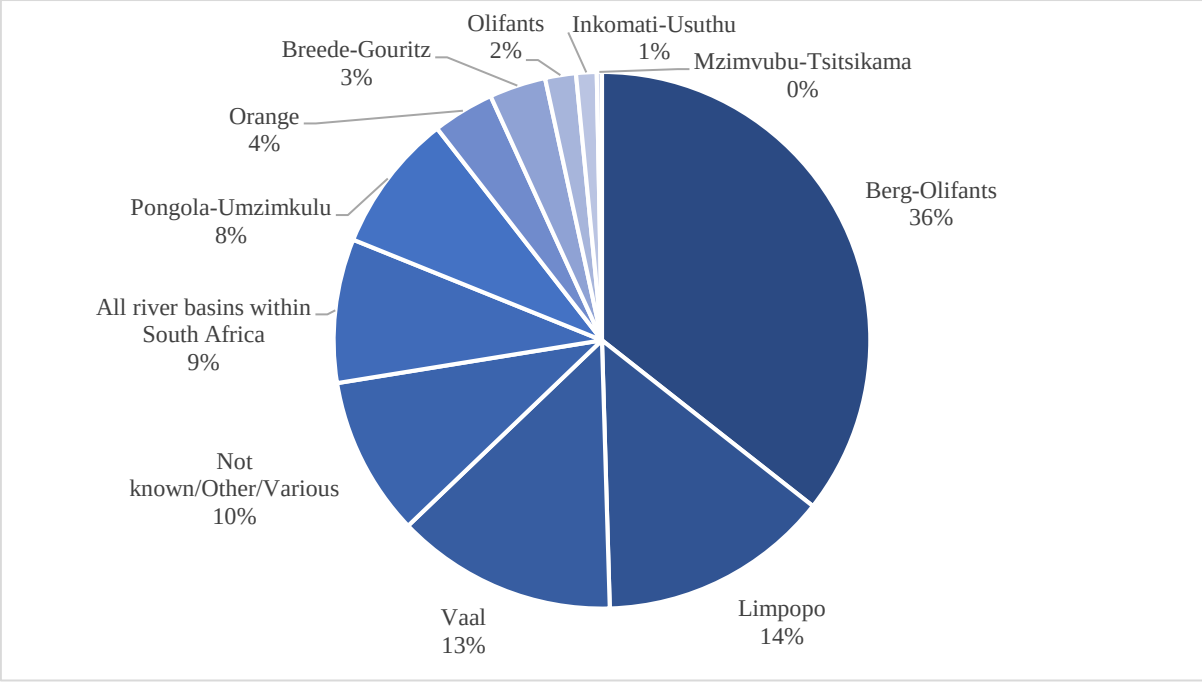


Figure 11: Water Management Areas in South Africa

Once companies had established their location through the river basin in use, impact drivers and their consequential impacts related to water were explored. A 'driver,' according to Griffiths & Lambert (2013; p.43), "provides impulse or motivation and

causes a particular phenomenon to happen or develop". An impact is understood to be a noticeable effect or influence. Thus, impact drivers are the cause, reason or force behind what companies experience. These influence the incidents companies respond to. Impacts are then the effects companies experience as a result of the drivers. For example 'negative media coverage' could be the impact driver behind the impact of experiencing 'disruption to sales.'

3.2.2.2. Impact drivers

Within the survey, impact drivers are separated into either physical, regulatory, reputational or other impact drivers. A total of 28 different affects were identified by companies in 2015 and 2016 to have caused water related detrimental impacts to their company (Fig. 12). Physical impacts were the biggest driver affecting almost two thirds (65%) of companys' operations. There was an increase in the number of physical impact drivers (by 31) between the two years. Regulatory impact drivers had the second highest influence, affecting almost one third of companies (30%), while reputational and other impact drivers affected 5% of companies. Over the two years, 40 more impact drivers were experienced by companies in 2016 than in 2015.

Impact drivers relating to a lack of water played the biggest role (Fig. 12). A lack of water included 'drought' which affected 14% of company operations. Drought is defined by a prolonged period of abnormally low rainfall that leads to a shortage of water (IPCC, 2014a). The severity of the drought was prevalent as almost 50% more operations recorded drought as an impact driver in 2016 than in 2015. The other two components of a lack of water included, 'increased water scarcity' (8%) and 'increased water stress' (7%). The CEO Water Mandate differentiates between these two terms as water scarcity referring to the quantity of water available usually as a proportion of water consumption to available supply whereas water stress is more comprehensive, it includes the ecological water demand, the quality of water and accessibility (Shulte, 2014).

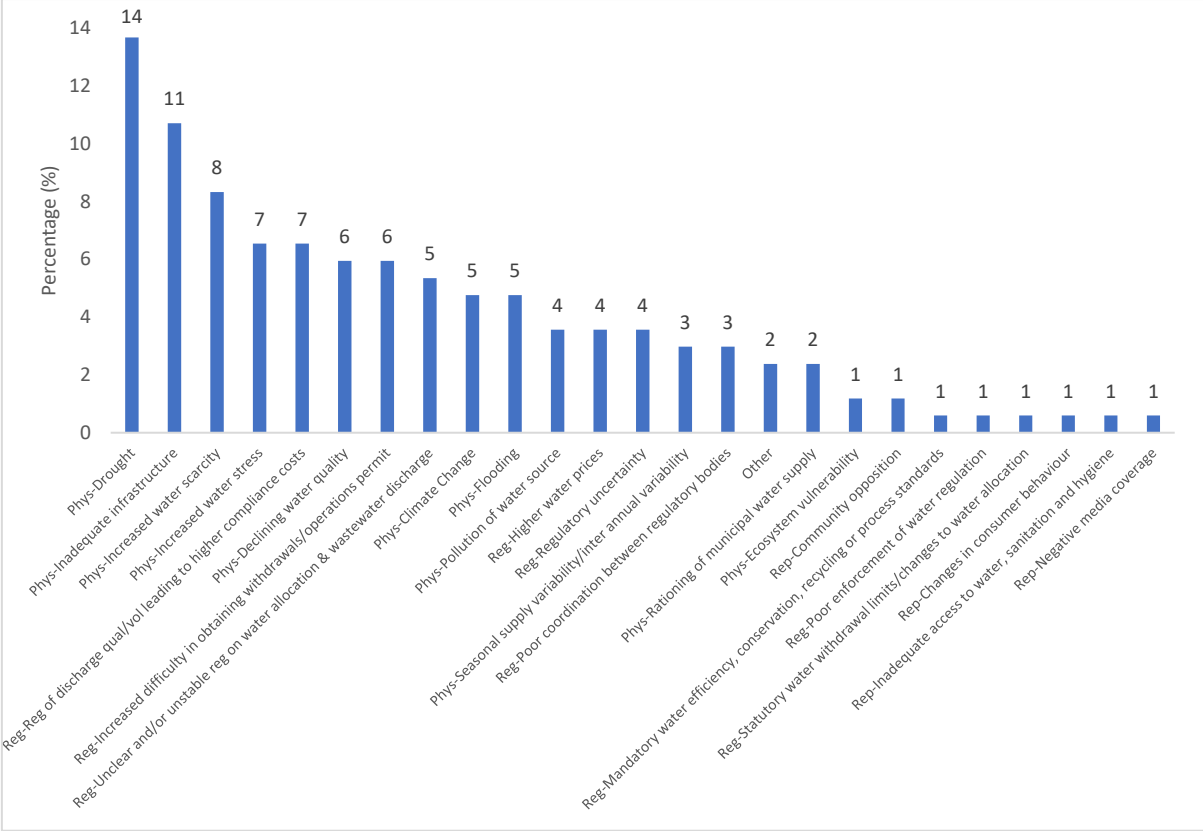


Figure 12: Impact drivers behind companies experiencing detrimental impacts related to water over 2015 and 2016

In light of PCA findings, exposure to water risk is highly associated with all physical impact drivers (Fig. 13). When referring to the cumulative variance of factor three factor in addition to factors one and two, statement still stands true. Within factor three, an orthogonal relationship is found between exposure to water risk and the physical impact driver of 'declining water quality.' This indicates that a decline in water quality is not necessarily influenced by experiencing water risk according to companies in 2016. Although not significant, an independent relationship is also highlighted between exposure to water risk and 'increased water stress' and 'seasonal supply variability/inter annual variability' when referred to by factor three. Company water risk exposure is thus not sensitive or inclusive of ecological water demand and seasonality change as opposed to dealing predominantly with availability.

Although it seems that very little relationship is seen between drought and increase water stress or scarcity, when viewed in isolation, it appears that a positive relationship exists between scarcity and stress (Appendix B). As a result, indicating that companies who

experience the one is most likely to also experience the other. An independent relationship also exists between experiencing drought and increased water scarcity.

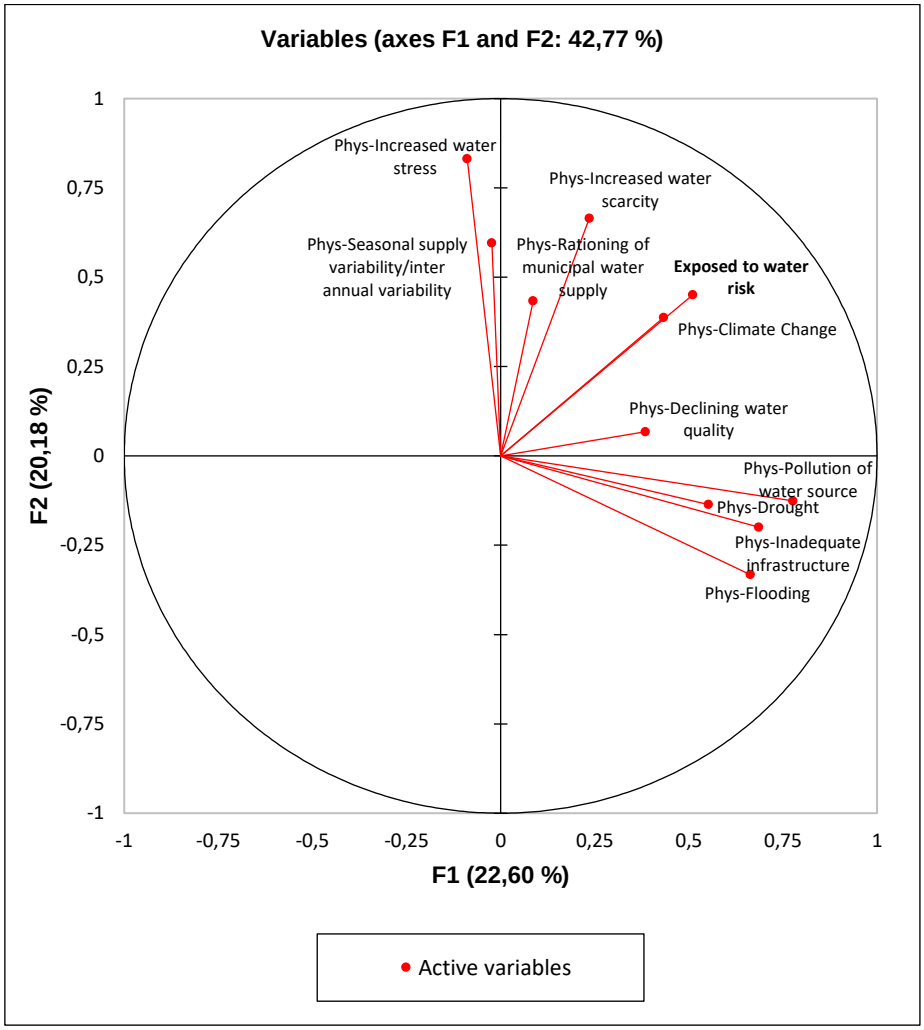


Figure 13: PCA for physical impact drivers companies experienced in 2016

3.2.2.3. Impacts

Over 2015 and 2016, 25 different types of impacts were identified. These impacts were as a result of the impact drivers mentioned previously (Fig. 12). 'Higher operating costs' was an impact experienced by almost one third of companies (31%; Fig. 14). Only five companies who mentioned a lack of water (drought, increased water scarcity and stress) as an impact driver, faced 'higher operating costs' as an impact. Ten different types of physical impact drivers did, however, contribute to over a third (35%) of companies experiencing a 'higher operating cost.' Other physical impact drivers included 'declining water quality,' 'ecosystem vulnerability,' 'pollution of water source,' 'rationing of municipal water supply' and 'flooding' to name a few (Fig. 12). 'Water supply disruption,'

in contrast to ‘higher operating costs’ was as a result of 91% of physical impact drivers specifically related to a lack of water.

Several reactions and responses to periods of companys’ experiences of water stress were noted. These either included direct or indirect responses. Of the companies interviewed, money was not purposefully allocated to manage the drought, this approach relates to the findings from the CDP data. However “*a lot more time and resources from employees has gone towards it*,” (Participant B). In addition, the issue involved not the availability of water but the availability of infrastructure to supply water that needed extra funding. The Cape Town situation in contrast to the 2015/2016 drought did require a purposeful allocation of money for some.

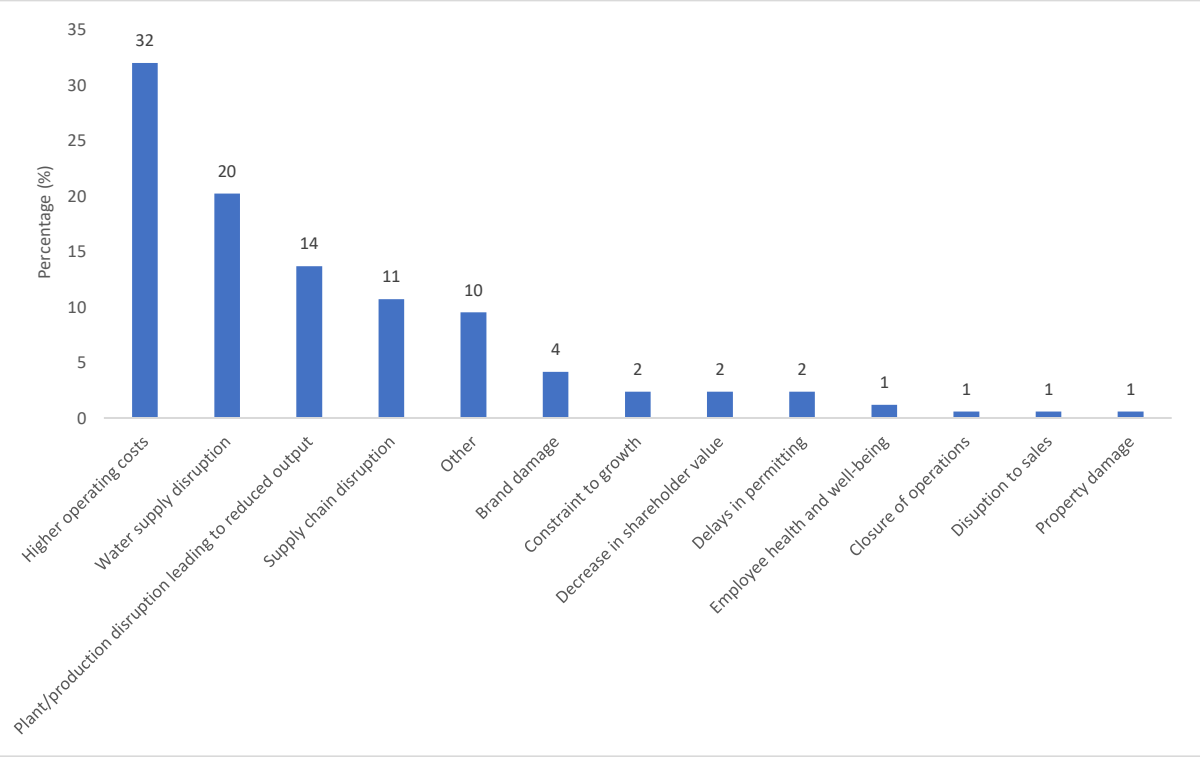


Figure 14: Water related impacts experienced by companies between 2015 and 2016

With respect to PCA, the impacts companies experience are all associated with water risk exposure (Fig. 15). Using the cumulative variance of factors one to three however, indicates an inverse relationship between being exposed to water risk and the impact of experiencing constraint to growth. The relationship indicates that experiencing water risk does not restrict business growth. In addition, relationships shown by factor one and two

indicate a close association between exposure to water risk and supply chain disruption. Upon further examination, factor three illustrates a positive relationship between the two.

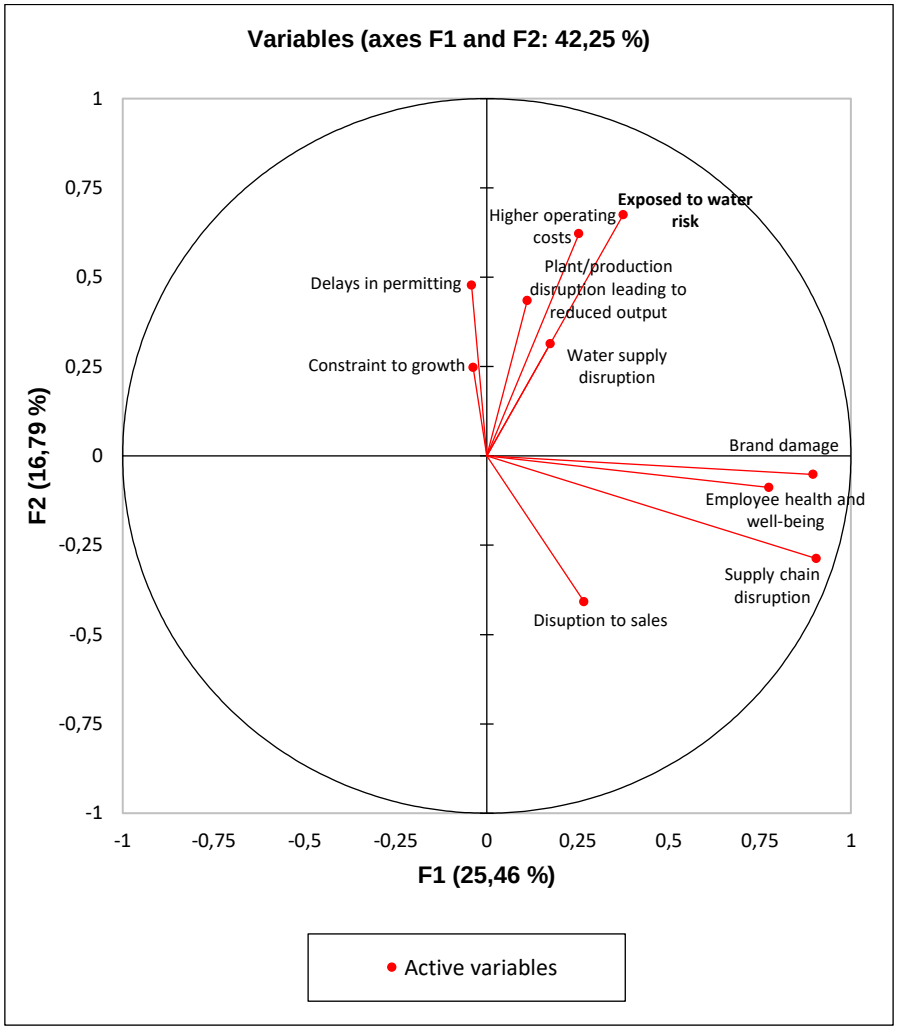


Figure 15: PCA for impacts which companies experienced in 2016

Having explained some of the contextual factors configuring certain aspects of water risk for companies, attention now turns to examining how companies plan for the variability in climate. Given the multitude of encounters companies mention facing, the opportunity for adapting is highlighted as well. Taking into account what companies experience, coupled with considering if companies are able to adapt to changes in climate, provides initial insight into governance and decision making which follows in the subsequent section.

3.2.3. Climate variability for planning and the opportunity of adapting

Owing to the weather changes companies have experienced above, variability was also probed as a driving factor shaping company planning. For all companies interviewed

variability is addressed; however their approaches differ. Many make use of models through scenario based analysis. At a strategic level, an industrial company (Participant D) asks, "*How do we adapt our business model in the medium to long term to create a more resilient business,*" whereas at an operational level the question is more towards "*the resilience in the operations from physical risks*". Other companies have policies and guidelines that "*are the principles that guide [us] in terms of climate change in our organisation*," (Participant E). The need to be prepared has increased as many have experienced operational disruptions. Nevertheless this awareness has brought about new opportunities to understand "*where in the process we can potentially save water […] or opportunities for recycling water, but also in terms of again, are there opportunities to develop new facilities in different areas*," (Participant F). Many have linked adapting to climate variability and change as an opportunity for innovation, "*it just challenges business unusual, so innovation comes with that"* (Participant B). The take home message is that the trigger for innovation has come about due to the unpredictability climate variability poses to business. Simply put, *"…it's a good opportunity to just become a better business*," (Participant B).

For some companies (Participant C), the risk of climate variability is around the Department of Water and Sanitation reliability and questioning, "*is the department in a position to respond to climate adaptation and is our water board like Rand Water in a position to do it*," with the fear being that this is not the case. Adapting is, however, seen as a risk and an opportunity depending on the time scale, "*I think the opportunity space is more in the medium term to the longer term, it's about how to do pre-empt changes at a system level, driven by climate change that's to create new opportunities for yourself and the risks we see it short and long. But in the short term it's a bit hard, you kind of navigate the space, in an environment where [there is] increasing volatility in the weather system*," (Participant D). Lastly there is a reputational advantage, "*both in terms of potential investors, but also in terms of brand development*," (Participant F).

Having illustrated company's ability to adapt to climate variability and foresee opportunities in adaptation, attention now turns to focus on to what extent and how companies are incorporating and building such issues into their decision making – particularly in terms of water management. Issues probed include whether water

management is included into the business strategy, who leads in such decision making and how often meetings on water related issues occur.

3.2.4. Decision making around water issues

Three areas are addressed in the CDP Water survey to make sense of decision making around water issues within companies. The themes explored are: (3.2.4.1) if water management is integrated into a company's business strategy, (3.2.4.2) who has the highest level of direct responsibility for water issues and lastly, (3.2.4.3) the frequency of briefings around these issues. To fully capture decision making around water issues, these three aspects are brought together and coupled with water risk exposure (3.2.4.4).

3.2.4.1. Water management integrated into business strategy

The CEO Water Mandate (2018) promotes the value of integrating water management into a company's business strategy as it gives water issues the attention it requires, especially if water is crucial for long-term business viability. Between 2014 and 2016, 91% of companies integrated water management into their business strategy. Five companies did not integrate water management into their business strategy, four of which belong to the industrial sector.

Close to half the companies who responded between 2014 and 2016 said that water has negatively influenced their business strategy through 'increased water expenditure' (45%). There was a total of 12 different reasons for a negative influence, of which almost a quarter (22%) revealed there was no measurable impact.

In comparison, there was a total of 33 different reasons for how water positively influenced a company's business strategy, as a result creating variable responses. The 'establishment of sustainability goals' (18%) had the highest response followed by an introduction of management KPIs (Key Performance Indicators; 17%) and 'publicly demonstrated our commitment to water' (14%).

3.2.4.2. Highest level of direct responsibility for water issues

The seriousness of water issues is highlighted as all companies have a 'Board of individuals/subset of the board or other committee appointed by the Board' that have the

highest direct responsibility for water issues by 2016 (Fig. 16). Over the years companies have moved away from having an ‘Environmental Manager’ or ‘Sustainable Development Manager’ who has chief responsibility over water. Emphasis is placed on the Board having involvement in who makes water related decisions by creating a specific group.

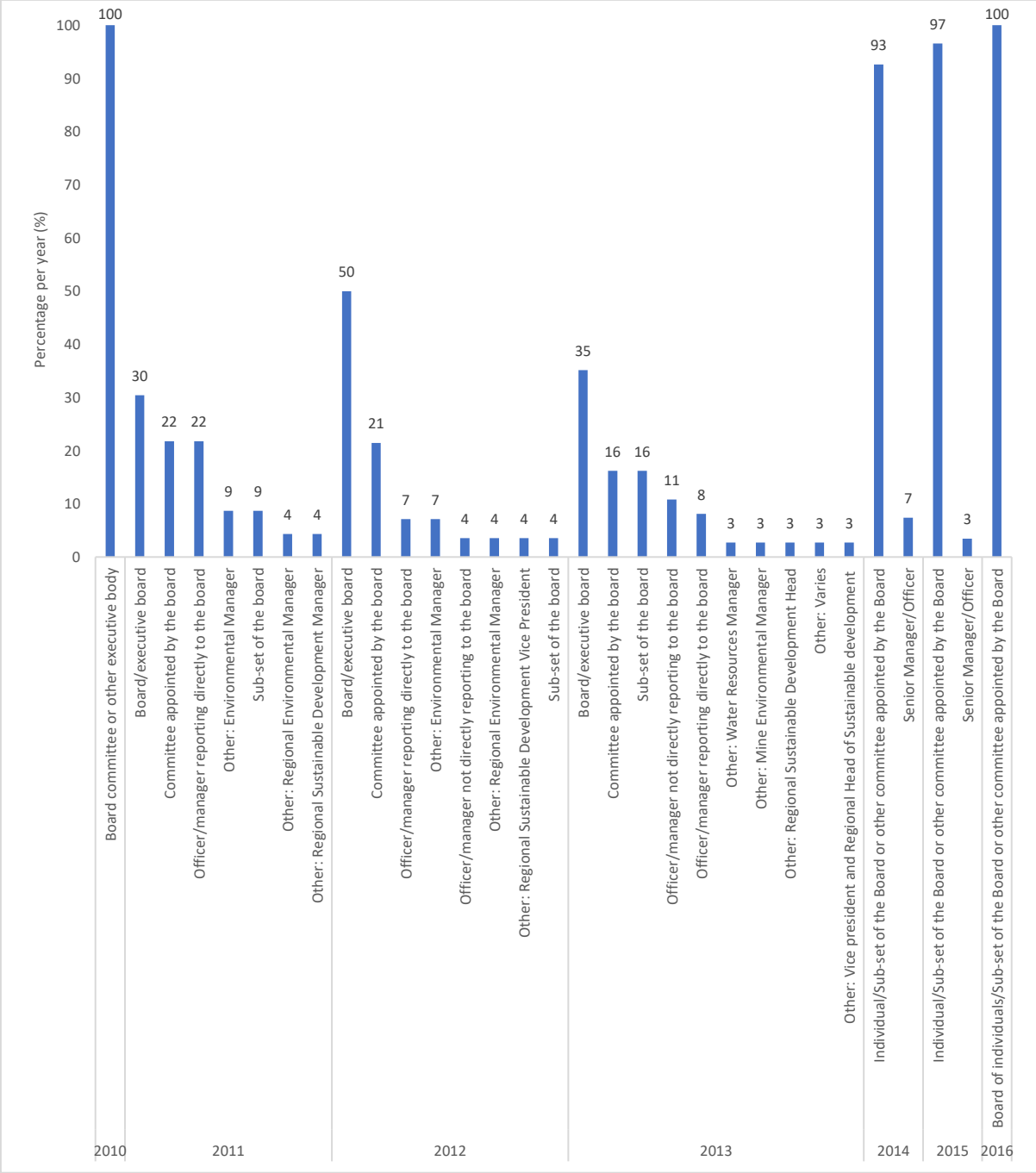


Figure 16: Highest level of direct responsibility for water issues over 2010 to 2016

3.2.4.3. Frequency of briefings on water issues

Between 2014 to 2016, almost a third of companies (30%) met for briefings on water issues on a 'scheduled-quarterly' basis (Fig. 17). However more than half did not answer how often they meet (54%). The lack of responses is especially alarming as the majority of companies answered a 'probable' likelihood (69%) and short timeframe ('current up to one year' and '1-3 years' (54%)) of experiencing inherent water risks that could generate a substantive change within their company.

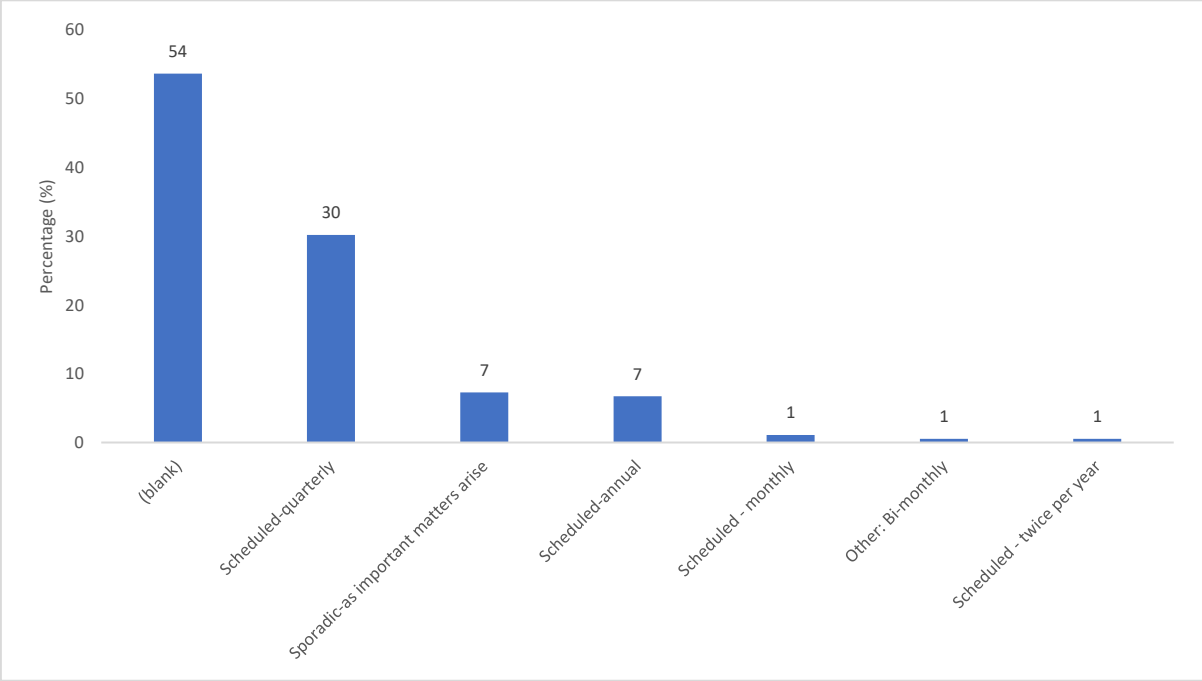


Figure 17: Frequency of briefings on water issues from 2014 to 2016

3.2.4.4. Governance and decision making in light of water risk exposure

At a first glance a governance disconnect can be seen through an inverse relationship between water risk exposure and the integration of water management into a company's business strategy (Fig. 18). When looking at the cumulative variance explained by factors one to three, the relationship is not inversely related but rather independent. The cumulative variance explanation that accounts for at least 50% of the variability in the data set is more plausible to the governance disconnect indicating that integrating water management into a business strategy is not guided by being exposed to water risk. In addition, there is an inverse relationship between being exposed to water risk and meeting on a scheduled quarterly basis (which is also highlighted by factor three). This inverse relationship indicated that companies who are not exposed to water risk still meet on a quarterly basis and do integrate water management into their business strategy.

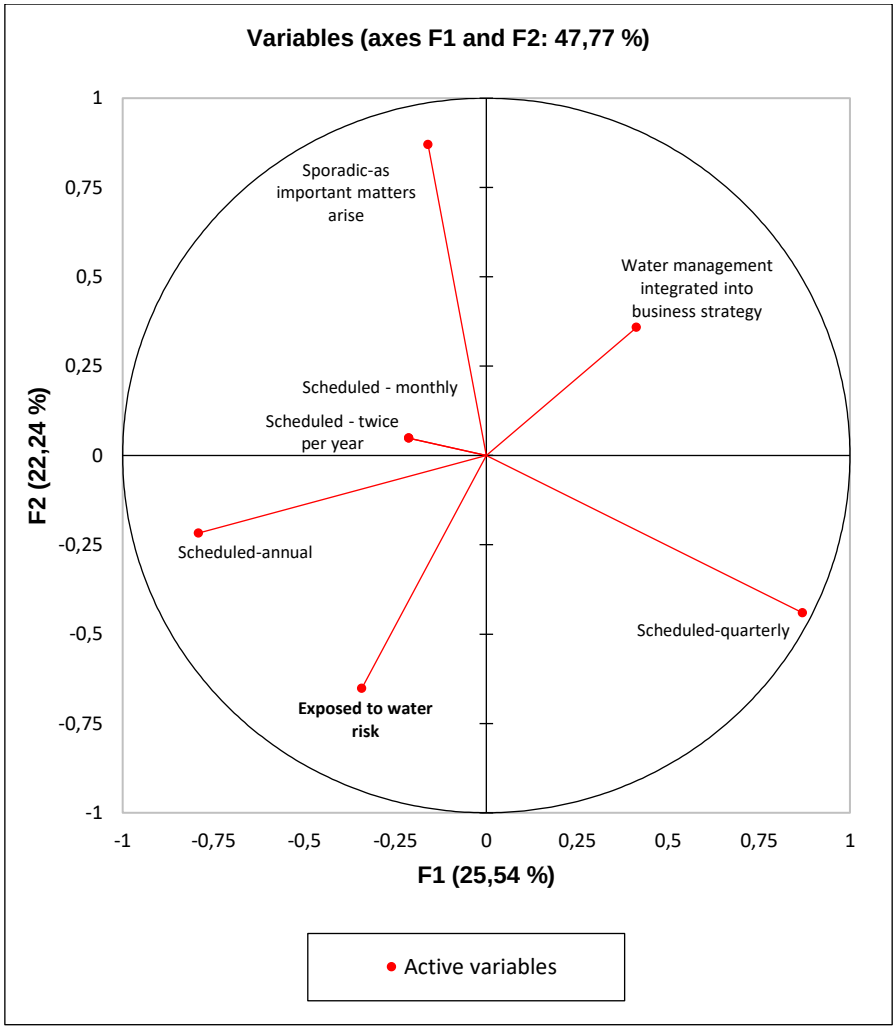


Figure 18: PCA for governance and decision making in 2016

In light of these findings, governance and decision making play an important role in a company. By looking into how company's financial reporting metrics are affected by water related risks, the knock-on effects of decision making are considered in the following section.

3.2.5. Financial reporting metric that could be affected by water related risks (related solely to direct operations)

Crucial to company growth one also needs to record and evaluate the condition of the business and one way of quantifying this assessment is through financial reporting metrics. Between 2014 and 2016, 140 river basins were identified for direct operational use by companies in South Africa, which were categorised into the nine Water Management Areas for the country (Fig. 10). For each river basin mentioned, companies were asked to

provide the proportion of their chosen financial reporting metric that could be affected by water risks (Fig. 19). Over the three year period, a total of 14 different financial reporting metrics were used. The ‘percentage global production capacity’ was applied by a third of companies (33%) while 23% made use of the ‘percentage global revenue’ metric. The proportion of metrics that could be affected by water risk was highly variable. Yet, regardless of the metric, 60% of responses covered four proportions (1-5, 6-10, 11-20 and 91-100%). Nine companies mentioned that a 91-100% proportion of their chosen metric would be affected by water risks, five of these companies made use of the ‘percentage global revenue’ financial reporting metric. As these metrics suggest, they are used at a headquarter level. As a result the location of river basins did not correlate to any metric used suggesting that financial reporting metrics are not sensitive to water. Additionally, the proportions used, further suggest that the use of these metrics will not be affected as the metrics tend towards a global scale rather than at a business level.

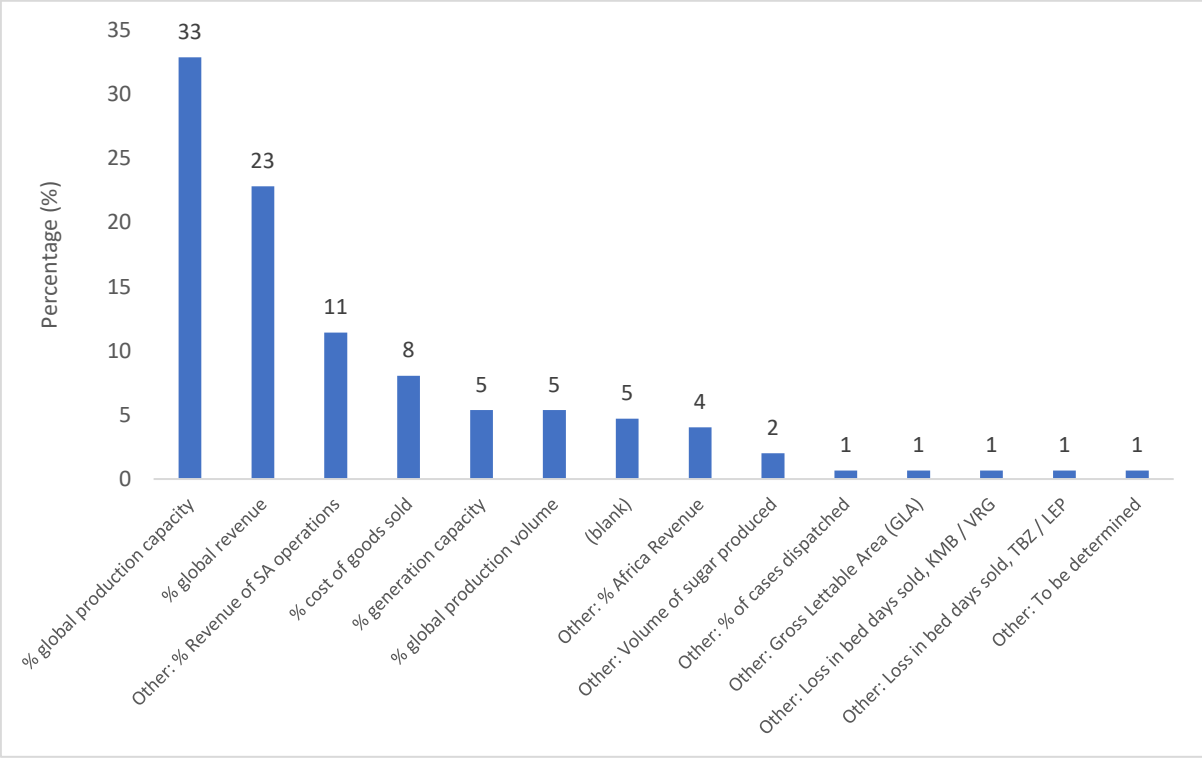


Figure 19: The range of financial metrics that could be affected by water related risks between 2014 and 2016

3.2.6. Summary of company background

Companies have become increasingly affected by weather and climate events. As a result climate variability has developed into an important component of business planning. Companies see this as an opportunity to change business as usual and to

innovate. Zooming into water specifically, it is found that perception of water risk is the driver behind decision making. Accordingly, dependent on the role water plays within a company, water risk is perceived on how operations are able to run without this resource. The opportunity for adapting as a result has brought about a range of innovation to deal with the unpredictability that climate variability poses to business.

To understand perception, over 60% of companies are exposed to water risk where impacts experienced are chiefly due to physical drivers (65%). The main drivers here are a lack of water (drought, water scarcity and water stress), yet the full range of drivers have resulted in almost a third of companies experiencing 'higher operating costs.' Of this experience, only around a third (35%) was due to physical impact drivers. As expenditure increases, decision making around water issues attracts greater attention. The urgency to address water risk resulted in almost all companies (93%) integrating water management into their business strategy by 2016. In addition, all companies have a 'Board of individuals/subset of the board or other committee appointed by the Board' who have the highest direct responsibility for water issues.

Lastly, when dealing with expenditure around water related risks, companies primarily make use of financial reporting metrics that tend to a global level rather than addressing issues at a business level or river basin scale.

3.3. Company Responses to Water Related Concerns

In the second section, companies' response to water security concerns, both in abundance and shortage, are investigated. Responses were researched first through the lens of water importance. By gaining insight into how companies place importance on water, an underlying understanding is considered for the consequential responses and interventions put in place to manage water risks. This insight further allowed for investigating what companies base water risk decisions on to assist their decision making. Company decision making is then assessed through water restrictions which is used as an indicator for whether current practices are preparing companies to be more adaptive. Lastly, in an

attempt to drive water efficiency, with reference to climate variability and coping capacity to water security concerns, company water related goals and targets are reviewed.

3.3.1. Companies and the importance of water

The boldness and speed behind a company's case for action around the water risks they experience are highly reliant on the importance placed on water. Importance is for both water quality and quantity needed for a company to run their daily operations.

Companies were asked to rate the importance (current and future) of water quality and quantity to the success of their organisation. The importance was questioned through both a direct and indirect use importance rating by sufficient amounts of good quality freshwater and sufficient amounts of recycled, brackish water. From 36 companies over the 2014 to 2016 time period, almost three quarters (72%) said that sufficient amounts of good quality freshwater is 'vital' for their direct use. The indirect need for sufficient amounts of good quality water was rated as 'important' for nearly two thirds of companies (65%) which highlights the need for good water management among South African companies.

Although all companies rated the direct use of both sufficient amounts of good quality freshwater and recycled water as 'vital for operations' and 'important,' only 14 of the total 35 companies (between 2015 and 2016) experienced 'higher operating costs' (Fig. 14) as an impact. Consequently, importance does not equate to an increase in costs.

Companies were asked to report on their total water consumption, their water withdrawal and water discharge by quantifying and comparing to the previous year of reporting. In practice a company's total consumption should equal their water withdrawal minus their water discharged. Where total water withdrawal according to the Global Reporting Initiatives (GRI) Standards (GRI, 2016; p.18) is "the sum of all water drawn into the boundaries of the organisation from all sources for any use over the course of the reporting period. Sources of water withdrawal can include surface water, ground water, rainwater and municipal water supply." Total water discharge in contrast as defined by the GRI G4 Sustainability Reporting Guidelines (G4 online, 2018) is "the sum of water effluents discharged over the course of the reporting period to subsurface waters, surface waters,

sewers that lead to rivers, oceans, lakes, wetlands, treatment facilities, and ground water either through: a defined discharge point (point source discharge); over land in a dispersed or undefined manner (non-point source discharge); wastewater removed from the organisation via truck. Discharge of collected rainwater and domestic sewage is not regarded as water discharge." Lastly, water consumption outlined by the Water Footprint Network (Hoekstra *et al.*, 2011; p.193) is "the volume of freshwater used and then evaporated or incorporated into a product. It also includes water abstracted from surface or groundwater in a catchment and returned to another catchment or the sea."

The high value placed on water by South African companies resulted in 76 to 100% of sites/facilities/operations of a company's total operations to be regularly measured and monitored in all water aspects across all companies in the country over 2015 and 2016. Managing water in this manner included facilities providing fully functioning WASH (water, sanitation, and hygiene services) for all workers, water consumption (total volume), water discharge (quality data by standard effluent parameters, total volumes, volume by destination, and volume by treatment method) and water withdrawals (total volumes and volume by sources) (CDP, 2017d).

Although companies were asked to quantify (in megalitres/year) their water accounting metrics (water withdrawal, water discharge and water consumption), the majority did not. Over 2015 and 2016, only 45% of companies quantified their operation's water withdrawals (238 operations from a total of 531) and 38% quantified their water discharge (122 operations of a total 325). In contrast, only one company over these two years recorded 'not applicable' to quantifying their operation's total consumption. Although consumption recorded a high response rate, quantities vary as different tools have been used to measure their water use as a result restricting comparisons. As a specialist highlights, "*you have to be very careful of the water use metrics, because there's such a huge variability in how people measure water and how people understand water*," (Participant I).

While more detail could be explored into these water accounting metrics, due to the low response rate and inability to compare companies and sectors, this investigation was avoided. A specialist confirms that in order to compare, a standard method would be ideal, *"... common accounting framework or standard [would be ideal], but that doesn't*

typically exist in practice" (Participant H). Essentially the issue of low response rates exist because "*context is the critical element in water*," (Participant H). To explain the setting and context of water, the following example was given, "*If you use a million litres of water out of the mouth of the Tugela, just before it flows in to the sea, you can use as much as you like because it's going to go into the sea… But if you use a million litres of water in the Karoo, it's a very different prospect*," (Participant I). As a result, addressing the water withdrawal metric may not explain water use.

Having explained the importance companies place on water in spite of their lack of quantifying water accounting metrics, the next section examines the interventions implemented to counter the risks companies face. The range of response strategies are explored in isolation as well as through the use of PCA.

3.3.2. Responses and interventions to water risk

Company-based responses and interventions to the water risk they face are explored in the next section. Responses assist in understanding how different companies deal with the inherent water risk they face.

Companies initiated 33 strategies to respond to water related detrimental impacts that were experienced between 2015 and 2016. Of these responses, 13 were included in 'other' (Fig. 20). Responses provided by companies were as a result of 70% of physical risk drivers. 'Engagement with public policy makers' was the most frequent response strategy (15%). Just over half of the companies who responded with 'engagement with public policy makers' experienced the impact of 'higher operating costs' (51%).

The main impact operations experienced was 'higher operating costs' (Fig. 14), and responses to the impact of increased expenditure included 15 different interventions, the most common of which were of 'engagement with policy makers' (24%), 'increased capital expenditure' (22%) and 'infrastructure investment' (15%).

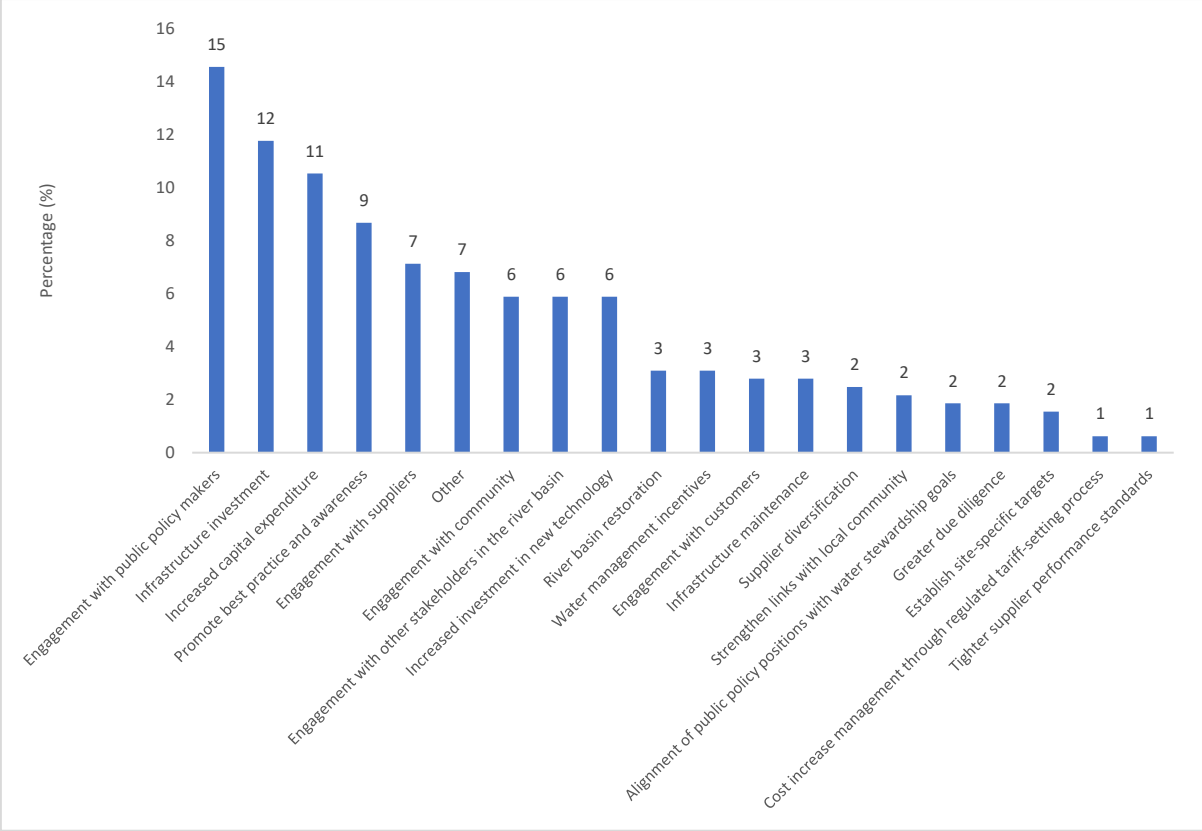


Figure 20: Company responses and interventions as a result of impacts experienced in 2015 and 2016

A strong positive correlation is implied by factors one and two between exposure to water risk, ‘infrastructure investment’ and ‘engagement with public policy makers’ (Fig. 21). Looking into the cumulative variance explained by factors one to three, a positive relationship between the three response strategies still exists but it is less strong. A strong relationship is however highlighted with the cumulative variance of factors one to three, between ‘engagement with public policy makers’ and ‘engagement with suppliers’. This strong relationship indicates that companies generally respond to inherent water risk with both these responses. Although not significantly illustrated by factors one and two, a cumulative variance indicates an independent relationship between being exposed to water risk and responding with ‘due diligence.’ This independent relationship suggests that the experience of water risk exposure does not influence taking responsible steps to avoid any wrong doing.

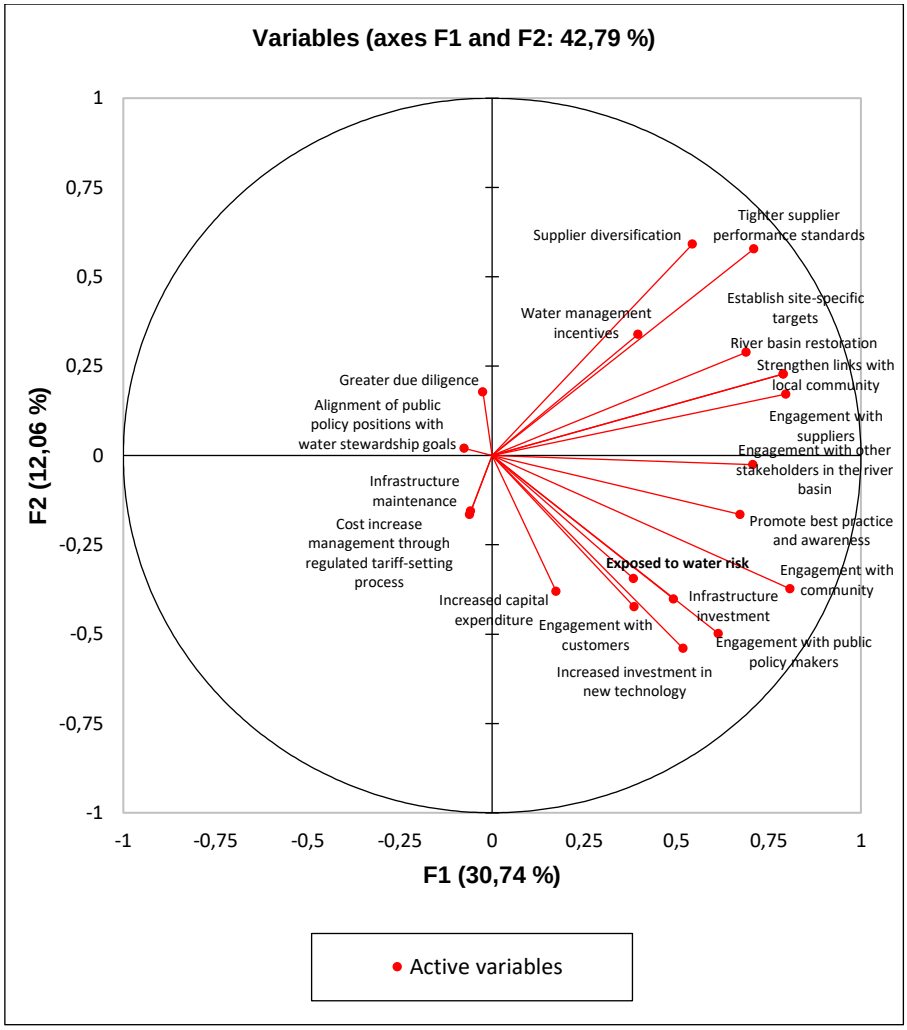


Figure 21: PCA response strategies for companies in 2016

As observed, a range of interventions is implemented by companies in response to the imminent water risks they face. The following section examines what avenues companies have taken to assist decision making in order to arrive at implementing their corresponding response strategies.

3.3.3. Enhancing water risk decisions – databases, tools, approaches

Companies experience a large variety of risks that occur in a variety of ways, which all bring about a range of responses (as seen above). During interviews, companies were consequently asked what they use (e.g. databases, tools and or approaches) on which to base water risk decisions. It was found that companies use a range of methods to address water risk. Some have internal capacity and have developed their own tools and processes by using specialists within their company. Through an internally developed methodology an industrial company (Participant D) stated, "*We look at risks in short, medium and long*

term within the business operation, along our supply chain and the value network and then we try and identify where water risks will emanate from and then address them pre-emptily".

In addition, tools such as the WRI (World Resources Institute) Aqueduct and the WWF (World Wide Fund for Nature) Water Risk Filter were popular amongst all interviewed companies. WRI Aqueduct has a Water Risk Atlas that maps current and future conditions of water risk. These conditions can be broken down into a number of categories that feed into water risk (Reig *et al.,* 2013). A materials company (Participant E) mentioned the use of the Water Risk Atlas map, "*In terms of risk we use the model called Aqueduct Risk map where we put the co-ordinates where we operate to see in terms of the availability of water up to 2020 so that we can plan efficiently or effectively for this… That gives us the broader view of what is happening in the catchment*". The WWF's Water Risk Filter is an easy to use tool, where water risk is broken down into company related risk through which a questionnaire is provided (companies are able to upload CDP answers) and basin related risk which makes use of the operation's location (WWF, 2014). A consumer staples company which is active in incorporating practice beyond the fence mentioned, "*We've used the Water Risk Filter model by WWF, [it's] one that aligns with water stewardship*," (Participant F). 'Beyond the fence' is the phrase used to describe practices that companies conduct outside their immediate operations. This generally involves other practices related to parties such as communities or companies.

When additional data are required above the information gathered from these tools, companies make use of different governmental organisation data sources. From a consumer discretionary company (Participant B), "*Data received from the water SAWS (South African Weather Service) data portal and from the Department of Water Affairs as well is used if we need to get more specific data*."

In light of exploring further the aforementioned methods to address and make decisions regarding water risk, in the following section a company's ability to adapt to climate variability is assessed. Water restrictions is used as an indicator to evaluate how companies responded, if these responses were effective and if they required a lot of time and energy to implement, to name but a few.

3.3.4. The case of water restrictions – an indicator of adaptation

Water restrictions were used as an indicator of how companies have adapted to changes in climate variability. For South Africa, 2015 was the warmest year (temperature) on record since 1951 in addition to having the driest season (rainfall) between July to June 2014/2015, since 1991/1992 (Blunden & Arndt, 2016). As a result water restrictions were implemented in areas affected to manage consumption.

All companies interviewed experienced water restrictions during the 2015/2016 drought and/or the Western Cape drought, dependent on the location of their operations. It was found that companies responded very differently to the water restrictions they experienced. Some made changes to their building (such as improving general infrastructure) as opposed to their operations, where they felt they were already working with minimal water. Some of these enhancements included introducing a grey water system and waste water treatment plan for example. A consumer discretionary company (Participant B) mentioned that "…*it's been process driven at the moment, and then also looking at what happens when there's not water and developing contingency plans and processes for that*." As a result some have implemented water conservation programs that deal with "*starting to take a longer-term view on how we deal with water rather than being too focused on fighting the fire of the immediate drought situation*," (Participant D). Water conservation programs, in many cases brought about a behaviour change which one company (Participant F) mentioned is "*the quickest thing that can be done*."

Despite these responses, a materials company felt that they "*woke up a little bit too late*" (Participant A) in order to effectively deal with the lack of water. In spite of a delayed reaction, a positive take home message was that the crisis "*definitely has created a lot more awareness around water throughout our colleagues and I think buy in for the more we communicate the more we seem to get positive responses*," (Participant B). The behaviour change in some "*moved from a reduction target to actually a saving target for the operations*" (Participant C), which may not have occurred without the event of a decrease in water.

In addition to a delayed reaction for some, responses also required a great deal of time and energy to implement, "*mostly because there are no existing resources in the business to*

implement," (Participant D). Although "*a lot of them [responses] were quick wins*" (Participant A), this fuelled water efficiency for many interventions that did not allow for quick fixes, "…*when you got something in abundance you become comfortable but once you realise that water is now becoming a scarce commodity that's where we started looking at a resource efficiency drive, where we had to look at water uses, where are we losing water metering, those kind of things. So some of them required revaluation, it's not like you know quick fixes*," (Participant A). This "*work in progress*" (Participant B) approach was mentioned across sectors as "*it's about building capacity that still needs to happen*" (Participant D).

More water mature companies, although still affected by restrictions, found process changes easier as discussions with the Board had already occurred. Approval for fast tracking longer term plans into a shorter time period to assist dealing with water shortages are simpler and speedier as the understanding around the water risks being experienced are already understood. For these companies a lot of time and energy was saved as awareness raising and building capacity did not need to happen.

While taking into consideration the occurrence of water restrictions, setting water-related goals and targets is seen as a practical solution to drive water efficiency, take on climate variability and cope with water security concerns. In the section to follow, company water related goals and targets are considered between 2014 to 2016 as well as the motivation behind why these achievements are set.

3.3.5. Water related goals and targets

A crucial response to dealing with water security concerns lies in setting goals and targets to drive water efficiency. Targets are quantitative while goals are qualitative. Setting achievable goals and targets does, however, require a good understanding of the company's water use and risk. Once a company identifies the drivers behind the risks and impacts they experience, decisions can be made and addressed through setting goals and targets.

As the questionnaire became more specific over the years of reporting, 91% of companies set goals and targets related to water. Between 2014 and 2016 most companies set both

goals and targets rather than only one of the two, with an increase over the years (Fig. 22). By 2016 two thirds (67%) of companies were setting both targets and goals as opposed to less than 50% in 2014. In addition, the category of targets set varied over the years (2010 to 2016) with almost a third of companies relating their targets to their 'direct operations' (30%). However, as the NBI pointed out from South Africa's 2017 data, only 11% of companies that set targets set absolute and intensity targets (NBI, 2017b).

The CDP has consequently started examining the use of 'Context Based Targets.' As one specialist noted, the understanding is around "*If I'm in a water scare region, my conviction around using water should be far stronger than if I'm somewhere else*," (Participant I). In light of this observation, the way in which water is measured may need to change allowing for a relative comparison to availability, "*how much of the available water do you abstract would be a much better indicator than how much do you abstract overall - making it relative to the supply*, (Participant I).

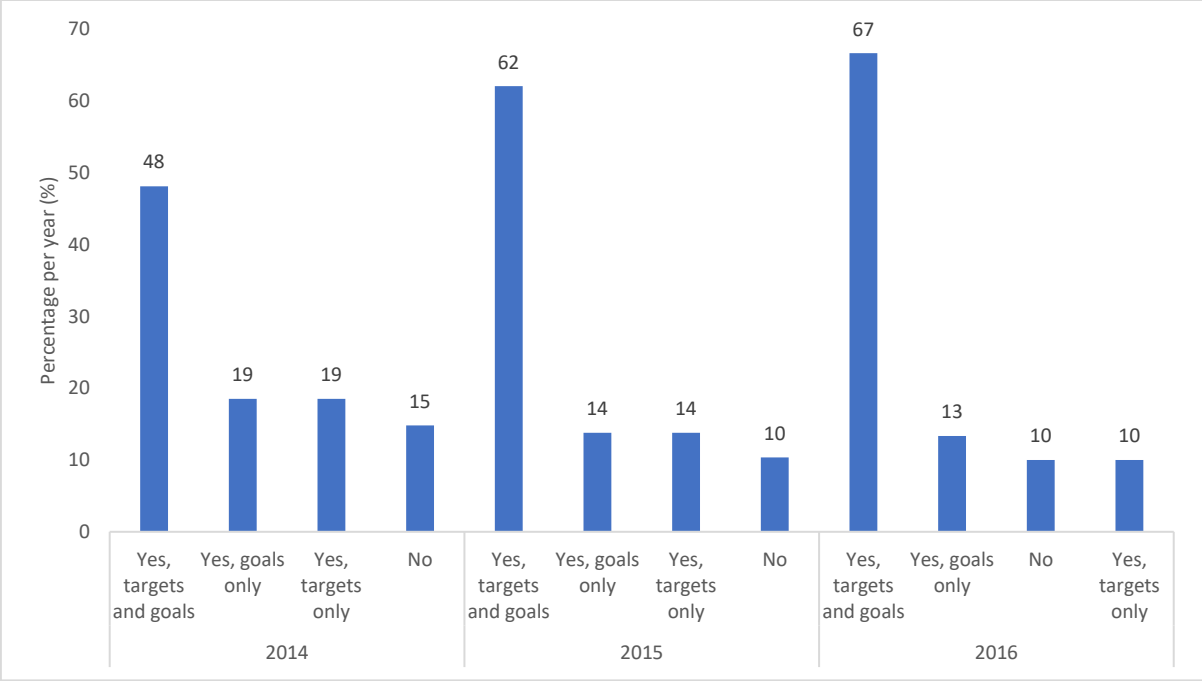


Figure 22: Company-wide targets (quantitative) or goals (qualitative) related to water from 2014 to 2016

When addressing the motivation behind company targets and goals, more than half (57%) do not know why they set what they do (Fig. 23). The absence of drive is concerning as motivated goals and targets are meaningful and set to be achieved. Nonetheless, the highest known motivation is 'water stewardship' (18%), followed by 'risk mitigation' (8%) and 'cost savings' (7%).

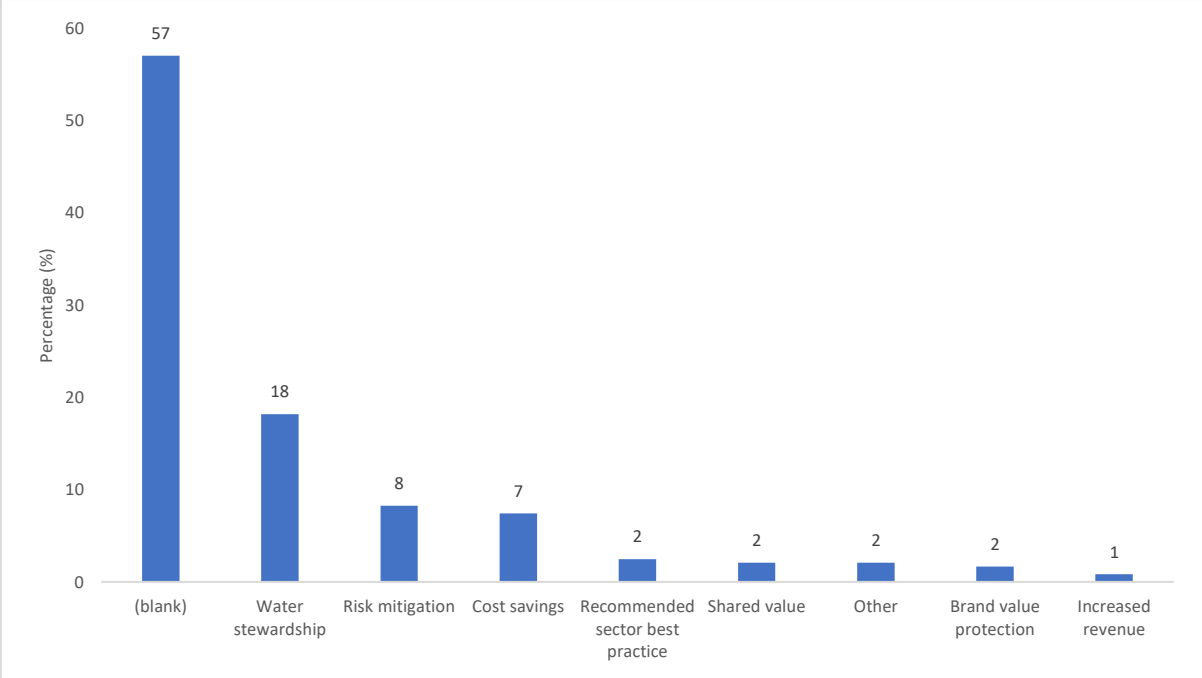


Figure 23: Motivation behind company targets and goals between 2011 and 2016

3.3.6. Summary of company responses to water related concerns

Sufficient amounts of good quality freshwater is 'vital' for almost three quarters (72%) of companies' direct use, highlighting the need for good water management. However, reporting on water accounting is low and incomparable. One the one hand, less than half of companies responding quantify their water withdrawals (45%) and water discharge (38%). On the other hand, over 2015 and 2016 only one company did not quantify their water consumption during both years. Although the methods used need to be addressed to allow for comparison and understanding behind the value produced, companies are gaining an understanding and reporting on their water use.

A variety of response strategies were initiated by companies to overcome the impacts they experience. In addition, interventions were provided by companies who are not exposed to water risks as well. The most popular interventions included 'engagement with public policy makers,' 'infrastructure investment,' and 'increased capital expenditure.'

Decisions around water risks are, as a result, addressed in a variety of ways. The importance of these decisions played a role in how companies have dealt with or are dealing with the implementation of water restrictions. Using water restrictions as an indicator of how companies adapt to climate variability, a range of responses were presented. Quick fixes were found to be easiest by some (including general infrastructure improvements) rather than process changes. Water mature companies highlight building a business case for addressing water risk issues as the understanding behind how this affects business is essential for counteracting 'crisis' situations (such as Day Zero in Cape Town) efficiently. One way of effectively responding to water security concerns is through setting meaningful and motivated goals and targets. A good understanding of the company's water use and risks are essential in setting these achievable targets and goals.

3.4. A View on CDP Water Reporting – Potential to Transform the Way in Which Water Related Risks and Opportunities are Considered

The last section of this chapter examines the role of CDP Water. This is done through assessing if CDP reporting, coupled with the acknowledgement of threats to water security, such as climate variability, has the potential to transform the way CEOs see their company's water related risks and opportunities. First the opportunities involving water are explored. Consequently, exploring water-related opportunities highlighted the prospect for water stewardship which is further investigated through the use of both CDP Water data and interviews. The findings around water stewardship interventions stress the role CDP plays in aiding company's understanding and ability to address water related risks and opportunities. CDP reporting is reviewed through their role in reporting and disclosing, the benefits they provide and subsequently how water reporting through the CDP can improve governance. Water governance in the private sector cannot be separated from the influence of the public sector. This partnership is considered with the hope of companies extending governance and decision making beyond their fence line.

3.4.1. Water as an opportunity

"*…If you are able to identify where the risks are and see those as opportunities then you are able to be more innovative in how you address those risks*," (Participant B). Over 2010 to 2016, 87% of companies said that water presents strategic, operational or market

opportunities that substantively benefit, or has the potential to benefit, their organisation (Fig. 24). Only 10% said water does not present an opportunity and 3% mentioned they 'don't know.' Over the years, more companies saw the opportunity that water could present even though the proportion of companies who answered 'yes' was above 80% through 2010 to 2015 with 2016 reaching 97%. Of the companies who said 'no,' two thirds (67%) belong to the industrial sector.

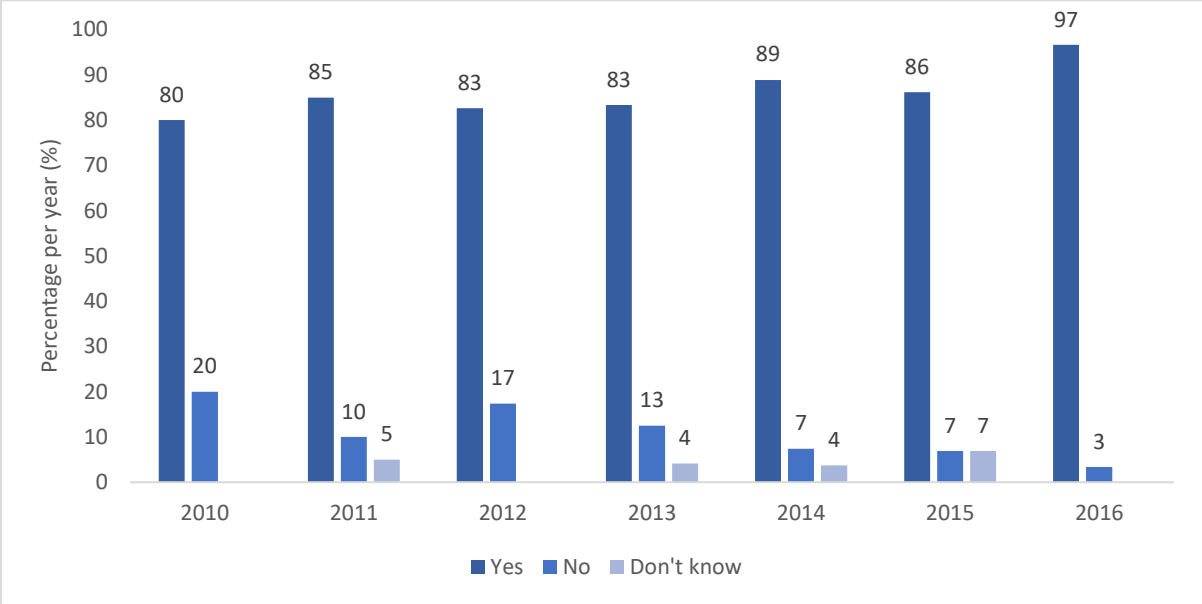


Figure 24: Water as an opportunity over 2010 to 2016

All interviewed companies had the general consensus that "*with other risks emerging in the system, new opportunities start to emerge*," (Participant D). Over the 2015 and 2016 period, 20 types of opportunities were mentioned by companies (six listed as 'other;' Fig. 25). 'Improved water efficiency' was the most prominent opportunity (26%) where companies highlighted the "*need to manage it effectively or efficiently and not pollute it*" (Participant E). This is a notable finding for water stewardship as more companies see 'improved water efficiency' as a principal opportunity and 'cost saving' as a consequential benefit.

The material sector recognised a total of six different types of opportunities while companies within the consumer discretionary sector varied their opportunities over 15 different types. Water quality was also mentioned as an opportunity during an interview, specifically "*looking for alternative sources of supply and to look for cleaner water is that you know there could be cost saving opportunities as well as waste management*

opportunities, meaning if we get cleaner water we don't have to handle salts as a result of treating it" (Participant C).

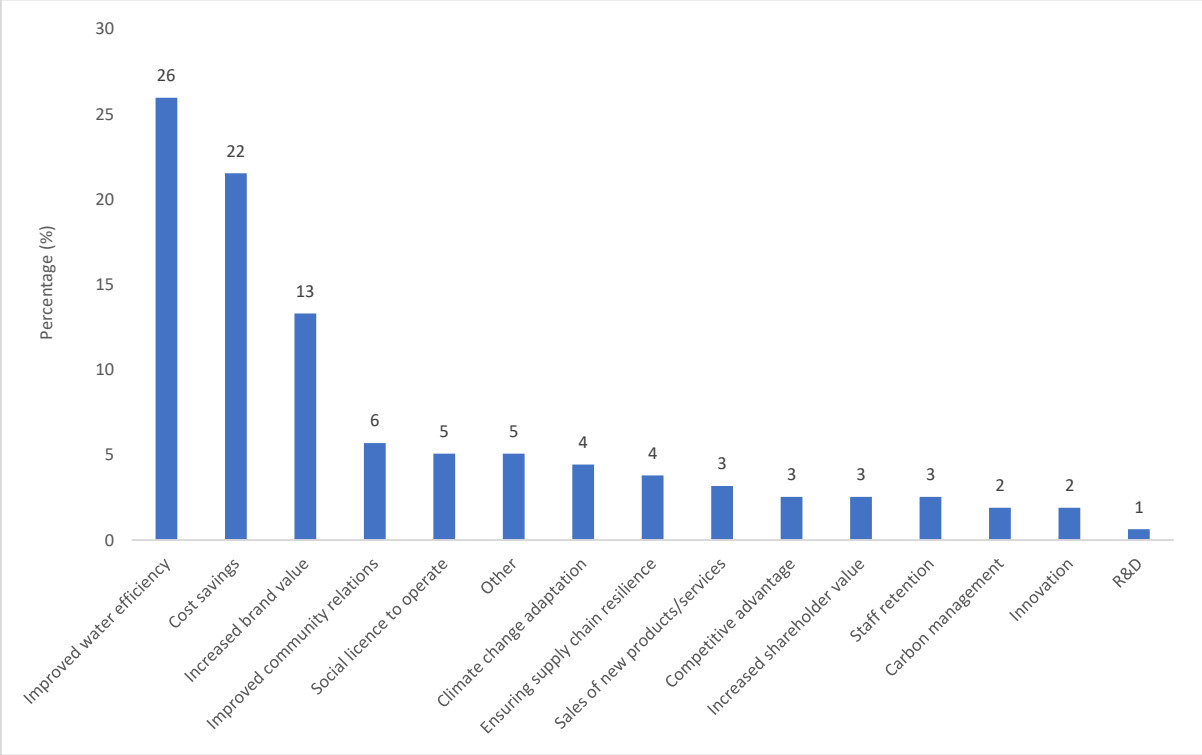


Figure 25: Types of opportunities water presented over 2015 and 2016

The association between improved water efficiency and cost savings highlights the prospect for water stewardship. This opportunity is explored in the following section through both CDP Water data and interviews.

3.4.2. Water stewardship as an opportunity

As the idea of water stewardship is fairly new, companies were asked whether they are familiar with the concept and what they thought it entailed. All companies have an understanding of water stewardship and could give a definition, however, more water mature companies gave greater explanations.

The key themes that emerged were water responsibility by companies being "*custodians of water*" (Participant A). Responsibility however extended first beyond "*your own water usage*" as "*it's not just within your own direct operations, it's also within the broader supply chain"* and secondly *"you not just looking [at] what happens within your own*

fence but also beyond the fence," (Participant F). The notion of inclusivity was underlined through "*working with other stakeholders within your river basin essentially to manage water risks*" (Participant B) which highlights the need for collaboration. Lastly, the use of framework guidelines was pointed out such as the *"CEO Water Mandate"* for example (Participant C).

From the view of specialists, water stewardship is "*definitely doable*," (Participant H). From fairly limited experience over the past three years it was found that companies were able to work across sectors, "*… Often they [are] not in the same sector which helps, it's based on the idea and the understanding that they're interconnected. Especially if they're geographically in the same location*," (Participant H). In addition, CDP plays an important role in companies recognising the long term benefit of water stewardship, "*The CDP voluntary reporting process helps companies over time. They never going to get it right in the first year but in the third year [they] really have a good handle on what those risks are and the realisation they come to is they cannot solve for those risks on their own. That leads to partnership, and if other companies have done similar kinds of assessments and answered similar kinds of the questions, that's fertile ground to facilitate partnerships… It's also important that they partner with government*," (Participant I).

The concept of water stewardship was highlighted three times within the CDP questionnaire. This included water stewardship as a response strategy (3.4.2.1), as a positive influence on the inclusion of water management in company business strategies (3.4.2.2) and lastly as a motivation behind goal and target setting (3.4.2.3). Owing to finding low water stewardship reactions within these, interviews were used to question whether an increase in legislation or policies may assist companies in taking a water stewardship approach. The following was found:

3.4.2.1. A water stewardship response strategy

A total of five companies between 2015 and 2016 responded to inherent water risks with a water stewardship strategy. Of all the potential impacts, companies acknowledged due to all risk drivers (physical, regulatory, reputational and other), just over a quarter (26%) responded with a water stewardship response strategy. Over half (56%) of these responses were as a result of physical risk drivers.

'Higher operating costs' was a potential impact listed by over a quarter (76%) of operations who viewed water stewardship as a response strategy in reply to inherent water risks that could generate a substantive change in business operations (Fig. 26). However, 14% of operations were 'unsure' what water stewardship was an appropriate response strategy for. As a result we can deduce that water stewardship is not as yet seen as a mitigating risk related to drought.

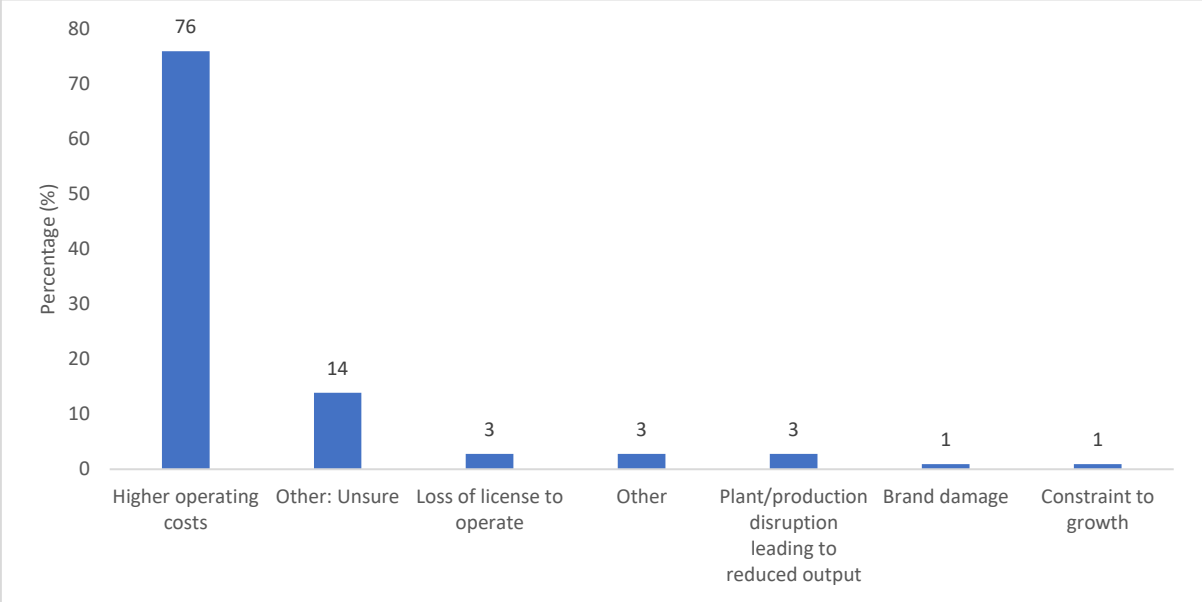


Figure 26: Potential impacts that resulted in water stewardship as a response strategy between 2015 and 2016

3.4.2.2. Positive influence of water on business strategy

Between 2014 and 2016, seven companies mentioned how the 'alignment of public policy positions with water stewardship goals' has had a positive influence on their business strategy. Of all the 33 reasons, alignment covered 6%, being mentioned 16 times over the three year time period. An alignment response was provided by six sectors, consumer discretionary, consumer staples, financials, health care, industrials and the materials sector.

3.4.2.3. Motivation behind target setting

Water stewardship became a motivation behind target setting in 2014, resulting in 18% of operations between 2014 and 2016 using this as a driving force behind the goals and targets their company sets. Overall, almost three quarter of companies came from the material (43%) and energy (30%) sectors. There were 15 types of targets where water

stewardship was a motivation, the highest being ‘reduction in consumptive volumes’ by almost a third of companies (30%) of which 92% of companies were from the material sector and the remaining from health care (Fig. 27).

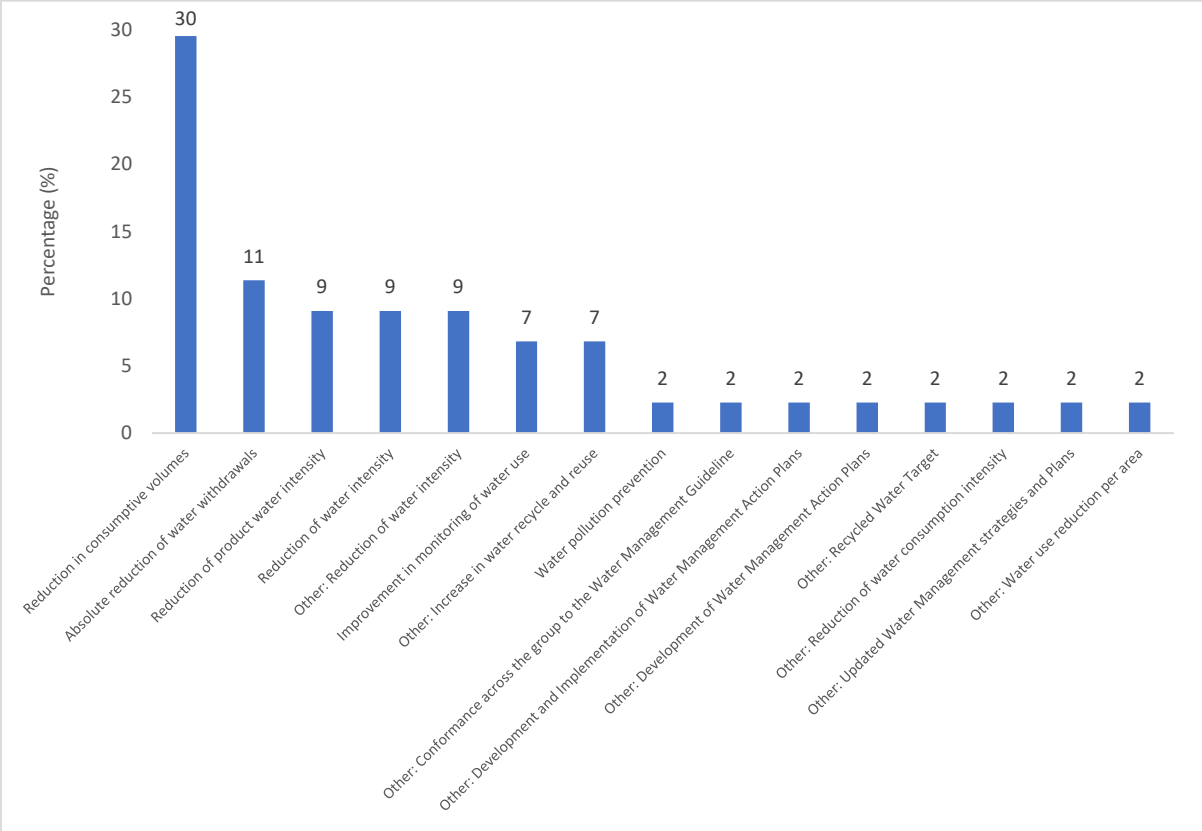


Figure 27: Targets set with water stewardship as a motivation from 2014 to 2016

3.4.2.4. Increase in legislation/policies to assist in taking action

All companies believe that an increase in legislation/policies around water stewardship in the country would assist their company and others in taking action. A company from the materials sector (Participant A) highlighted the need for context-based realistic targets by stating “…*we tend to commit like very high targets... The thing is yes we need to do that but we should take into consideration the problems that we have in our country. We cannot for instance commit to what we committed on climate change meanwhile we not putting it into action, we still have how many power stations and building more power stations*.” The answer may not, however, lie in additional policy implementation, as a materials company (Participant E) suggests that within the South African context there is already “*good legislation around water and other environmental issues to be specific, we just have to make sure that we adhere to those as a business and the authorities enforce*”.

The business case then becomes important as some highlight, "*hopefully whatever policy gets shaped allows for business incentives to invest beyond their factory fence*," (Participant C). Some have called on collaboration to "*help shape the government's thinking in terms of how or what water stewardship is*" (Participant C). A concern again, however, lies in the amount of money the private sector is expected to produce ,which then stresses the issue of corruption - "*…the risks around the municipal on the government side, [are] in terms of corruption risks, so that sort of makes that process a little bit more difficult*," (Participant F).

Although companies suggest that an increase in legislation or policies to assist in taking action may be a viable solution going forward, there is still a large variation trending in water management. "*You've got companies that are extremely mature and investing a lot of money and full time managers and so on, on the other end of the spectrum you've got food companies who say that they don't have an impact on water or that there's water having an impact on them… Water is less mature than any other environmental issue given it's magnitude of its risk*," (Participant I). Despite the varying maturity, South Africa has some highly ranked water stewardship examples specifically as a result of the drought experienced in Cape Town. A phrase stressed by a number of participants became increasingly clear, *'don't waste a good crisis.'*

3.4.2.5. Joint water stewardship interventions

The three water stewardship interventions were positively linked in the PCA indicating that similar companies adopt a similar water stewardship response strategy (Fig. 28). This positive association is also found when looking at the cumulative variance of factors one to three (which accounts for at least 50% of variation). In addition, companies with water stewardship interventions mainly meet on a scheduled quarterly basis. They also have a positive relationship with integrating water management into their company's business strategy. An orthogonal relationship is found between exposure to water risk and using water stewardship as a motivation for target and goal setting. To further investigate this independent relationship, with reference to cumulative variance, the association is rather shown to be positive with less significance placed on exposure to water risk. As a result,

indicating that using water stewardship as a motivation does not infer that the company is exposed to water risk.

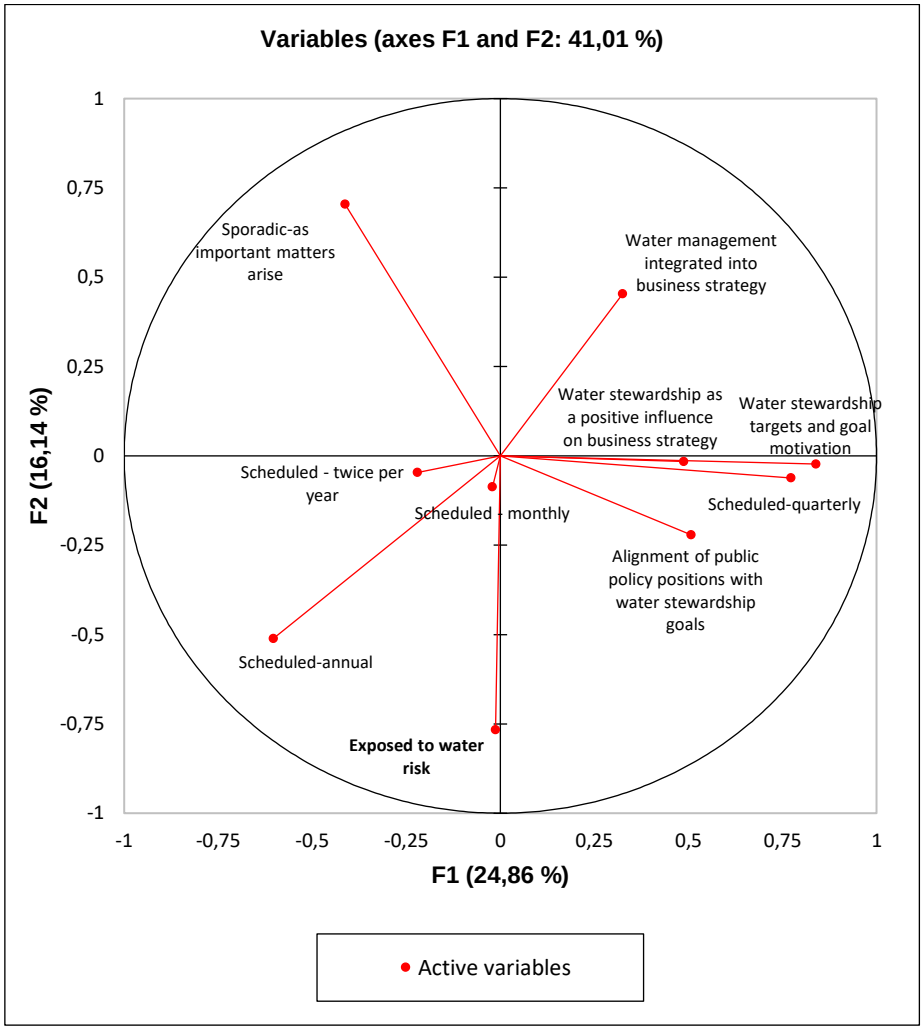


Figure 28: PCA for companies who responded with water stewardship in 2016

CDP plays a key role in drawing attention to opportunities such as water stewardship mentioned above. Their assistance in aiding a company's understanding and ability to address water related risks in addition to opportunities are examined in the next section.

3.4.3. The role of CDP in understanding and addressing water related risks and opportunities

The position CDP reporting takes is reviewed in this section. First, through the role in establishing the perception companies have to water risk (3.4.3.1), followed by why companies conduct CDP reports and their view on disclosure (3.4.3.2), the benefits companies have found through CDP reporting is then uncovered (3.4.3.3) and lastly, how

water reporting (through the CDP for example) can improve governance is explored (3.4.3.4).

3.4.3.1. CDP's role in perception of water risk

The perception of water establishes itself in different ways dependent on where the business is located. Accordingly, CDP has played a role in shaping companies perception of water risk as "*risks are all localised and dependent on the basin and the specific area and the specific climates in that area*" (Participant B). Thus even within a company, operations in different areas experience different water risks. An industrial company (Participant D) gives an example of, "*If you're in Cape Town right now then it's about access and that lack of access to water as an impact to revenue. If you were in Durban last year when the storms were happening then it's a direct impact on infrastructure damage and then Capex, capital expenditure, required to correct that".*

Companies in Sweden have also become increasingly aware of their water dependence and understand that this dependency needs to be understood along with considering water risks and impacts in order to lessen the risks and innovate (WWF, 2015). In addition, CDP's role in the perception of water risk has shifted towards the opportunity to innovate, "…*if you are able to identify where the risks are and see those as opportunities then you are able to be more innovative in how you address those risks*" (Participant B).

3.4.3.2. Reporting and disclosing

There are a number of reasons why companies conduct CDP reporting, the first being that all those interviewed see disclosure as an important component of their company. Many have highlighted that they are a responsible company and CDP reporting assists in helping disclose these good water management practices as well as "*keeps us honest in terms of how we value water in the system" (*Participant C). With disclosure comes transparency and accountability which also brings along investor value. For some the reason for undertaking CDP Water "*is to give us a benchmark of where we're at and to allow us to improve year on year*" (Participant D). The questionnaire itself has increased awareness around water as well as led companies into a "*more sustainable water understanding*," (Participant F).

3.4.3.3. Benefits of CDP reporting

One of the key benefits of CDP reporting is that the global platform brings together a worldview perspective on water coupled with collaborative opportunities and information sharing. A consumer discretionary company (Participant B) summarises their benefits as follows, "…*we are able to be on the same platforms with our peers, sharing information, looking at what other companies are doing, working with, collaborate, and also just driving efficiency within the business*". CDP has been seen as a catalyst to drive efficiency while also being used as a benchmark for improvement. "*We benefitted in the sense that we are able to reflect year on year and then give ourselves an incremental improvement plan to get to where we need to get to*," (Participant D). Furthermore, the questions asked have assisted companies by guiding the process of understanding water risk, "*what do you understand as the risk almost having a helicopter view, where you are, what you use and then drill it down in terms of, now what can you change or what can you influence*," (Participant F).

3.4.3.4. Water reporting to improve governance

Water reporting can thus be seen as a tool to improve governance. Besides the ability to be "hyper transparent" (Participant B) when responding to questionnaires like CDP, companies are able to track their usage and see improvements. Some see reporting as a catalyst for change, *"Depending on what you report, because it shouldn't just be reporting but it should be reporting something that would add value or even change the decision makers,"* (Participant E). As CDP reporting specifically requires CEO sign off, there is an element of guided understanding provided by this reporting metric that has the ability to improve governance at a higher level. As a specialist confirms, *"They're asking about, do you integrate water into your strategy, and into your risk management, and these are core business processes that align the organisation. So, if a company takes that seriously and they have it signed off at the right levels of seniority, then you can expect over time for the company to become far more sophisticated about how they respond to water,"* (Participant I).

As mentioned, the governance of water cannot be viewed solely through the private sector without consideration of the role the public sector plays. The section which follows discusses the influence of a public-private partnership in securing water for the future.

3.4.4. Public-private partnership influence

From the interviews, business do feel that they can play a role in influencing government and societal responses to water risk, in some cases already feel that there is a *"growing movement towards collaborating"* (Participant B). *"Collaboration is always the best especially around water, around water resources, because it's a shared resource so we all need it in the catchment where we're operating"* (Participant E). The issue, however, lies in the inability to *"draw the line between where private sector mandate ends and where public sector mandate starts"* (Participant B). This 'role responsibility' was highlighted multiple times with besides requiring a *"legal framework to get involved in such partnerships"* (Participant C), companies want a *"trust relationship"* (Participant D). The risk companies highlight is the notion of 'corruption,' *"government or government departments become reliant on industry and also don't realise how business works"* (Participant C). The assumption from government is that business have *"this huge pot of money"* and the fear that money disappears and business are unable to see a return on their investment. As a result business are *"very careful in terms of the types of partnerships we get in"* (Participant C).

In addition to a 'corruption' risk, *"the first challenge"* that an industrial company (Participant D) mentioned is *"getting through the political dimension of power dynamics around politics".* The effect of politics was emphasised by a materials company (Participant A), *"the problem is a lot of things are political, it's political in South Africa unfortunately"*. Yet there is a sense of responsibility that should come from government, *"Government has to remember that part of its responsibility is to ensure fair and equitable access to all of these things like basic resources, and if we have a challenge with water and it can be unlocked by promoting practices then it's in their interest to do this as well"* (Participant G).

Likewise, added to politics are policies, where it is considered that *"government is implementing a whole lot of policies, yet they are not following them through"* (Participant A). The resolution may lie in creating a *"business case*" according to a specialist (Participant G), *"it's about how one makes the case and ties it back to national strategy that they have already put in place".* A large component of establishing a business case stemmed towards 'water education' and the role government play in educating

communities, as one company mentioned, *"People think it rains, you've got water. They don't understand that [when] it rains, water goes into the river but that water is not viable".* Thus the question is, *"Are we educating our people enough to understand what the situation is? You need to teach them from a very young age that water is as precious as a diamond for instance"* (Participant A).

A collaboration with government is one step towards a movement beyond the company fence. Highlighting that managing water cannot be viewed in isolation, the following section touches on moving governance and decision-making beyond the company fence-line.

3.4.5. Governance and decision making beyond the fence

All companies interviewed have examples of how their water governance and decision making extends beyond the company. A consumer discretionary company (Participant A) states the importance of moving beyond the fence line, *"we recognise the bigger picture and how important it is overall we don't have a licence to operate without considering our impacts on the wider surroundings".* The need for some is to *"have a more systemic approach to understanding water,"* with *"simple things like removing alien vegetation upstream"* (Participant D), for example. The need to move beyond the fence also deals with the right to water as *"it becomes a hostile issue when the society says you are taking away water"* (Participant E).

3.4.6. Summary of view on CDP Water reporting

A key component to transforming the way CEOs see their water related risks are through the opportunities that arise. Almost all companies (97%) see water as an opportunity by 2016. These range from 20 different types with almost half of companies noting 'improved water efficiency' (26%) and 'cost savings' (22%). An opportunity that arises where benefits are seen from a collective interest rather than solely individual efforts, is water stewardship. All companies understand the responsibility of sharing this water resource to essentially ensure a sustainable use among stakeholders within a shared river basin. Companies interviewed view a water stewardship approach as a viable option for their company as well as feasible for the country. The belief is that working together is the only way forward in

safeguarding water for the future. Some already partake in water stewardship projects and reap the benefits of engaging and collaborating, especially in Cape Town.

The CDP Water survey has played an important role in highlighting the basis of water stewardship which involves the understanding that risks are localised and thus dependent on the location of a river basin. Through the emphasis on context, CDP creates a platform that brings companies together to learn, engage and collaborate across borders. This learning experience in many ways is one-way reporting tools can be used to improve water governance. CDP requires CEO sign off for approval.

Furthermore, companies believe that through collaboration with each other they are able to influence and assist governmental and societal responses to water risk. Although apprehensive due to trust issues regarding corruption, with the assistance of legal frameworks or guidelines to aid a partnership, companies believe this is achievable. Hence companies have the ability to extend governance beyond the fence, taking into account their impact on the environment and society as well.

3.5. Conclusion

In this chapter findings have been presented using both data from the CDP Water survey as well as interviews. Together the study's three objectives have been addressed by first attending to company background and around what they have experienced and have in place in terms of water issues, and as a result examining how companies respond to these experiences and lastly considering whether conducting the CDP Water survey has assisted them in addressing these issues.

With the results chapter, the complexity of researching the role of companies and how they view water and its use in their business practice is showcased specifically though the large number of findings. Through exploring this complexity and the multi-faceted nature of water within business, in an attempt to bring the collection of numerous findings together, possible company archetypes are considered within the next chapter (Chapter 4, discussion). As PCA outcomes within the results chapter have suggested similar responses,

company clusters are explored on the basis of ‘water stewardship readiness.’ In addition, the next chapter attempts to discuss these findings in light of other available literature as well as the South African context.

4. CHAPTER FOUR – DISCUSSION

4.1. Introduction

"Water stands at the centre of the challenges around food security, economic development, energy generation and climate change"

(Pegram *et al.*, 2013; p.3).

In this chapter the main findings of the research are presented. How companies in South Africa experience and manage water risk is examined, including probing to what extent climate change adaptation and governance and decision making is factored into their overall decision making. In particular, the ways in which companies respond to water security concerns, both abundance and shortage is profiled. Finally, the role of the CDP reporting is examined with respect to companies' water decision- making practices notably in the light of varying water demands in the country and region. Using the information gathered, company archetypes that exemplify 'water stewardship readiness,' are created.

4.1.1. The complex, water context in company decision making

As emphasised within the results chapter (Chapter 3), the complexity of addressing how companies within the private sector view and utilise water for their business practice cannot be underestimated. Each company has a unique situation determined by their water source locations, their management systems and understanding risk management and design environments. In the results captured (Chapter 3) some of this complexity and nuance including perceptions of weather and climate risk, water risk exposure, opportunities and decision-making around water issues are illustrated. Within these topics, outcomes increasingly lead to the crucial concept that *"Context is the critical element in water"* (Participant H).

The complexity of researching the context of water within companies first arose during the analysis of CDP Water data. These data extended from 2010 to 2016 with around 40 companies completing the survey during this time period. Questions within the survey that were most applicable to answering this project's aims and objectives were selected. In an attempt to assess the richness of these data, depending on the questions, information was

explored using three avenues, by sector, by river basin and by company. Results observed, however, revealed little to no trend in responses when assessed by sector or river basin. This indicated that companies respond in their own way, emphasising their uniqueness. In many cases this distinctiveness resulted in probing data at a company level.

The unique context of each company was further amplified by the use of Principal Component Analysis (PCA, an explanation of PCA can be found in Chapter 2). PCA essentially summarises a multi-dimensional dataset while maintaining variability (Jolliffe, 2011). Strengthening the implication around context, it was emphasised by the great deal of variability observed within the PCA findings. To explain ~75% of cumulative variability, more than four factors were required. The large variety of answers, through diverse strategies and perceptions, further emphasised that companies generally respond in an fragmented manner. In this way, different responses are given by different companies from the same sector exposed to the same risks. Thus on most occasions, as mentioned, data were queried at a company level.

4.2. Company Background

Company background provides a setting of what companies experience and have in place in terms of climate change adaptation, water risk and water governance and decision making. As the experience of extreme events have increased (Allen *et al.,* 2018), these aspects were first explored through this lens. Additionally, the experiences related to extreme events influence the perceptions companies have, thus guiding how risks are managed and decisions are made. Water risks are then considered through the different river basins companies belong to, the drivers behind the impacts they experience and their consequential impacts. With the range of incidents companies mentioned facing, coupled with an increasing climate variability, the opportunity for adapting and planning for this unpredictability is reflected. With an importance placed on preparing, decision-making around water issues are investigated. Lastly, a review of how financial reporting metrics could be affected by water related risks is conducted to assess the knock-on effects of decision making.

As “water ecosystems underpin functioning economies” (Pegram *et al.,* 2009; p.12), it became imperative to assess how the private sector in South Africa was dealing with water

security concerns. First off, insight is gained into what weather and climate effects influences a company's ability to perform their daily operations (Chapter 3, section 3.2.1). In accordance with reactions from interviews, companies across different sectors have emphasised that in light of South Africa being a water scarce country (Percival & Homer-Dixon, 1998; NDP, 2011; Hedden & Cilliers, 2014; Wort, 2015; Donnenfeld *et al.*, 2018), scarcity extends not only in terms of its supply, but in terms of water quality as well (Duse *et al.*, 2003; Donnenfeld *et al.*, 2018).

Both water scarcity and quality have knock-on effects on food related industries, for example. With a great reliance on water, companies are affected through the production of produce, experiencing a decreased output (Schulte *et al.*, 2014) and lower quality produce. As a result, the lack of water required either alternative crop growing strategies or a change in irrigation scheduling due to the variation in season changes (WWF, 2018a). In addition, companies faced difficulty in selling produce due to price increase and in some cases, customers being unable to reach stores. In 2016, the harsh drought coupled with the weakening of the Rand resulted in food inflation by 9.8 %. Considering that purchasing food makes up over 40 % of expenses for the economically marginalised (Kelly, 2016), food price inflation poses a serious problem for food security.

Extreme weather and climate effects experienced by companies were not, however, solely related to water. Companies mentioned to acquiring new system thresholds for machinery to withstand the effects of weather events such as stronger winds, increased lightning strikes and an increased occurrence of floods (e.g Gornall *et al.*, 2010). It is, however, stressed that extreme events experiences have already increased in comparison to the past and are only set to increase going forward (Allen *et al.*, 2018). These experiences pose a range of risks for companies to perform their daily operations over and above considerable economic costs (Franzke, 2017).

Focussing on water specifically, it is unlike other resources. It is unique because *"context is the critical element in water"* (Participant H). "The availability, management and impacts of water are local at a watershed or river basin level" (Schulte *et al.*, 2014; p.11). Water cannot be measured to mean the same quantity in different locations (Pegram, 2010; Orr *et al.*, 2011). Consequently, company water related risk is primarily associated with location and the exposure to water related impacts at a local level (Pegram *et al.*, 2009; Orr *et al.*, 2011; Pegram, 2010; Schulte *et al.*, 2014; WWF, 2015).

Considering this, assessing risks is dependent on the way in which risks are perceived rather than whether they are considered to be real or not (Kosovac *et al.*, 2017). One of the key influences on water risk specifically is the experience of extreme events (see Chapter 1, section 1.3). As these perceptions differ between companies, sectors and river basin locations, varied responses across the board are found. Given the context of water, these diverse reactions, regardless of location, may be a function of poor risk perception. In spite of this, all interviewed companies provided a similar consensus of the perception of water risk as a prevention of their business functioning as it is intended to. This prevention from operating as 'usual' is attributed to directly impacting a company's profits.

To bring these perceptions together water risk exposure was first considered (Chapter 3, section 3.2). As for many companies, confronting exposure to water challenges is the initial step in understanding risk (Pegram, 2010). Overall, responses between 2012 and 2016 indicated that 62% of companies were exposed to water risk, excluding 2014, which was the only year where more than half of the responding companies were not exposed to any detrimental impacts related to water. The effects of experiencing the driest year on record in 2015 (de Jager, 2016) was prevalent as only 28% of companies were not exposed to water risk during this year.

These periods of water stress were examined through company impact drivers and impacts, where impact drivers are the force or reason behind what companies experience. The range of impact drivers varied between physical, reputational and regulatory. As data for these questions were available for 2015 and 2016, it was found that impact drivers relating to physical risks were the most prominent (Chapter 3, section 3.2.2.2). In addition, exposure to water risk was highly associated with all physical impact drivers. Encountering physical impact drivers additionally increased (by 31 counts) between the two years (2015 and 2016).

Impacts experienced as a result of the drought were most documented during the 2015 and 2016 time period, emphasising the knock-on effects of a decline in water (Chapter 3, section 3.2.2.3). Effects experienced included 'plant/production disruption leading to reduced output,' 'supply chain disruption,' 'water supply disruption' and 'higher operating costs', to name a few. Moreover, drought was associated with 'increased water scarcity' and 'increased water stress' as a lack of water to indicate a general water shortage.

Essentially the shortage restricts the quantity of water a company can utilise and consequently the amount of produce it can yield (Schulte *et al.,* 2014).

While exploring the interaction between the impact drivers of drought, increased water stress and increased water scarcity, it was found that a positive relationship exists between scarcity and stress. As a result, indicating that companies who experience the one is most likely to also experience the other. However, experiencing the impact driver of drought is not dependent on facing increased water scarcity. In this manner suggesting that companies either view the shortage of water as short term through increased water scarcity (which primarily deals with the availability of water for consumption (Schulte, 2014)), or long term through drought (which is defined by a prolonged period of abnormally low rainfall; IPCC, 2014a).

The occurrence of all impact drivers brought about the experience of 25 different impacts. The most prominent impact was 'higher operating costs.' Although higher operating costs were strongly linked to water risk exposure, it was less associated with physical risk drivers, in particular a lack of water (drought, increased water stress and scarcity). In addition, no strong relationship was established between the impact of 'higher operating costs' and integrating water management into the business strategy. As a result, implying that there are companies who face water risk and encounter increased expenditure, but do not effectively manage these risks by integrating water management into their business strategy. Jorisch *et al.,* (2018; p.12) stated that "revenue and growth are most impacted by water risks" in an overview and analysis of *Water risks and financial market.* Although the former was observed to be true, the latter was not. A negative relationship was established between being exposed to water risk and the impact of experiencing a 'constraint to growth'. Hence indicating that experiencing water risk does not necessarily restrict business growth.

Bearing in mind the changes companies are exposed to, an important risk to explore was how and to what extent climate variability is being considered when planning for the future (Chapter 3, section 3.2.1). The highlight here lies in bringing about the opportunity for adapting to the changes experienced which in turn may trigger innovation as a result of the unpredictability climate variability poses to business. Sustainability as a whole has become known to be a driver for innovation. As Nidumolu *et al.* (2009; p.12) suggest that

without innovative solutions, “traditional approaches to business will collapse.” Water is crucial for this road towards sustainable development, playing an integral role in the environment, economy and society. Already in 1991, Biswas flagged that the “magnitude and complexity” (p.345) of the water crisis is new to any generation.

Responding to variability requires an active water governance system (Chapter 3, section 3.2.4). By carefully and effectively combining adaptation measures with effective governance and decision making, the existing risk from climate variability can be lessened (Adger, 2001). To further emphasise the important role governance plays in complex climate change settings, Dow and Carbone (2007) share the value of understanding climate information and the need to bring this into decision making in order to build adaptive management systems that are able to cope with the uncertainty of climate change and variability.

In light of water risk exposure, a governance disconnect is seen with the integration of water management into the company’s business strategy and the frequency of briefings on water related issues (Chapter 3, section 3.2.4.3.). Initially it was found that integrating water management into the business strategy was independent of being exposed to water risk. Thus, companies who do not experience detrimental impacts related to water, did integrate water management into their business. In addition to this disconnect, companies who are not exposed to water risk also meet on a scheduled quarterly basis for briefings on water-related issues. This inconsistency in decision making may be as a result of a lack of understanding of water issues through an incomplete river basin assessment which has resulted in a ‘tick box’ approach to reporting.

The finding of an inconsistency in decision making is in contrast to findings by Schulte *et al.,* (2014; p.4) who question if companies indeed do have an interest in “robust water governance and sustainable water management.” According to their outcomes, “A large and growing body of research says yes—they do,” (p. 4). The reasons for more active engagement in water risk management is because a company’s water risks is influenced by river basin conditions beyond the fence line that has the ability to negatively influence the company’s operations. The consequence of the negative influence on the company’s operations guides the way in which companies see the governance of their water related plans (Schulte *et al.,* 2014). In addition, improved water management, in these cases that

were examined, arose from public pressure and investor interest as awareness around sustainable practices has increased.

A further disconnect in the governance of water is seen when assessing the proportion of companies financial reporting metrics that could be affected by water related risks (Chapter 3, section 3.2.5). Acknowledging that water risks are related to the location of a river basin, financial reporting metrics interestingly, however, are found to not correlate with any river basin implying that they are not sensitive to water. Additionally, the proportions of metrics that could be affected by water risk further suggest that the use of these metrics will not be affected as the metrics tend to measure impacts at a global scale rather than at a business level. Orr *et al,* (2011; p.13) summarise the importance of the local environment state that, "The availability, management and impact of water are local at a watershed or river basin level. This means that business and investor risk around water is fundamentally related to location and exposure to local water conditions. Conversely, the most effective response will be improved management and taking account of the local context."

Given the examples above, attention now turns to examine local level cases relevant to this study. Through interviews and data analysis, it was discovered that companies with a more reasonable governance and decision making strategy are more successful at managing water due to one or many of the following activities: undertaking a comprehensive river basin assessment, the ability to communicate risk at a Board level through creating a business case which in most cases involves a water champion who drives water related concerns and most importantly, there is a level of understanding around water issues at a Board level. These activities allow companies to move away from a 'tick box' approach and engage with reporting tools to support their water management practices. In the sections that follow examples of ways in which companies are approaching water in the day-to-day decision making contexts are examined.

4.3. Company Responses to Water Related Concerns

In this section, company responses to water security concerns, both where they are in abundance and where they display a shortage, are investigated. The importance companies place on water is first researched, thereby providing insight into the consequential

responses and interventions put in place to manage water risks. This was followed by an investigation on what companies base water risk decisions on to assist their decision making. The effectiveness and efficiency of decision making is then examined through the lens of water restrictions as an indicator for how companies may have adapted to changes in climate variability. Lastly, to evaluate how companies prepare for future encounters, company water related goals and targets are reviewed.

Companies use a range of varying metrics to measure water consumption, use and the overall contribution to the 'bottom line.' The importance companies place on water for their operations does not correspond to how their water accounting metrics were reported (Chapter 3, section 3.3.1). These metrics included quantifying water withdrawal, water discharge and consumption to provide an understanding of how water is used within companies. As almost three quarter (75%) of companies mentioned sufficient amounts of good quality freshwater as 'vital' for their direct use, this necessitates good water management or water use. However, low rates of responses for quantifying water accounting metrics were found. This inconsistency in the management of water further amplifies a water governance disconnect in South African companies. Poor management and valuation of this resource can only increase business water related risk (Orr *et al.*, 2011). Similar to the importance placed on the local environment for financial reporting metrics, conducting a comprehensive river basin assessment to understand water in a local context is essential to reporting on a company's water accounting metrics. In addition, this assists companies in gaining insight into their water related risks.

A comprehensive river basin assessment can allow companies to respond effectively with appropriate interventions (CDP, 2017b). In 2003, Mukheibir and Sparks noted the importance of an intentional and organized use of river basins in South Africa as an approach to ensure a sustainable use of water. An assessment allows for companies to thoroughly understand their water risk which permits for appropriate decision making and the ability to increase preparedness and proactively react to challenges (CDP, 2017b). According to CDP's 2017 *Sector and Performance Insights*, only 20% of South African companies take on water risk assessments at a river basin scale (CDP, 2017e).

In spite of this, a range of response strategies were provided by companies primarily in reply to the experience of physical risk drivers (Chapter 3, section 3.2.2.2). The most

common intervention included ‘engagement with public policy makers’ (Chapter 3, section 3.3.2), which was a similar response given by companies recognising a lack of guidance from government policy as a barrier to climate change adaptation (NBI, 2017a). Companies who mentioned ‘engagement with public policy makers’ also noted ‘engagement with suppliers’ as a response strategy to the impacts of experiencing water related risks. Engagement in this manner adds to a more holistic view of water use. Other responses required financing from the company itself rather than seeking for help beyond their scope, included ‘infrastructure investment’ and an ‘increased capital expenditure’.

Besides company experiences of weather and climate related events, in order to respond appropriately decision making also requires support from alternate sources such as experts and tools (Chapter 3, section 3.3.3). Companies rely on a range of methods including specialists, internally developed methodology and government data sources for decision making. In addition two tools were mentioned specifically by companies interviewed, the WWF Water Risk Filter and the WRI Aqueduct. Both tools give companies an idea of their water related risks in relation to their river basin (Reig *et al.*, 2013; WWF, 2014a).

As of the 31st of October 2018, WWF launched an upgraded Water Risk Filter, version 5.0. The latest interactive interface allows companies and investors to ‘explore,’ ‘assess,’ ‘value’ and ‘respond’ to water risks (Fig. 29; WWF, 2018c). Applicable to companies, water risk can be assessed through a basin risk which deals solely with the location of the river basin in use and operational risk which requires participants to complete a questionnaire. The questionnaire requires insight into physical risk, regulatory risk, reputational risk and operational responses (WWF, 2018d) to provide a holistic view of the risks which companies face, coupled with the associated basin risk. As questions within the survey are similar to those asked within CDP surveys, respondents have the option of uploading their CDP answers.

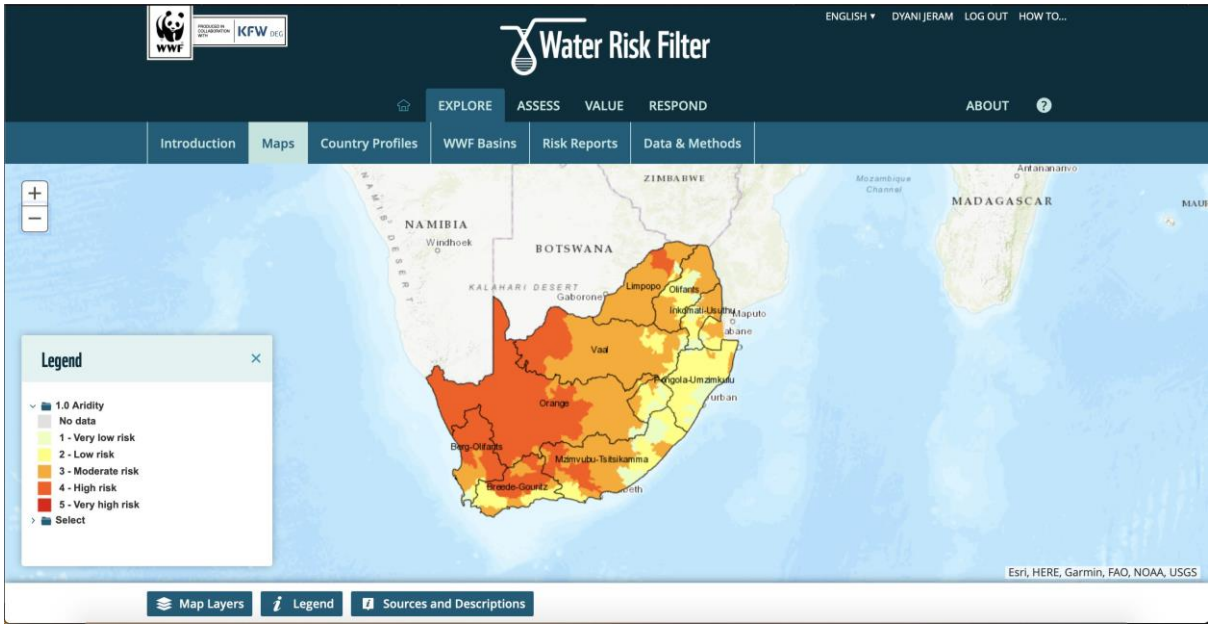


Figure 29: Water Risk Filter (Source: http://waterriskfilter.panda.org)

To explore the Water Risk Filter, an organisation based in Johannesburg was used as an example. Only a basin risk assessment was conducted to assess water risk exclusive to the organisations location. Based solely on locality, the organisation makes use of water from the Vaal river basin and has an overall ‘low risk’ of 2.4 (Fig. 30). Three very high water risk concerns however lie in the ‘quality’ of water (physical risk), the ‘enabling environment (policy & laws)’ (regulatory risk) and ‘media scrutiny’ (reputational risk) for the organisation (Fig. 30). The Water Risk Filter further breaks down these risks for more insight. For example ‘media scrutiny’ is high due to the high risk from the history of protests in the region and some risk from the exposure South Africa acquires as a result of ‘global media coverage reporting on criticizing on possible water issues’ (WWF, 2018d).

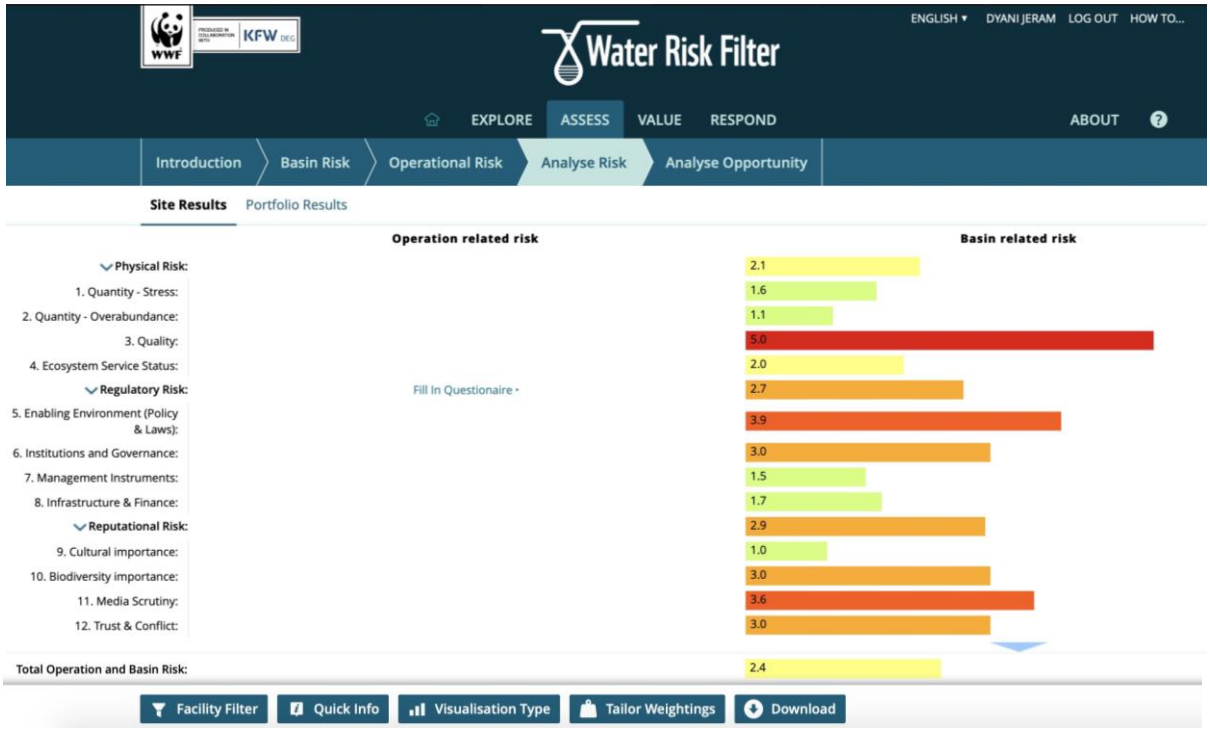


Figure 30: Analysis of basin related water risk for an organisation located in Johannesburg

WRI's Aqueduct Water Risk Atlas also provides a world map of the overall water risk for current conditions (Fig. 31). Within the current conditions map, locations can be added to analyse water risk specific to the locality of company operations. A range of water related risks can be focused on specifically including physical risks dealing with water quantity (e.g. drought severity) and quality (e.g. return flow ratio) as well as regulatory and reputational risks (e.g. media coverage; Aqueduct, 2018). In addition, future projection maps can be explored as well (Fig. 32). Different indicators can be used for various time scales across different climate scenarios (Aqueduct, 2018).

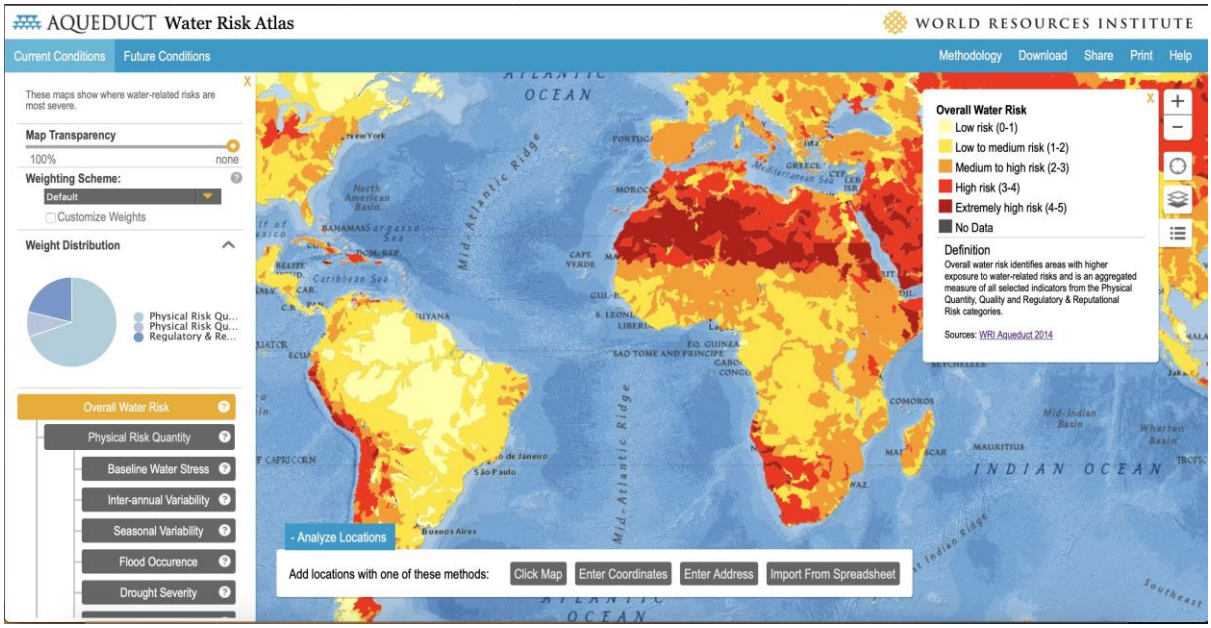


Figure 31: Aqueduct Water Risk Atlas Current Conditions (Source: https://www.wri.org/applications/maps/aqueduct-atlas/)

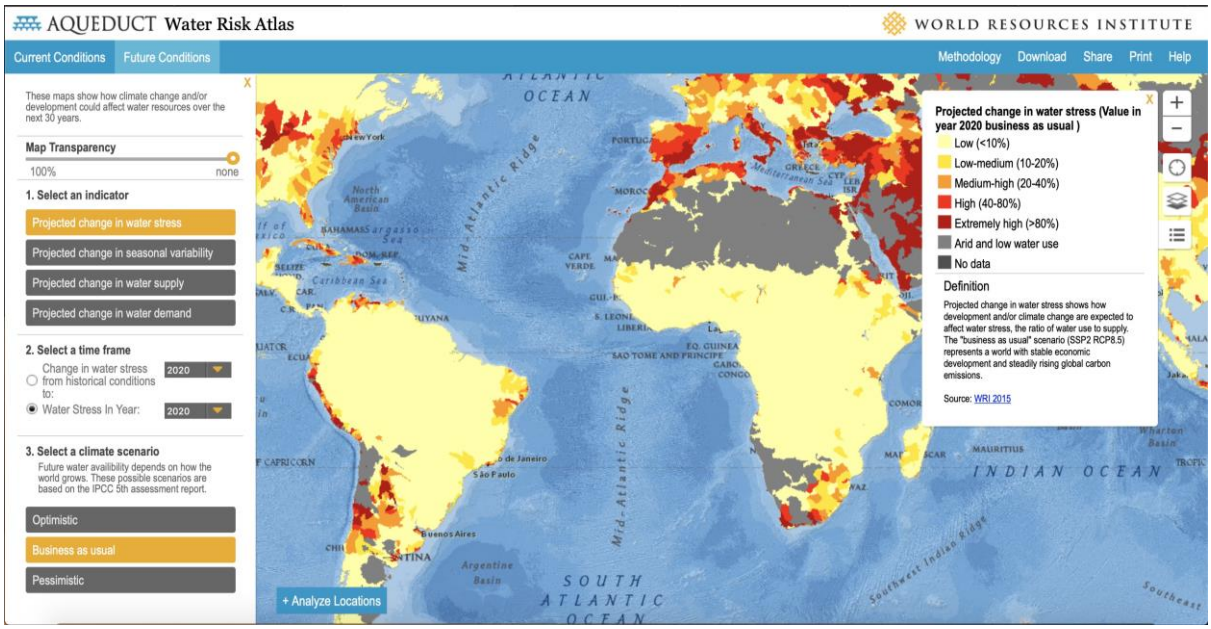


Figure 32: Aqueduct Water Risk Atlas Future Conditions (Source: https://www.wri.org/applications/maps/aqueduct-atlas/)

In a recent study by Jorisch *et al.* (2018) a collection of tools, databases, approaches and studies or scenarios in relation to assessing water risk are explored (Fig. 33). On the first tier of 'real economy,' instruments were directed towards measuring impacts at a company

level of which both WWF's Water Risk Filter (under WRF in Fig. 33) and WRI's Aqueduct are mentioned. However, in the context of overall economy and financial system, it was found that although a number of tools were evolving, "the assessed tools show several shortcomings from a public policy perspective," (Jorisch *et al.*, 2018; p.6).

The study mentioned a focus on physical risks which as a result overlooked the importance of reputational and regulatory risks by stating that, "the current tools and data are not necessarily suited to engage the private sector for alignment with public water policy goals" (Jorisch *et al.*, 2018; p.6). This reference speaks to companies responding to water security concerns by means of 'engagement with public policy makers'. This engagement is again important as the risk experienced may be outside of the company's control. Thus, the view of water risk in a narrow sense is insufficient in attempting to address the consequences of these risks. The intersections between water risk, adaptation and governance and decision-making (Fig. 5, Chapter 1) assist in viewing a wholesome take on managing water.

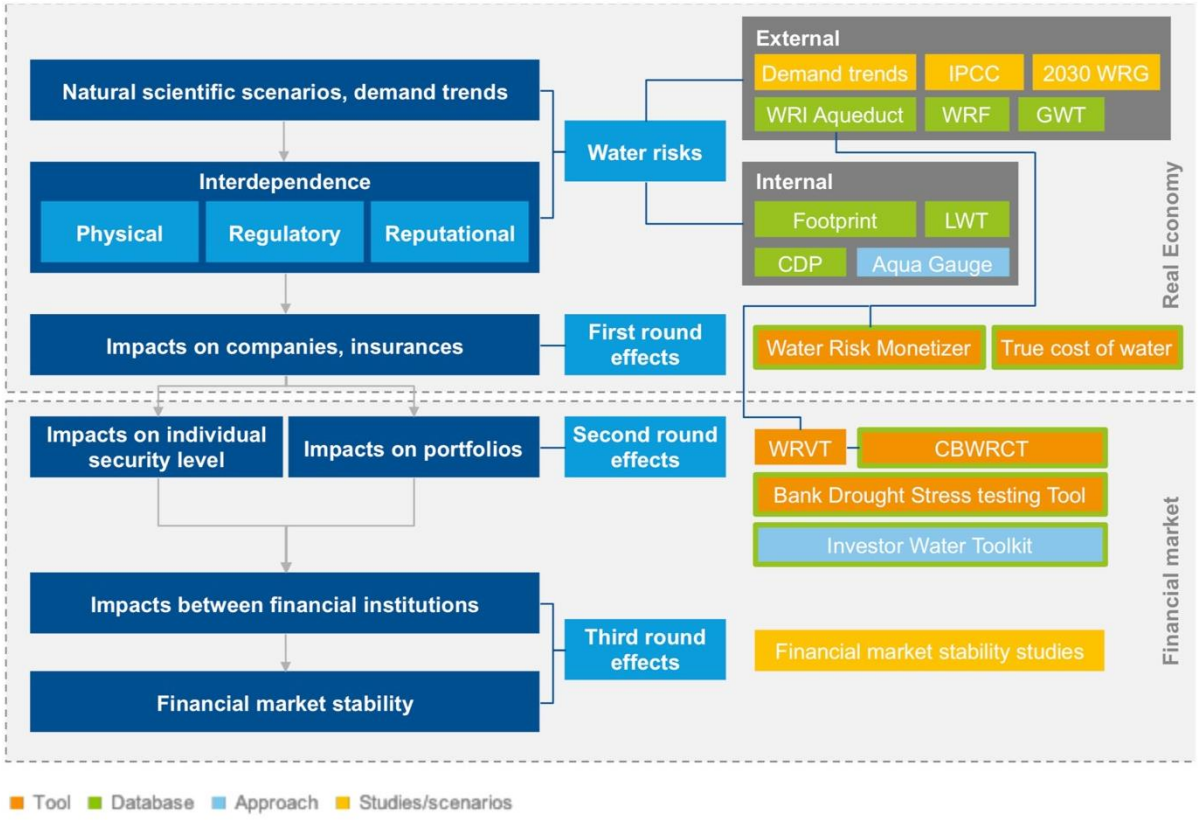


Figure 33: The effects of water risks and available instruments for assessment (Source: Jorisch et al., 2018)

In light of the decisions companies make around water issues, water restrictions were used as an indicator to examine how companies are responding to changes in climate variability (Chapter 3, section 3.3.4). Between 2015 and 2016 South Africa experienced high temperatures coupled with low rainfall, resulting in 2015 being the driest year on record (de Jager, 2016; Allen *et al.*, 2018). Additionally, the Western Cape province experienced exceedingly low dam levels in 2018. To manage water consumption, water restrictions were implemented in both cases.

The varied responses by companies interviewed (Chapter 3, section 3.3.2.) indicated the different levels of maturity related to climate response, specifically related to water. Nottingham and Yeo (2017; p.6) defined climate responses and attempts as 'resilience' as "the capacity not only to survive, but also to adapt and succeed in the face of climate change and its direct and indirect impacts, including changes in regulation and policy".

Companies are placed into three 'mindsets' or categories of thinking or approaches (Fig. 34) of which the first is concerned with "reputation management," the second looks further into lessening the effects of environmental risks and lastly becoming climate resilient by encompassing the "ability to capitalize on the strategic opportunities presented by the shift to a lower-carbon and resources-constrained economy," (p.6). Although companies responding to CDP Water in South Africa do integrate water management into their business strategy and reported having Board level engagement on water issues, the governance disconnect explained earlier suggests that companies have not strategically assessed water risks to fully capitalise on opportunities.

This result is evident as companies had a delayed response to the risk of water restrictions as a result of the drought (primarily 2015/2016). Similarly to companies described under a CSR-Focus (Fig. 34), many reacted through "initiatives linked to employee-engagement programs" (Nottingham & Yeo 2017; p.6) such as water conservation programs. For some, experience of limited water use led to looking into the future and conducting practices to reduce water risks going forward such as introducing a grey water system and waste water treatment plan for example. Mature companies, although still affected, could fast track plans to deal with the immediate risks as prior understanding and planning were already conducted.

The use of Nottingham and Yeo's (2017) 'climate resilience' is to compare the varying responses to the implementation of water restrictions (as an indicator of adaptation). The paradigm shift gave a baseline to assess how companies addressed such concerns. The responses created by companies to deal with water restrictions raises the same question highlighted in the introductory chapter (Chapter 1, section 1.5), namely, does viewing water as a systems challenge make it more resilient? Similarly, it is highlighted that this may not be the case. With the consideration that water in this manner may become unmanageable as mitigation measures outside of the company are not within the company's control. 'Managing water' then becomes a matter of influencing and not solely management. However, with regards to the event of water restrictions, specifically related to the Western Cape (see Chapter 1, section 1.3), it may require influencing other companies on efficient water use or increased engagement with public policy makers which has been presented. With limited control, viewing water risk holistically in light of adaptation and governance and decision making becomes imperative.

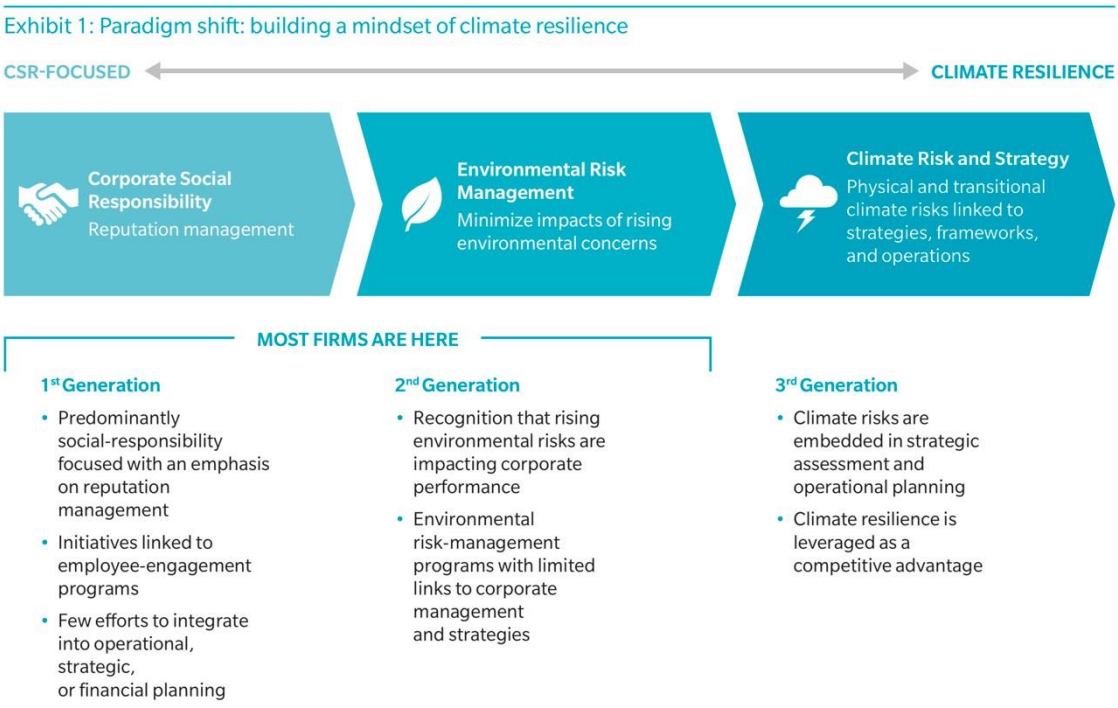


Figure 34: Concepts towards climate resilience (Nottingham and Yeo, 2017)

An active response in positively capatalising opportunities lies in setting goals and targets to drive water efficiency (Chapter 3, section 3.3.5). Effective targets require a good understanding of water risk in order for them to be achieved (CDP, 2016, 2017a, 2017b).

An understanding of water risk, however, encompasses the motivation behind the target being set. As a result, motivated goals are meaningful and set to be achieved. Futhermore, setting targets has the ability to improve the function of a company as targets assist in putting in place performance indicators (NBI, 2017b). The complexity around water may have prohibited successful target and goal setting. As a result, "Commitments to address water security are evolving from simple water use metrics to more strategic, context-based objectives" (CDP, 2016; p.18).

Context Based Water Targets are being explored by CDP for the future to assist companies (CDP, 2017c). The idea involves setting targets fit for their context as the targets should be suitable to a particular environment or setting (CDP, 2017c). The CEO Water Mandate defines context-based water targets as "A specifc time-bound objective that sets the desired outcome to include both a component that speaks to the company's water performance and a component that speaks to the basin's conditions. Context-based water targets better inform audiences on the extent to which performance respects the agreed upon thresholds of the basin or supports public policy," (Gillespy *et al.,* 2017; p.8). A context based approach to water targets, however, requires comprehensive river basin asssessments which companies lack at present. This requirement is in addition to engagements with communities, local government and other companies within the river basin (CDP, 2017c). Setting targets in this manner also involves supporting public policy, which in the South African context further emphasises engagement with public policy makers. The collaboration involved in the context-based water targets approach further supports the process of water stewardship through increased engagement with stakeholders from the same river basin.

4.4. How Does CDP Help?

Within the collection of tools, databases, approaches and studies or scenarios used to assess water risk by Jorisch *et al.* (2018), CDP fits in as an internal database to assess water risk impacts at a company level. Using tools such as CDP to identify water risks in contexts where variability of water may be an issue (either too much or too little that may be associated with climate variability and change), is essential to finding opportunities for coping that can extend to innovative practices. As mentioned earlier, a movement towards climate resilience encompasses the "ability to capitalize on the strategic opportunities

presented by the shift to a lower-carbon and resources-constrained economy" (Nottingham & Yeo 2017; p.6). The experience of variable water resulted in the majority of South African companies recognising a range of opportunities in water (Chapter 3, section 3.4.1). However, CDP's 2016 Annual Report which considers global responses, found that more than 50% of companies in each sector reported on opportunities, but all have low reporting on strategies to realise them (CDP, 2016; Fig. 35). Acting on opportunities is essential to seeing them through in order to reap their benefits.



Figure 35:Percentage of companies per sector reporting on opportunities in relation to reporting on strategies to realise them (Source: CDP, 2016)

The majority of South African companies considered improved water efficiency as a primary water-related opportunity followed by cost savings. This is a notable finding for water stewardship (Chapter 3, section 3.4.2). Water stewardship, according to the WWF, refers to the "use of water that is socially equitable, environmentally sustainable and economically beneficial, achieved through a stakeholder-inclusive process that involves site and catchment-based actions" (Morgan & Orr, 2015; p.42). The idea is for business to view water as a sustainable, shared, public resource while also understanding the risks they face from water scarcity and pollution. Consequently, water stewardship is a systemic

approach to the management of water. It involves viewing the resource as more than a supply for the business, and rather as an integral part of the environment, society and economy as a whole at various scales. Subsequently, water stewardship takes into account the sustainable use of water across the entire value chain (Hoekstra, 2014; Morgan & Orr, 2015).

Although water stewardship is a fairly new concept for South African companies, experts recognise that it is *"definitely doable"* (Participant H) with successful cases found where companies work across sectors as well. Even though water stewardship seems promising, not many companies are found to engage on this topic despite being aware of it. For example, water stewardship is not yet seen as a mitigating risk related to drought, and companies are 'unsure' why water stewardship is an appropriate response strategy. In addition, the majority of companies who engaged in a water stewardship intervention experienced the potential impact of 'higher operating costs,' thus viewing collaboration as an alternative to increasing costs.

Bringing three water stewardship interventions together, water stewardship as a response strategy, as a positive impact on business strategy and as a motivation behind target setting, a positive relationship between the intervention is found (Chapter 3, section 3.4.2.5). This relationship indicates that similar companies resolve to using a water stewardship approach. The majority of these companies also meet on a scheduled quarterly basis in addition to integrating water management into their business strategy and having Board level engagement. Being exposed to water risk, however, does not play a substantial role in up taking water stewardship interventions. Not all companies who were exposed to water risk see water stewardship as a mitigating risk option to drought. Partaking in water stewardship activities allows companies to move beyond their fence line regardless of what they experience within their own boundaries.

A wide range of engagement and promotion of water stewardship is conducted for South African companies (led by the National Business Initiative, NBI, for example). Yet, as the results show, not many companies are actually involved in water stewardship practices. Emphasised by those interviewed, companies believe an increase in legislation or policies around water stewardship would assist their company and others in taking public action. Already in 2013, a report by WWF stated, "Stewardship, therefore, requires policy

advocacy quite unlike anything most companies have done before," (WWF, 2013; p.13). This statement again points to companies responding to water risks through an increase in 'engagement with public policy makers'. Although companies suggest that an increase in legislation or policies to assist in taking action may be a viable solution going forward, there is still a large variation trending in water. An expert, however, highlights that *"Water is less mature than any other environmental issues given it's magnitude of its risk"* (Participant I). Despite this, the urgency around water requires companies to act now and learn as they go, rather than learn from past experiences.

CDP has as a result played an important role in assisting companies to understand their water risks (Chapter 3, section 3.4.3). The CDP survey is set out in such a way as to guide company understanding that risks are localised and originate from the river basin applicable. Thus without understanding the condition around the river basin, companies are less likely to report effectively on their consequential impact drivers, impacts and response strategies in addition to recognising appropriate water related opportunities. The importance of a comprehensive river basin assessment is once more emphasised through the survey.

The information companies gain this way becomes important for accurate reporting as well as effecting trustworthy disclosure of their practices. As seen by the lack of responses to company water accounting metrics for example, Money (2014; p.55) states, "Current approaches to corporate water risk disclosure are fundamentally unsatisfactory when applied to understand the scale of the challenges faced…". Nonetheless, disclosure does bring about a sense of transparency (Meyer, 2010) and accountability. When practices are positive, responsible reporting has the ability to increase investor value. Additionally, the platform promotes and allows for collaboration and learning. These are some of the value add reporting to CDP has brought companies.

In essence water reporting is considered as a tool to improve governance. Companies are able to track their usage and improvements with the knowledge that their practices can bring in investor value. This should move companies away from a 'tick box' approach to reporting which has been highlighted on numerous occasions. Another possible explanation involves sustainability departments being required to complete a number of reports. As a sustainability expert explains (Participant G) , *"Firstly, you got to consider*

the burden on the person doing the reports. If I've got ten things I need to report for, who do I focus on and what information do I give them - which sometimes means that they are going to be reduced to a tick box approach. Which is going to be can I just put the statement that satisfies the need and then I'm done. Whereas what you really want is deep change and actually engage in what are the issues, what's the problem [and] how do I fix it." As a result an increased alignment of different reports is being called for. One way in which CDP may move companies away from this approach is through CEO sign off. A guided understanding in this way has the ability to improve governance at a higher level.

While the focus was on companies who report to CDP specifically, it is important to touch on those who do not. Addressing the management of water by 'non-CDP' companies is one of the shortfalls highlighted within the methodology chapter (Chapter 2). However, some data were explored through interviews with specialists, as insight extended to companies who do not need water for their direct operations. All companies need water for their staff to be present and conduct their general activities (WWF, 2018b). As seen with the 'Day Zero' water crisis in Cape Town, a range of companies, regardless of their core business operations, were affected by water availability. Water, both in shortage and abundance may slowly become a material risk for companies. To put this into perspective, an expert (Participant I) explains, *"What you would have is to weigh up the costs that you would incur to solve the problem versus the cost you would incur if you didn't. So, if you had to shut your office for three days every ten years, not a risk, I wouldn't ever worry about. If it's going to happen three days a year, start to worry. If it's going to happen one day a month, I'm definitely worried".*

Government therefore plays an important role in co-operating with business as water scarcity affects both stakeholders (Chapter 3, section 3.4.4; Orr, 2009). "Ultimately government is always responsible for putting better water management in place, but businesses have a key role to play in helping to implement better management" (Orr, 2009; p.5). The mandate nevertheless belongs to government (Pegram *et al.*, 2009). The risk of poor water management, coupled with water scarcity, have adverse effects for all water users including the public (Orr, 2009; Grey, 2013; Hoekstra, 2014). South Africa's non-revenue water loss according to the Department of Water and Sanitation's Draft National Master Plan was estimated at 41.0% % in 2017 with seven of the nine provinces exceeding a 30% loss (DWS, 2017). This water loss, primarily through leaks and outstanding water

bills, costs municipalities R9.9 billion a year (Gosling, 2018). As a water expert (Participant H) highlights, *"there is a public wastage issue"* which is possibly *"a proxy for this infrastructure management issue as well".* Companies may be addressing the water wastage experience by responding to water risks through 'engagement with public policy makers' and 'infrastructure investment'.

An increase in collaboration with government brought about a number of concerns for companies. However, all companies felt that increased engagement was essential. Many mentioned requiring a *"legal framework"* (Participant C) to outline the role responsibility for each stakeholder involved. Their experience with government involved providing capital which in many cases stressed the notion of corruption, leaving companies apprehensive for engagement. Concern extended towards the political climate in South Africa and the lack of responsibility taken by the government that requires action rather than solely the implementation of policies. One proposition for a call for action involved 'water education' (Sershen *et al.,* 2016; Colvin & Muruven, 2017). The suggestion from an interviewee involved educating communities, specifically youth, from a young age to understand the value of water in addition to the process of water from rain to taps.

Companies consider collaboration as an opportunity for increased involvement by extending governance and decision making beyond their fence line (Chapter 3, section 3.4.5). Expanding in this manner allows companies to view water holistically. A focus is placed on a 'shared action' response to address the experience of 'shared risks' (Morrison *et al.,* 2010). "Shared risk is the idea that companies have an incentive to invest in sustainable water management beyond their fence-line in a way that advances the public interest, because it manages business risk at the same time" (WWF, 2013; p.11). Water stewardship as a result surfaces as a prospective opportunity for companies to engage beyond the fence line (Orr, *et al.,* 2011; WWF, 2013, 2014b; Jones *et al.,* 2015).

4.5. Three spheres - water risk, climate change adaptation and governance and decision making

Throughout the findings of this research, a number of points have been continuously highlighted within the three themes of (water) risk, climate change adaptation and governance and decision making. In an attempt to bring these together, the key influences

on these three spheres, as well as the interactions between their respective intersections, are explored (Fig. 36).

Risk (specifically related to water), is shaped by perception which in turn is influenced by experience. In most cases this is the experience of facing extreme weather-related events. Through the occurrence of such events, companies are most likely to perceive risks, depending on the way in which they were affected. Additionally, risk is driven by the company's reliance on water coupled with the location of their operations.

Climate change adaptation is motivated by future planning, and this in many cases drives innovation as uncertainty around current weather-related events requires a move away from a 'business as usual' approach. The incidents associated with change are also most importantly related to the local context and thus require local responses through collaborative action.

One of the key motivations for good governance and decision making involved creating a business case to address water issues. A business case entailed the ability to communicate water concerns to higher levels of responsibility in order to make the required changes in the governance and decision making of water. Water has proven to be a challenging resource to evaluate within a company, and as a result mature companies have a 'water champion' who is able to focus on water related issues specifically. Attention given to water consequently allows for improved governance.

Water risk interacts with climate change adaptation through the perception of a higher frequency of extreme events requiring adaptation measures. Risk reduction occurs through planning for uncertainty and finding innovative solutions to lessen vulnerability. The intersection between climate change adaptation and governance and decision-making requires strategic management and planning coupled with flexible and speedy responses. Lastly, the overlap between governance and decision-making and water risk entails a good understanding of risk in order to make appropriate decisions. Water risks specifically require robust decision making as these risks are shared and as a result require collaboration. Collaboration can only commence through the initiation from higher levels of governance.

The centre of the three spheres were expressed to create a ‘resilient business’ when each circle was fully addressed within the introductory chapter (Chapter 1) of this dissertation (Fig. 5). Essential to the attempt to become resilient is the undertaking of a comprehensive river basin assessment. Throughout the results chapter (Chapter 3), a river basin assessment became imperative in addressing water risks, adapting to the changing climate and as a result making appropriate decisions and governing water. To each sphere individually, as well as the connections as a whole, a comprehensive river basin assessment is thus found to be crucial.

In turn, this allows companies to move away from a ‘tick box’ approach to reporting for how water risk is understood, how effective decisions can be made, and how assessments follow future adaptation planning. Engagement through river basin assessments also allows companies to move beyond the fence line, engage with other companies and communities making use of the same river basin and in essence partake in water stewardship practices.

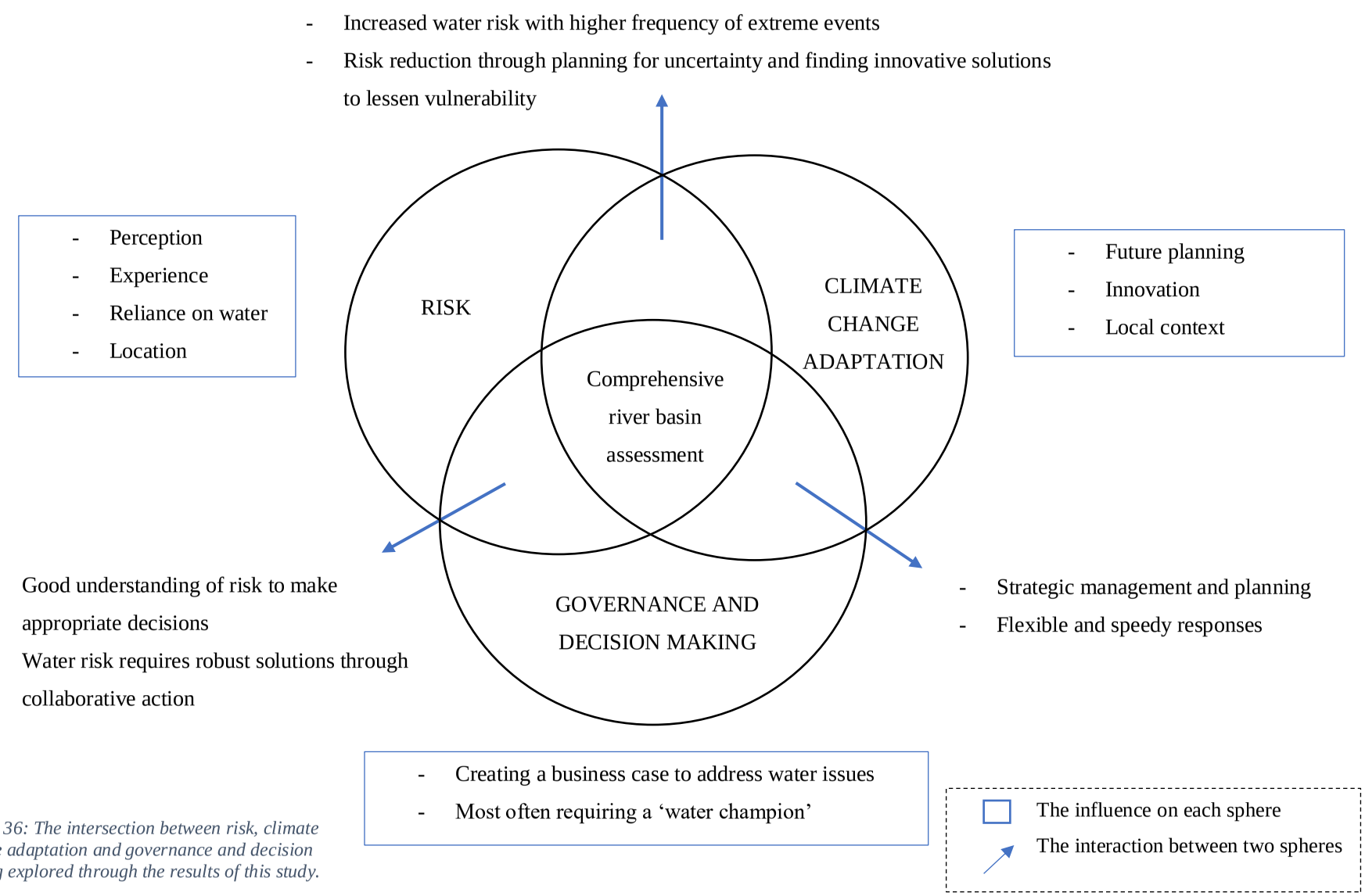


Figure 36: The intersection between risk, climate change adaptation and governance and decision making explored through the results of this study.

4.6. Archetypes

In an attempt to bring all the information gathered together, original archetypes were created. The term ‘archetype’ is believed to derive from the ancient Greek. Archetype theory came about through the work of Carl Jung, a practicing psychiatrist, who used the concept of archetype in his theory of the human psyche. Building on Jung’s definition, Faber and Mayer (2009; p.307), explain that “an archetype is an internal mental model of a typical, generic story character to which an observer might resonate emotionally.” Thus “archetypes represent personifications of behaviours,” (p.308).

Through the notion of similar characteristics exhibited by companies as a result of water behaviours and experiences, archetypes of companies based on ‘water stewardship readiness’ were created. This encompasses the likelihood of companies engaging in water stewardship practices as this is seen as one of the best ways forward for business to assist in securing water in the country. Additionally, the archetypes are created within the context of the three spheres explored throughout the research – water risk, climate change adaptation and governance and decision making (section 4.5). An explanation of the archetype, with the key characteristics defining them, includes:

4.6.1. Ostrich – risk perception

Ostriches are believed to bury their head in sand when they see danger. Consequently, ostriches may be aware of the risks that are coming their way but by burying their heads in the sand, are unable to prepare for the threats that may arise.

The first archetype is related to companies who mention not experiencing any detrimental impacts related to water (Fig. 37). Accordingly, these companies are not exposed to water risk. They are governed consistently according to their reporting as they do not note the experience of risk drivers and their water impacts are minimal. These companies also meet primarily twice a year, annually or sporadically when needed. The perception of companies is one that does not experience risks and hence do not need to make decisions governing them. In light of the water situation in South Africa, these companies may be hardest hit as they are perversely compliance consistent. This conclusion is drawn as

companies who complete CDP Water reports are water intensive and as a result are expected to be aware and prioritise water risks, specifically in South Africa.

'Ostrich' type companies are hiding from the danger that water risk poses.

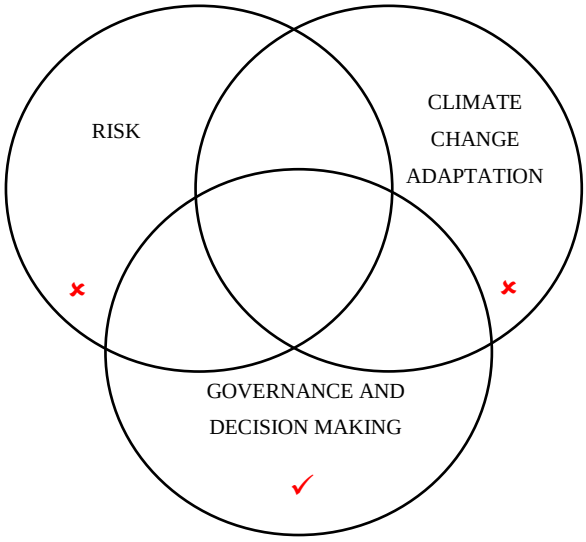


Figure 37: The intersection between risk, climate adaptation and governance and decision making explored through 'ostrich' type companies

4.6.2. Chicken - misaligned company strategy

The chicken archetype is associated with the idiom 'headless chicken.' The foremost trait of a headless chicken is to be extremely busy doing multiple tasks at a time, but in a disorganised manner or panic state – as a result not being effective.

The second archetype is therefore made up of companies who are not exposed to water risk (Fig. 38) but nevertheless do record experiencing impacts that are predominantly driven by physical factors (which primarily result in water supply disruption and higher operating costs). Response strategies are prominent in addition to having Board level decision making on water issues who meet on a scheduled quarterly basis and integrate water management into their business strategy. This indicates a perverse company strategy – companies do not experience any risk, however, they recognise the impact of drivers and cost and still meet quarterly to address these challenges, nonetheless, it is not recognised as

a risk. Owing to their internal governance mismatch, these companies are poor candidates for water stewardship.

'Chicken' type companies provide a disordered and consequently, inconsistent response to the water risks they face.

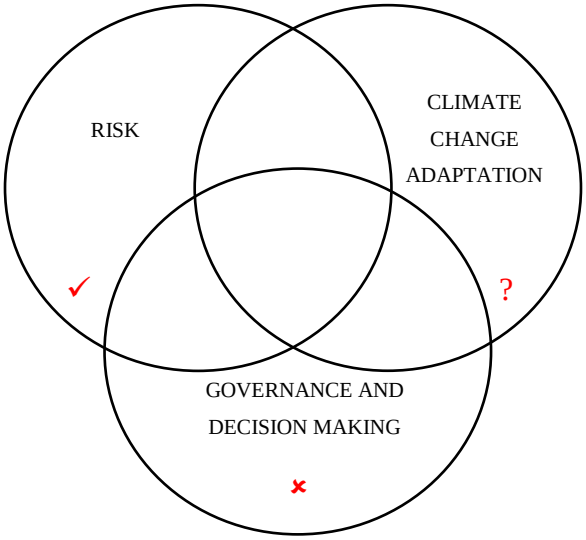


Figure 38: The intersection between risk, climate adaptation and governance and decision making explored through 'chicken' type companies

4.6.3. Owl - potential for water stewardship

Owls are considered to be a symbol for wisdom. Accordingly, wisdom is associated with the ability to think and act using knowledge, experience and understanding. Actions that are wise are consequently responsible.

The third archetype thus encompasses companies who are active in practices beyond the fence line as well as those who already conduct water stewardship practices (Fig. 39). These companies meet on a scheduled quarterly or monthly basis, they integrate water management into their business strategy and have Board level engagement on water related issues. These companies also recognise being exposed to water risk, they identify the drivers behind the impacts they experience and respond with interventions they recognise as appropriate. Above all, the majority of these companies have already conducted comprehensive river basin assessments or at the very least started using tools to

assist in identifying their water risks, impacts and opportunities within and beyond their fence line. If not already doing so, these companies are most likely to mainstream water stewardship within their company.

‘Owl’ type companies are responsible water stewards through their overall water risk management approach.

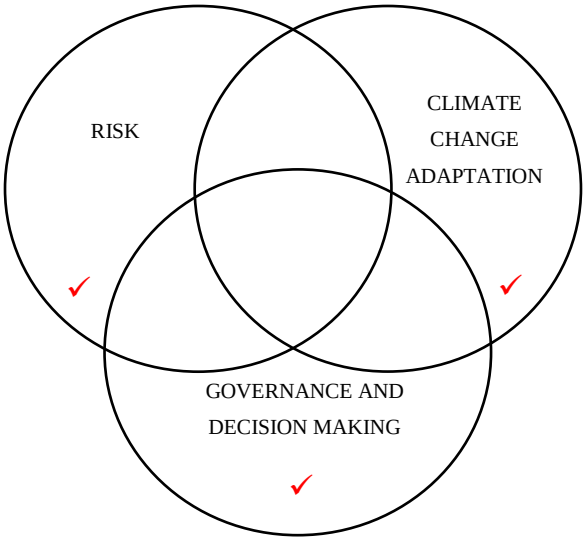


Figure 39: The intersection between risk, climate adaptation and governance and decision making explored through 'owl' type companies

Lastly, bringing these archetypes together, a potential Water Stewardship Readiness index is created illustrating the potential of different companies to undertake water stewardship initiatives (Fig. 40).

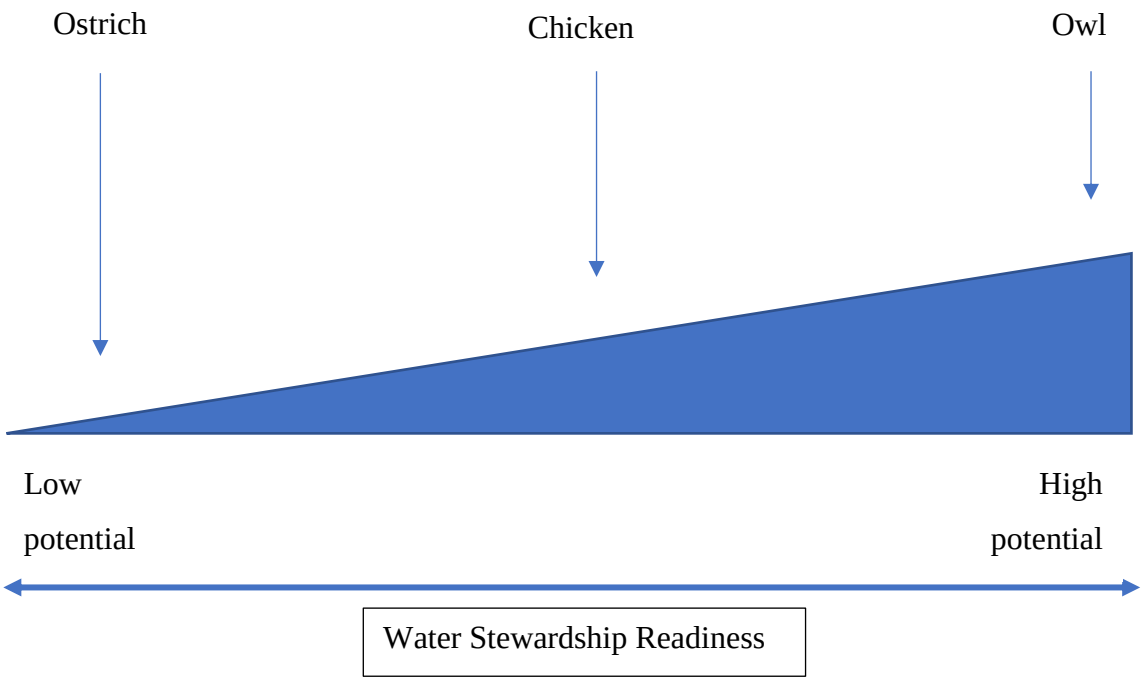


Figure 40: Water Stewardship Readiness Index

4.7. Conclusion

In conclusion, findings of the study have been presented. The have been explored based on the three overarching objectives which involved first giving insight into the background of companies, followed by how they respond to water security concerns and lastly how the voluntary reporting metric, CDP Water, has assisted this process. Additionally, due to the complex nature of assessing how companies manage their water related risks, results were explored in light of available literature as well as the South African context. Lastly, using the information gathered, company archetypes that exemplify 'water stewardship readiness' were explored. The last chapter (Chapter 5), concludes the research of this study by pulling together the key implications of this review.

5. CHAPTER FIVE – CONCLUSION

5.1. Introduction

The complexity of researching the role of companies and how they view water and its use in their business practice cannot be underestimated. The unique context of each company, their locations with reference to water sources, their management systems and over-arching-understanding of risk management and design are key. The findings presented illustrated some of this complexity and nuance including perceptions of weather and climate risk, water risk exposure, opportunities and decision making around water issues. Within these topics, outcomes increasingly lead to the crucial concept that, "*Context is the critical element in water*" (Participant H).

5.2. Addressing Each Objective

To conclude the study's key findings, each objective is addressed below:

1. *To gain a basic understanding of what companies experience currently, and what they may have in place in terms of water risk management, water governance and water decision-making with reference to climate as a major stress factor.*

    - How risks are perceived became vital as the risks companies experienced varied among sectors and river basins. The high variability highlighted poor risk perception among companies.
        - The connection between risk and perception is explored through the three spheres (Chapter 4, section 4.5, Fig. 36).
    - To put climate change and climate variability perception into perspective, over 60% of companies were exposed to water risk where impacts experienced are chiefly due to physical drivers. The main driver was a lack of water (drought, water scarcity and water stress), yet the full range of drivers has resulted in almost a third of companies experiencing 'higher operating costs.' Of this experience, only around a third of 'higher operating costs' was due to physical impact drivers.
    - As expenditure increases, decision making around water issues attracted greater attention. The urgency to address water risk resulted in almost all companies

integrating water management into their business strategy by 2016. In addition, all companies have a 'Board of individuals/subset of the board or other committee appointed by the Board' who have the highest direct responsibility for water issues.

- A governance disconnect was, however, prominent as regardless of water risk exposure, companies integrate water management into their business strategy, meet on a scheduled quarterly basis and have Board level insight into water issues.
    - The above description draws attention to the ostrich and chicken archetype for Water Stewardship Readiness (Chapter 4, section 4.6.1 and 4.6.2).
    - This misaligned company strategy leads to questioning how many companies undertake a 'tick box' approach to reporting.

2. *To investigate how a company is responding to water security concerns – both abundance and shortage.*

- Sufficient amounts of good quality freshwater are 'vital' for almost three quarters of companies' direct water use. The fundamental need for water highlights the necessity for good water management. However, reporting on water accounting is low and incomparable to each other.
- Multiple response strategies were initiated by companies to overcome the impacts they experience, specifically through the influence of physical risk drivers. Additionally, highlighting the governance mismatch again, interventions were provided by companies who are not exposed to water risks as well.
    - The companies who fall into the above description are considered to fall within the ostrich archetype of Water Stewardship Readiness (Chapter 4, section 4.6.1).
- The most common intervention under reported response strategies included 'engagement with public policy makers.' This engagement stressed that companies want to move beyond management and influence water use outside of their fence line when internal mitigation measures were insufficient.
- Using water restrictions as an indicator of how companies are dealing with water security concerns, a range of responses was presented, indicating different levels of water maturity. Quick fixes were found to be easiest by some (including general infrastructure improvements), rather than process changes. Water mature

companies drew attention to building a business case for addressing water risk issues as the understanding behind how this affects business is essential for counteracting 'crisis' situations efficiently (such as Day Zero in Cape Town).

    - Companies who fit the above description of 'water mature' are likely to portray characteristics of the owl archetype of Water Stewardship Readiness (Chapter 4, section 4.6.3).

- Setting meaningful and motivated goals and/or targets is one way of effectively responding to water security concerns. The majority of companies do set goals and targets, however, more than half do not have a motivation behind why they set their objectives. The complexity around water may have prohibited successful target and goal setting. As a result, Context Based Water Targets are being explored by CDP for the future to assist companies.
- To investigate how a company is responding to water security concerns, both in regard to abundance and shortage, the above findings highlight the need to conduct a comprehensive river basin assessment.
    - How a comprehensive river basin assessment assists a company is explored through the three spheres (Chapter 4, section 4.5, Fig. 36).

3. *To assess if CDP reporting, coupled with the acknowledgement of threats to water security (e.g. climate variability), has the potential to transform the way CEO's see their company's water related risks and opportunities.*

- CDP assists companies in viewing water as an opportunity as by 2016 almost all companies were seeing water as an opportunity. In addition opportunities ranged from 20 different types with almost half of companies noting 'improved water efficiency' and 'cost savings.' With more companies benefitting from 'improved water efficiency' rather than simply 'cost savings,' this highlighted the opportunity for water stewardship.
- The belief from companies interviewed ensured that working together is the only way forward in safeguarding water for the future, fitting the description of water stewardship. Some already partake in water stewardship projects and reap the benefits of engaging and collaborating, especially in Cape Town. In spite of this,

although a wide range of engagement and promotion of water stewardship is conducted for South African companies, results indicate that not many companies are actually involved in practices.

    - In the pursuit of water stewardship practices and improved water management, comprehensive river basin assessments are critical. These assessments assist companies in evaluating water in the local context in order to effectively address and fully engage with the water risks they face. In addition, efficient engagements with stakeholders in the same river basin can be conducted.

- The CDP Water survey has played an important role in highlighting the basis of water stewardship. This related to understanding that risks are localised and dependent on the location of a river basin. The CDP thus creates a platform that brings companies together to learn, engage and collaborate across borders. Additionally, by reporting companies reap the benefits of disclosing, which brings about a sense of transparency and accountability, for when practices are positive, this has the ability to increase investor value. This learning experience is one way in which reporting tools can be used to improve water governance. Companies are able to track their usage and improvements with the knowledge that their practices can bring in investor value. This should move companies away from a 'tick box' approach to reporting. A possible explanation for this approach involves sustainability departments being required to complete a number of reports.
- Advocating for a resource such as water has proven to be a difficult task by sustainability or environmental departments within companies. More mature companies within the water space are found to have water champions who drive these issues by taking it a step further rather than solely reporting on use. This is found to be central to understanding, awareness and decision making around water issues within a company. A vital step to becoming 'water mature' involves communicating water related risks at a Board level, in this manner creating a business case. Although the challenge of conveying risks at this level is not unique to sustainability or environmental departments, it emphasizes the importance of leadership within a company. CDP however does require CEO sign off which endorses approval.
- Furthermore, using leadership, companies believe that through collaboration with each other they are able to influence and assist governmental and societal responses

to water risk. Although apprehensive due to trust issues regarding corruption, with the assistance of legal frameworks or guidelines to aid a partnership, companies believe this is achievable. Hence companies have the ability to extend governance beyond the fence, taking into account their impact on the environment and society as well. Water stewardship as a result arises as a prospective opportunity for companies to engage beyond the fence line.

5.3. Reflection

A large dataset was reviewed for the research of this study. In addition the data were then explored in a number of ways. As a result, reflecting on the 'big picture take-aways' of the study was challenging. However, the findings investigated have amplified and contributed the following:

- Context is key.
- Conducting a comprehensive river basin assessment is imperative to understanding water through –
    - Addressing water risks,
    - Adapting to the changing climate and
    - Making appropriate decisions when governing water.
- Collaboration is essential.
- Companies play an important role in their water usage, but also in moving beyond their fence line by –
    - Engaging with other companies,
    - Engaging with government and
    - Educating communities they work in.
- CDP, like other voluntary reporting metrics, are beneficial when taken seriously and hence when used as a tool to establish improvements within the company.
- Risks are imminent throughout a company, and creating a business case to communicate addressing environmental risks as opposed to others is challenging for sustainability/environmental departments.
- Leadership within a company guides where the focus of the establishment lies, and when attention is given, changes can be made. Thus, in many cases addressing water issues requires a 'water champion.'

5.4. Conclusion

The findings of the research emphasise that for water specifically, context is key. As a result, context stresses the importance of conducting comprehensive river basin assessments. Such evaluations became imperative in addressing water risks, adapting to the changing climate and accordingly making appropriate decisions and governing water. A greater understanding around who the other actors within the river basin are is also presented, thus allowing for wholesome approaches to address water related risks and collectively discovering opportunities. In theory this in turn offers the opportunity for companies to then adopt water stewardship practices. Through the findings of this research, addressing the three spheres individually then moving to their interactions (Chapter 4, section 4.5, Fig. 36) increases a company's 'Water Stewardship Readiness' (Chapter 4, section 4.6, Fig. 38). However, as mentioned above, because water itself is a challenging resource to manage and account for, this requires leadership within the company as well as more attention possibly through a water champion.

Taking these findings one step further - the notion of leadership brought to light the value of education and creating individuals, regardless of their field of interest, with the understanding and knowledge that resources such as water are limited. These environmental issues should be embedded within these individuals for appropriate decision making given the current state and future projections of not only water, but environmental concerns going forward.

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7. APPENDICES

APPENDIX A

Research Office

HUMAN RESEARCH ETHICS COMMITTEE (NON-MEDICAL)
R14/49 Jeram

CLEARANCE CERTIFICATE	**PROTOCOL NUMBER: H17/09/10**
PROJECT TITLE	Water stewardship and resilience in South African businesses: challenges and opportunities
INVESTIGATOR(S)	Miss D Jeram
SCHOOL/DEPARTMENT	Animal, Plant and Environmental Science/
DATE CONSIDERED	15 September 2017
DECISION OF THE COMMITTEE	Approved Permission letters are required before data collection can commence
EXPIRY DATE	09 October 2020

DATE 10 October 2017 **CHAIRPERSON** (Professor J Knight)

cc: Supervisor : Professor C Vogel

DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10004, 10th Floor, Senate House, University. Unreported changes to the application may invalidate the clearance given by the HREC (Non-Medical)

I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee. **I agree to completion of a yearly progress report.**

Signature Date 13 / 10 / 2017

PLEASE QUOTE THE PROTOCOL NUMBER ON ALL ENQUIRIES

APPENDIX B

Additional PCA – used to assist explanations from Fig. 13 (p.41).

