PHYSICAL, REGULATORY AND REPUTATIONAL WATER RISKS AS PREDICTORS OF WATER STEWARDSHIP AMONG GLOBAL CORPORATIONS

by

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DEDICATION

This is dedicated to my loving and supportive family who has sacrificed so much to enable me to achieve this dream.

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ONE LOVE, IRIE mon!

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LIST OF ABBREVIATIONS

ALLRsk................Aggregate of Physical, Regulatory, Reputational and Other Water Risk
AWM .... Adaptive Water Management
AWS..................... Alliance for Water Stewardship
BCtA .... Business Call to Action
CDP..................... Carbon Disclosure Project
CDP-IWP .... Carbon Disclosure Project Investor Water Program
CPR..................... Common Pool Resource
CWRRS..................... Corporate Water Risk Response and Stewardship
CWS..................... Corporate Water Stewardship
ERM..................... Enterprise Risk Management
GICS .... Global Industry Classification Standard
GRI..................... Global Resources Institute
IWRM .... Integrated Water Resources Management
NRBV .... Natural resource Based View of the Firm
PHYS .... Physical Water Risk
RDT..................... Resource Dependency Theory
REG..................... Regulatory Water Risk
REP .... Reputational Water Risk
UN..................... United Nations
UNEP .... United Nations Environment Program
UNGC .... United Nations Global Compact
WEF .... World Economic Forum
WRI..................... World Resources Institute
WRRS .... Water Risk Response Spectrum
WWF..................... World Wildlife Fund

ABSTRACT

PHYSICAL, REGULATORY AND REPUTATIONAL WATER RISKS AS PREDICTORS OF WATER STEWARDSHIP AMONG GLOBAL CORPORATIONS

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There is growing consensus that the scope and complexity of worsening global water stress and associated physical, regulatory and reputational water risks, require a stewardship approach that involves collective action and community engagement among public and private sectors, NGOs, and communities. Corporate Water Stewardship (CWS) emerges as a strategic approach for companies to mitigate water risks, and many global corporations are publicly disclosing their water risk and responses to initiatives such as the Carbon Disclosure Project's Investor Water Program. While the Alliance for Water Stewardship (AWS) International Water Stewardship Standard, released in 2014, provides clearly defined guidelines and a six-step process —commit, gather and understand, plan, implement, evaluate, and communicate and disclose— required for CWS, there has been little empirical research on global corporations' CWS practices and related factors, in particular how reported CWS results relates to physical, regulatory and

reputational water risks, and other company characteristics such as revenue, number of employees, number of facilities located in river basins exposed to water risk, sector and the economic classification of the country where the company's headquarters are located.

In this research, I examined full public responses of 327 global corporations (the Full Disclosers) to the 2014 CDP-IWP survey, with the aim of understanding the most important factors related to CWS – and using the AWS Standard as the criteria for CWS. To achieve this aim, I explored four research questions. First, what water risk types (physical regulatory and reputational) are most prevalent among Full Disclosures to the 2014-CD-IWP? Second, how do physical, regulatory and reputational water risks relate to company characteristics? Third, how are the components of CWS practiced by Full Disclosures related to their reported physical, regulatory and reputational water risks? It was hypothesized that physical, regulatory and reputational water risks would explain a significant variance in CWS practice amongst the study participants.

The results show that physical water risk was the most prevalent type of risk among companies in the study, followed by regulatory risk, then reputational water risks. Significant relationships were observed between physical, regulatory, and the number of facilities a company had located in river basins exposed to water risk, but not with other company characteristics. For annual company revenue, sector, and the economic status of the country where the company's headquarters are located, relationships with physical regulatory and reputational risk types were not significant; however, the aggregate of all water risk was significantly related.

It was also found that global companies in this research study were engaging in CWS practice to varying degrees: 58% of the 327 companies in the study pursued action in all six AWS steps while 49% took action in four to five steps. Physical and regulatory water risk types significantly predicted and also explained a significant portion of the variance in CWS, while reputational water risk did not. The number of facilities a company had located in river basins exposed to water risk also proved to be a significant predictor of CWS. Annual revenue significantly predicted CWS but only for companies that pursued action in less than six CWS steps, while sector was a significant predictor among companies that pursued action in all six CWS steps. These findings provide insights into CWS practice among global corporations that fully disclosed to the CDP-IWP. These findings can be used to inform policy-makers on how to engage corporations in collaborative and collective actions for sustainable water resources management and governance. The methodology used in this research also have value to companies and water practitioners in setting targets and developing action plans to mitigate water risks.

CHAPTER ONE: INTRODUCTION

Water stewardship has emerged as a strategic response to address water risks and work towards ensuring access to water and sanitation for all (AWS, 2014; Rozza et al., 2013; Sarni, 2011b; Schulte, Morrison, & Gleick, 2011). There is growing consensus that the scope and complexity of worsening global water stress and associated physical, regulatory, and reputational water risks, require a stewardship approach that involves collective action and community engagement among public and private sectors, NGOs, and communities (BCtA, 2013; Cooley et al., 2014; Hepworth & Orr, 2013; Larson, Freedman, Passinsky, Grubb, & Adriaens, 2012; Rozza et al., 2013; Sarni, 2011a; Schulte, Orr, & Morrison, 2014; UNEP, 2012; UNGC, 2013; WEF, 2014).

The Alliance for Water Stewardship (AWS)[1] International Water Stewardship Standard defines water stewardship as

> "*the use of water that is socially equitable, environmentally sustainable and economically beneficial, achieved through a stakeholder-inclusive process that involves on-site and catchment-based actions*" (AWS, 2014, p. 6).

[1] The Alliance for Water Stewardship (AWS) is a collaborative effort of a multi-sectorial group of organizations (NGOs, private sector, public sector etc.) dedicated to "enhancing water stewardship capacity, and guiding, incentivizing and differentiating responsible water use" (AWS, 2010).

Water stewardship from the perspective of corporations – referred to as Corporate Water Stewardship (CWS) — was examined in this study. The main aim was to examine the most important factors related to CWS practice among global corporations that publicly disclosed to the Carbon Disclosure Project Investor Water Program (CDP-IWP). To achieve this aim required examination of several factors outlined in Figure 1. The first was to examine the types of water risks corporations recognized as business risks and identify which company characteristics were related to those water risks. Second was to ascertain the extent to which corporate water risk response incorporated the principles of water stewardship. Third was to determine which water risk types or other company characteristics were predictors of corporate water stewardship.

The study was based on the premise that physical, regulatory and reputational water risks are important drivers of corporate water stewardship (CEO Water Mandate, WWF, & WaterAid, 2015; Hepworth & Orr, 2013; Schulte et al., 2014). Another premise was that company size (measured by annual revenue and number of employees), sector, the country of the company headquarters; and the number of facilities located in river basins exposed to water risks, were also related to water risk and CWS (CDP, 2014d; Reig, Shiao, & Gassert, 2013; Schulte et al., 2011; Thebaut, 2009). The research findings contribute to the existing body of knowledge addressing CWS and increase understanding of CWS theory, practice, and related corporate factors.

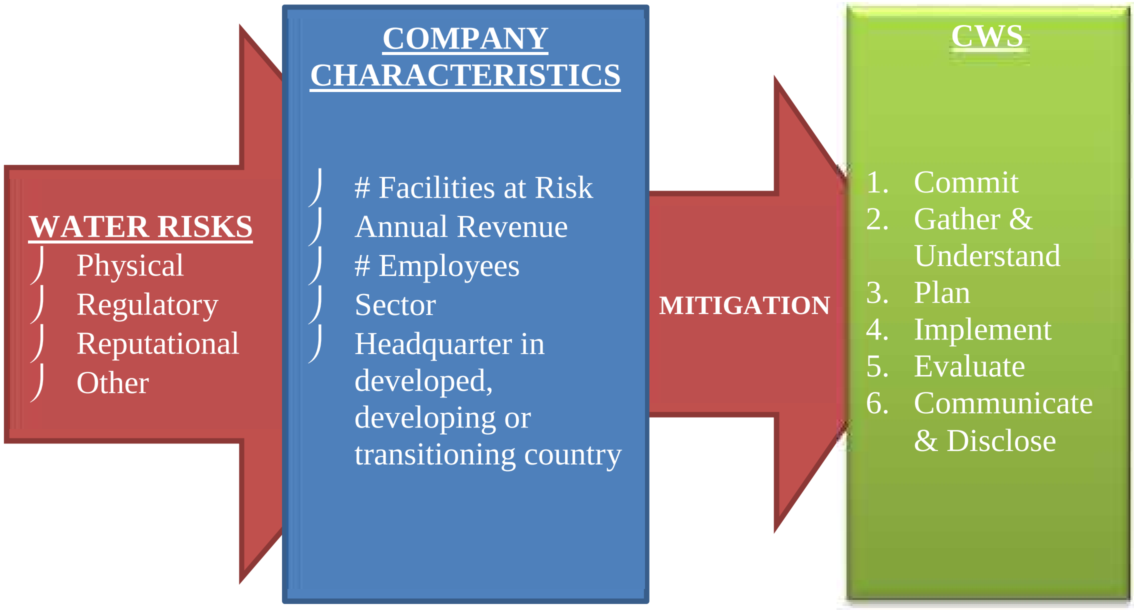

Figure 1: Potential Factors related to CWS and Analysis Path

Background

Population growth, water stress, water risk and climate change

"Water is at the core of sustainable development. It is critical for thriving people, planet, and prosperity. Water is needed for domestic, agricultural, and industrial uses and energy production and is central to climate change" (UN Water, 2015, para. 1; UNESCO, 2015, p. 2).

The world's freshwater supplies come from less than one percent of water stored in aquifers (groundwater), lakes and rivers, stored in dams, glaciers and ice caps, and from rainfall (**Figure 2**). Population growth and associated economic development over the past century have increased global demand for water and resulted in withdrawal rates twice the growth rate of population (UN-Water, 2013b). The United Nations (UN) also highlighted that population and development have placed tremendous pressure on limited water resources. The stress is expected to worsen with global population projected to reach 9.1 billion by 2050 (UNESCO, 2015).

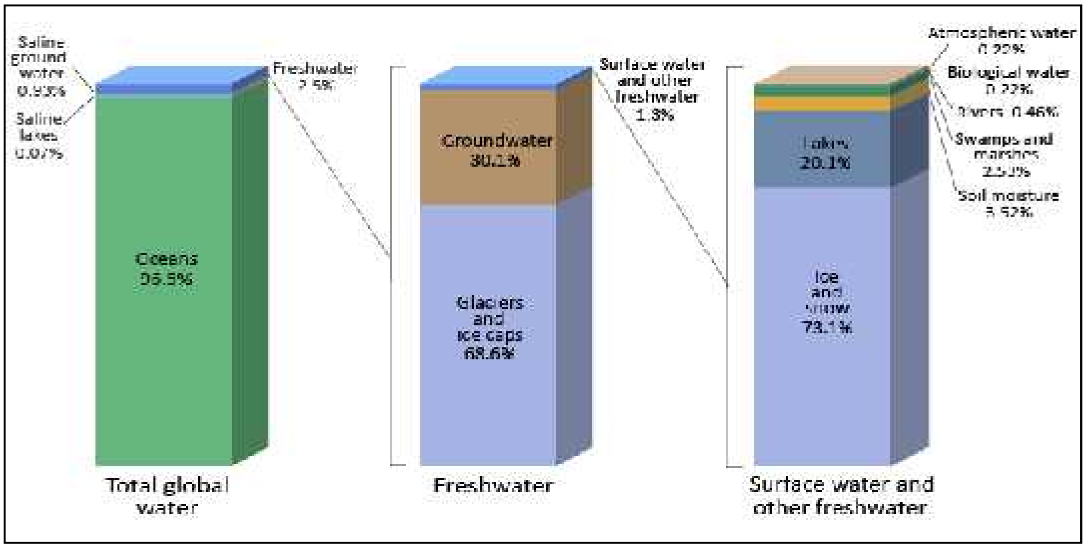

Figure 2: Distribution of Earth's Water, per Igor Shiklomanov (1993)
(Shiklomanov, 1993; USGS, 2011)

It has become increasingly difficult to meet human and ecological demands for water in many parts of the world (Schulte et al., 2014). The state of world water resources is considered to be in crisis (WEF, 2016). The 2015 World Economic Forum's (WEF) multi-stakeholder perception survey ranked water as one of the most impactful risks faced globally today. A key factor of the problem is that global freshwater resources vary spatially and temporally in any given year. In addition, available resources are oftentimes disproportionately low in the areas of highest demand, limiting access. This has contributed to scarcity and stress amidst declining water quality and quantity (Schulte, 2014). *The United Nations World Water Development Report 2015* states that 1.2 billion people live in areas where water has been physically scarce, and one quarter of the global population also reside in developing countries with water shortages due to weak governance and lack of infrastructure to transport water from rivers and aquifers (UNESCO, 2015). The extent of the problem was quantified in Reig, Shiao, & Gassert (2013) contribution to the *World Resources Institute (WRI) Aqueduct Atlas*. They calculated water stress — defined as “the ratio of total annual water withdrawal to total annual available blue water” (or renewable supply) — for 200 countries and river basins and catchments globally (Gassert, Luck, Landis, Reig, & Shiao, 2014, p. 12). The water stress ratios were used to score and rank countries and river basins using the classification summarized in Table 1.

Table 1: WRI Aqueduct Atlas Water Stress Classification (Reig et al., 2013)

Water Stress Ratio	**Score**	**Water Stress Category**
<10%	0-1	Low
10-20%	1-2	Low to medium
20-40%	2-3	Medium to high
40-80%	3-4	High
>80%	4-5	Extremely high

Figure 3: Water stress by country (Gassert, Reig, Luo, & Maddocks, 2013)

Gassert et al. (2013) *Aqueduct Atlas* showed that that one third of 200 countries analyzed had a ratio exceeding 40% and ranked as being “high to extremely high water stress” (Figure 3). Among river basins ranked high to extremely high water stress were the Colorado River (USA and Mexico), the Dead Sea (Israel, Jordon and West Bank), and the Indus River (Afghanistan, China, India, Nepal, and Pakistan). These river basins were also identified as locations where corporations were experiencing water risks in the 2014 Carbon Disclosure Project Water Program survey (CDP, 2014a). High levels of water stress contribute to higher levels of competition among water users, and expose these users to water risk (Reig et al., 2013).

Water risk is the “probability of an entity experiencing a deleterious water-related event” (Schulte, 2014, para. 6). There are three types of water risks discussed in the literature— physical, regulatory, and reputational water risks. ***Physical water risk*** is exposure to changes in the quantity and/or quality of water that may impact water availability ("too much or too little") and access ("inaccessible or unfit for use") (Orr, Cartwright, & Tickner, 2009; Schulte et al., 2011, pp. 26–28). ***Regulatory water risk*** is exposure to changing, ineffective or poorly implemented public water policy and/or regulations. ***Reputational water risk*** is associated with potential conflict with the public regarding perceived or actual unsustainable use of water by corporations (Orr et al., 2009; Schulte et al., 2011). Water stress and scarcity from increasing demands on these resources poses risks to people, planet and prosperity. Solutions to mitigate water risks and build resource resilience are therefore crucial, especially for water stressed countries and catchment areas.

Global water stress and water risk are compounded by climate change. The Intergovernmental Panel for Climate Change's (IPCC) reported that it is "very likely" to "virtually certain" that climate change impacts will exacerbate stress on water resources globally (IPCC, 2013). Expected impacts of climate change include increased variability in temperature, extreme weather events such as droughts and floods, more frequent and intense tropical storm and hurricane activity and increased incidence and/or magnitude of extreme weather events and high sea level rise. There will be more periods and places with too much or too little water. Climate change impacts within the context of the projected population growth and already stressed water resources will undoubtedly exacerbate water risks to the population, economies and the natural environment.

The United Nations (UN) estimated that if current population growth trends continue, by 2025, 1.8 billion people will be living in countries or regions with absolute water scarcity,[2] and two-thirds of the world's population could be under water stress (UN-Water, 2013b).

Corporate water use

The demand for water to meet the needs of a growing population also includes private sector water use in the production of goods and services, i.e., corporate water use. Corporate water use includes water withdrawals for industry, which account for 19% of global water withdrawals per year (UNESCO, 2015). When water withdrawal in the supply chain is considered, corporate water use also includes some agricultural water use (70% of global withdrawals). Industries then discharge an estimated 300 to 400 million tons of polluted waste into waters every year. UN-Water (2013a) identified nitrates from agriculture as the most common chemical contaminant of groundwater globally. Businesses impact water quantity and quality both through their water consumption and waste-water discharge. The core function of some businesses (water utilities) is water supply and treatment. Other businesses manage water as part of the inputs or outputs for their operations (Kurland and Zell, 2010). Businesses and water are therefore intricately intertwined. The potential for businesses to impact water resources is global and of great magnitude based on the scale of their use and discharge of water.

Corporate water users are increasingly cognizant of the importance of water to their profitability (economic capital), social and environmental capital (triple bottom

[2] Absolute water scarcity is the inadequate physical natural water resources to meet demand. This is differs from economic water scarcity which is inadequate availability due to poor management and insufficient resources (UN, 2010).

line[3]) and the risks associated with increasing water stress, unreliable water supply, and unsustainable use and management (Schulte et al., 2011). Water risk creates further risks to business continuity and wider economic development, including financial risks, increased costs, risks to markets and products, and risks to employees' and customers' health (Larson et al., 2012; WBCSD, n.d.). Physical, regulatory, and reputational water risks are especially critical for corporations heavily dependent on water as a key input into their operations, both directly and indirectly through their supply chains (for example, businesses in the food, beverage and tobacco and materials industries). Increasing exposure to water risk and detrimental impacts related to water have prompted many corporations to take action to mitigate physical, regulatory, and reputational risks (CDP, 2013b). Many large multinational corporations are reporting these risks and mitigating actions publicly. These corporations have started to drive CWS efforts with the support of international NGOs, small businesses, consultants, financial services institutions and bilateral and multilateral aid agencies. The AWS, the 2030 Water Resources Group,[4] and the CEO Water Mandate[5] are examples of these CWS collaborations.

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[3] Triple bottom line (TBL) is a measure of the economic value or performance of a company that factors in its economic capital (profit), social capital (people) and environmental capital (planet) instead of the traditional financial bottom line performance measures (Bennett & Lewis, 2015; Elkington, 2004; Ernst & Young LLP & Miami University, 2013; Gross, 2015).

[4] The 2030 Water Resources Group (2030 WRG) is a public-private-civil society collaboration that facilitates "open, trust-based dialogue processes to drive action on water resources reform in water stressed countries in developing economies" (WRG, 2016).

[5] "The CEO Water Mandate mobilizes business leaders to advance water stewardship, sanitation, and Sustainable Development Goals (SDGs) in partnership with the United Nations, governments, peers, civil society and others" (CEO Water Mandate, 2016). The CEO Water Mandate is a special initiative of the UN Secretary-General and the UN Global Compact, implemented in partnership with the Pacific Institute.

CWS is a critical component of corporate strategy as it could mitigate water stress and related physical, regulatory and reputational water risks (CDP, 2013b; Cooley et al., 2014; Franco-García & Bressers, 2010; Hepworth & Orr, 2013; Larson et al., 2012; Sarni, 2011b; WBCSD, n.d.). The business-as-usual approaches with current unsustainable water usage practices will likely increase water stress for corporations.

The CDP reported that 1,064 companies globally disclosed their water use, water risks, and responses to those risks listed in the Water Disclosure Project in 2014 (CDP, 2014b). In its — *From water risk to value creation: CDP Global Water Report 2014*— the report highlighted 174 of participating companies were noted as FSTE Global 500 companies, and accounted for over 700 million acre-feet (863,436 million cubic meters) of global water withdrawals in 2014. This withdrawal rate was equivalent to 25 percent of the total annual water withdrawal by corporate water users in 2013, indicating the scale for potential impact from these companies for CWS (The World Bank Group, 2014).

Three hundred and twenty seven (327) companies made full public disclosures to the 2014 CDP-IWP —referred to the Full Disclosers from this point forward in this dissertation. The responses of the Full Disclosers were available to the public, and these responses were acquired for this study. Preliminary analysis of responses of the data used in this research showed that 66% of the 327 companies that publicly disclosed had water policies which set out clear goals and guidelines. This is an indicator of the first step in CWS—committing to CWS (AWS, 2014). Disclosures on water risks and responses are critical components of CWS, and are important to much wider integrated water resources management and water sustainability practices. Corporate water use and practices impact other water users, managers, and policy makers (Money, 2014). CEO Water Mandate et al. (2015) posited that CWS practice and disclosure will help address the root-causes of water risk, namely to reduce data collection efforts, and improve measuring progress and sustainability reporting with harmonized global metrics. Moreover, CWS is an integral component of a larger water stewardship framework for mitigating water risk and securing sustainable water resources for all users and especially in water stress areas (Hepworth & Orr, 2013; Money, 2012).

Addressing water risks

Sustainable water resources management has traditionally been the purview of governments or quasi-government entities and, to a lesser extent, the private sector. Approaches to addressing water challenges, managing and governing water resources in a sustainable way have ranged from systems focused on water rights and allocation to integrated water resources management (IWRM), and adaptive water management (AWM) (Gleick, 2000; Pahl-Wostl and Sendzimir, 2005). While these approaches can in no way be deemed failures, they no longer appear adequate to mitigate risk from persistent and growing global water stress and scarcity (Hepworth & Orr, 2013; Peter H. Gleick, 2003; Peter H. Gleick et al., 2011).

As a common pool resource (CPR), and a basic human right, water is a shared resource. Physical, regulatory, and reputational water risks associated with stressed and scarce water resources are also shared risks. Similarly, action by any group to mitigate water risks without the use of power to gain and/or maintain control of the resource at the expense of other groups —referred to as policy capture— should also be considered to create shared value.

Corporate water stewardship (CWS) has emerged as a way for corporations to mitigate physical, regulatory, and reputational water risks within their scope of influence (operations and supply chain) but also beyond corporate fence lines as well as to include all users (people and planet), hence reducing shared risk and creating shared value (Hepworth & Orr, 2013; Money, 2012, 2014; Sarni, 2011b; WWF, 2013). CWS requires corporations "understanding their water use, shared risk and catchment context from the perspective of water governance, balance, quality and important water related areas" (AWS, 2014). The AWS (2014) also argues that the core of CWS is "corporations engaging in meaningful individual and collective actions that benefit people and nature."

Scholarly literature and empirical research on CWS have been growing as seen in works by Hepworth (2012); Hepworth & Orr (2013); Jones, Hillier, & Comfort (2015); Rozza et al. (2013); Sarni (2011b); and Sojamo (2015). Information is available in popular and trade press, and on corporate and NGOs' websites as well as some empirical studies. However, there is a need for a better understanding of the drivers and outcomes of CWS, and its implications for mitigating water risk and contributing to achieving the UN Sustainable Development Goal for water (Hepworth & Orr, 2013; Kurland & Zell, 2010).

Research Questions

This research aims to operationalize the AWS International Water Stewardship Standard (AWS Standard) and global corporations' responses to the CDP-IWP water information survey to assess the most important factors related to CWS practice the Full Disclosers to the CDP- IWP. The following research questions were explored:

RQ1: What water risk types (physical, regulatory, reputational) are most prevalent among Full Disclosers to the 2014 CDP-IWP?

RQ2: How do physical, regulatory and reputational water risks relate to company characteristics such as number of facilities located in river basins exposed to water risk; company revenue; number of employees; sector; and headquarter country's economic classification?

RQ3: How are components of CWS practiced by the Full Disclosures to the 2014 CDP-IWP related to their reported physical, regulatory and reputational water risks?

Research Contributions

Water stress and scarcity and water stewardship are well established constructs in the academic literature. However, examining these issues from the perspective of risk to society and businesses only emerged in the past decade. Additionally, the 2014 launch of the AWS Water Stewardship Standard provides a clear definition of water stewardship within today's water challenges, for example, stress and scarcity, and opportunities, such as cost reduction, improved water efficiency, increased brand value and business and community resilience. Further, relatively new to literature are publications concerning corporate disclosure of companies' water use behavior, water risks and responses to those risks. A large contributor to the trend in disclosure has been the CDP-IWP to which companies started reporting their water use, governance, risk, response practices in 2010. CDP issued the first questionnaire to 300 companies in April 2010, with 146 companies providing public responses in June, 2010. This research explored the linkages between the AWS Standard, the 2014 CDP-IWP questionnaire to obtain companies' responses about their exposure to water risk, and responses to those risks and water stewardship behavior, to answer the research questions.

This research contributes to the literature concerning CWS through a synthesis of theory and practice using defined key steps for CWS. It provides insights into physical, regulatory, and reputational water risk exposure among companies and how these risks relate to other company characteristics and responses. The research also adds to the body of knowledge on the role of private sector entities in undertaking collective action and stewardship to mitigate water risks outside of their corporate fence line, for all users. The research contributes to discourse on water governance, policy, stakeholder engagement, and collective action for sustainable water resources management and corporate water stewardship.

Organization of Dissertation

Following the introduction, the second chapter of this dissertation presents an overview of the main theories on which this research is based – resource dependency, natural resource based view of the firm, stewardship enterprise risk management and water risk response spectrum. The theories were explored within the context of the existing body of knowledge on water risks and responses and corporate water stewardship, its drivers and deterrents. The factors that drive water risk and CWS behavior from the theoretical and practical perspectives and the gaps identified are examined in chapter three. The research design and methodological approach for this research are presented in chapter four. Additionally, chapter four provides a detailed description of the research questions, hypotheses, data collection and data analysis and a description of the companies in the study. The research findings are presented and discussed in chapter five, six and seven. Chapter six includes answers to RQ1 on water risks while chapter six details CWS practice and chapter seven details findings on the most important factors influencing CWS among companies. The conclusions and future research are included in a final summation in chapter eight.

CHAPTER TWO: THEORETICAL FRAMEWORK

CWS is a reflection of the complexity of the problem for which it was intended to overcome – water stress and scarcity. It sits at the juncture of the environmental science, sustainability, business management, and social sciences disciplines with a plethora of theoretical underpinnings. This research was based on the Corporate Water Risk Response and Stewardship (CWRRS) conceptual framework, which is a synthesis of existing theories: (1) Larson et. al. (2012) Water Risk Response Spectrum (WRRS) (2012), (2) Pfeffer and Salancik's (1978) Resource Dependency theory, (3) Hart's (1995) Natural Resource-based View of the Firm (NRBV) theory, (4) Davis, Schoorman and Donaldson's (1997) stewardship theory, (5) Enterprise Risk Management (ERM) theory, and (6) the AWS (2014) Water Stewardship Standard. These frameworks characterize organizations' decision-making processes related to natural resources such as water. In general, the theories converge around the notion that collaboration and cooperation are strategic choices under circumstances of shared environmental risks. This chapter provides an overview of the CWRRS and the theoretical frameworks that underpin the framework and this research.

Corporate Water Risk and Stewardship (CWRRS) Conceptual Framework

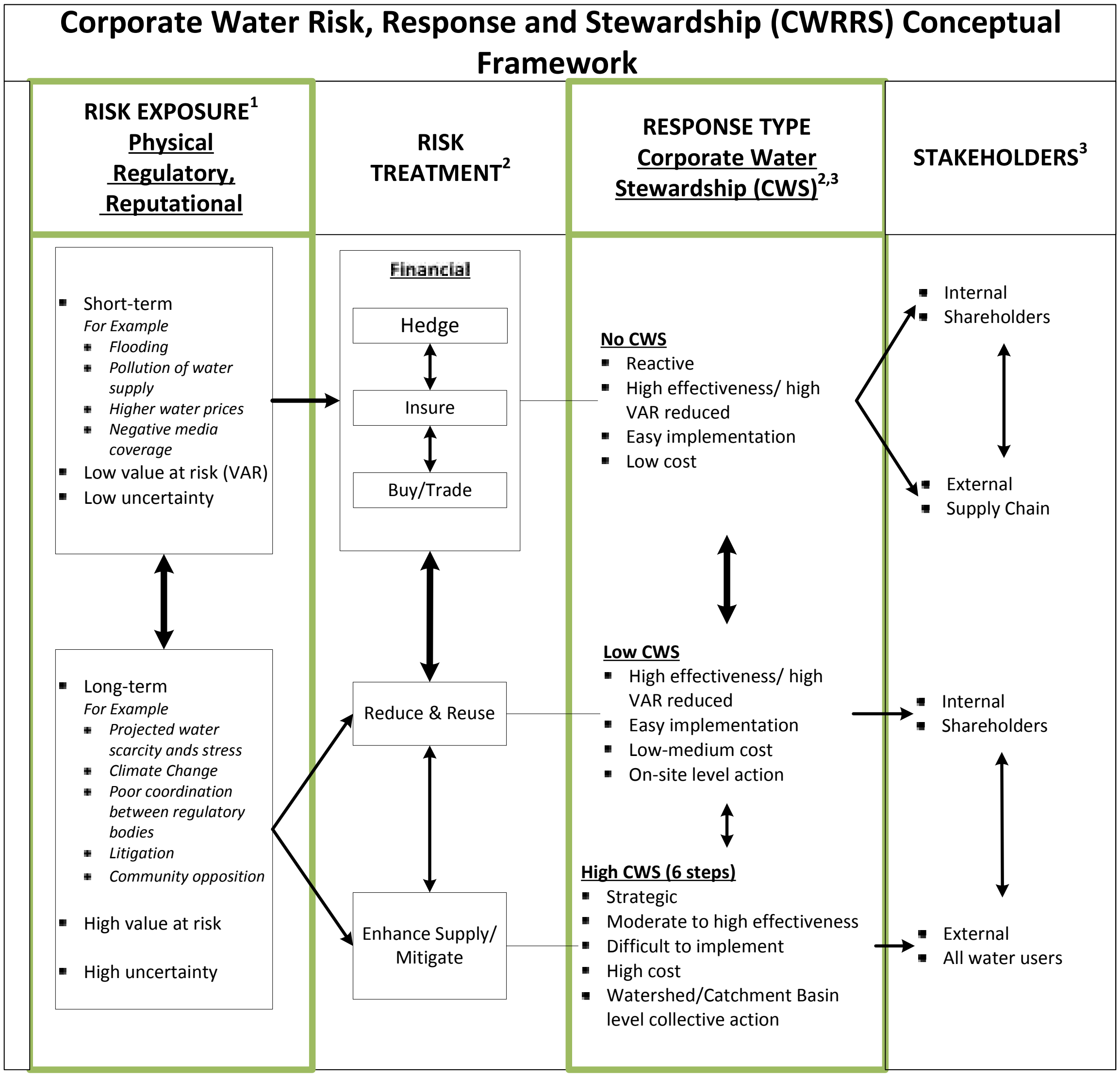
The CWRRS conceptual framework is shown in Table 2. It indicates in the risk exposure column that corporations may face, and experience impacts from short-term or long-term physical, regulatory and reputational water risks with varying degrees of uncertainty. It also shows that the value at risk (VAR), defined as the value of assets within the corporation's operations or value chain, exposed to risk may vary from low to high VAR.

In depicting the types of responses and treatments of those risks, the CWRRS reflects the COSO Enterprise Risk Management (ERM) framework's claim that there are multiple types of responses to risks ranging from reactive to tactical to strategic responses (Ernst & Young LLP & Miami University, 2013; Essaides, 2013). ERM is discussed in detail later in this chapter. Reactive responses are generally short-term, and low cost strategies that are internally-focused. According to Larson et al. (2012), reactive responses have the tendency to involve financial solutions while responses that fall in the tactical category involve some negotiation and trading with parties' external to the corporation, but with some preexisting relationship such as partner in their supply chain. The literature also indicates that responses could also be strategic. Strategic responses tend to be external, involving a wider range of stakeholders outside the influence of the firm. The CWRRS framework include Larson et al. (2012) theory there is a tendency for costs and difficulty in implementation to increase as the response range from reactive to strategic, with strategic responses having the highest cost and most difficult to implement. Similarly, the stakeholders that benefit from the response and treatment of the risks vary accordingly.

The CWRRS also reflects Larson et al.'s (2012) notion that reactive responses mitigate water risks for the corporation on a short-term basis, while tactical responses tend to benefit the corporation and their supply chain. Moreover, strategic responses mitigate water risks for the corporation, its supply chain, and the wider society with long-term effects. Strategic responses therefore contribute to sustainable water resources and sustainable development. It is however argued that strategic responses tend to have higher transaction costs, and the value created is more difficult to quantify than other more reactive and tactical responses such as hedging and insurance (Larson et al., 2012).

Based on the AWS, RDT, NRBV and WRRS, water stewardship is the strategic response to water risk. However, given the level of difficulty to implement, high transaction costs, and difficulty in quantifying benefits, corporations may opt for responses that are reactive and tactical over strategic. This raises the question of which factors are most important correlates of corporate water stewardship among companies – the main question explored in this research. In answering this question, this study focused on the risk and response types components of the CWRRS, bordered in green in Table 2. A more detailed examination of the underlying theories in the CWRRS conceptual framework may shed some light on why corporations would opt for CWS and is discussed in the remainder of this chapter.

Table 2: CWRRS conceptual framework



Note: This framework integrates: 1 ERM; 2 WRRS; and 3 RDT, NRBV and CWS theories

Natural Resources and Organizational Behavior Theories (Exposure to Risk)

One theoretical framework that underpins this research is Pfeffer and Salancik's (1978) ***Resource Dependency Theory (RDT).*** RDT states that organizations depend on resources that may be in the control of others (Pfeffer and Salancik, 1978, cited in

Vargas-Hernández, 2008). In order to survive, organizations seek to gain control over or reduce the power of others over needed resources and to reduce uncertainties about resource access through strategic alliances and inter-organizational cooperation (Lin & Darnall, 2010).

Similarly, Hart's (1995) ***Natural Resource Based View of the Firm (NRBV) Theory*** states that the sustained competitive advantage of the firm is based on its relationship with the natural environment. He argues that the firm's internal capability and capacity determined its strategic response to external pressures from competitors and other stakeholders. The firm's strategic response can range from pollution prevention to product stewardship to sustainable development (Hart, 1995; Hart & Dowell, 2011). NRBV predicts that the firm's strategy progresses over time from internal, purely competitive activity to external activity that establishes a firm's legitimacy then culminated in strategies based on a shared vision within the context of broader societal development (Table 3).

The RDT and NRBV theories were further elaborated by Davis, Schoorman, and Donaldson (1997) ***Stewardship Theory.*** This theory was based on the notion that "organizational, collectivist behaviors have higher utility than individualistic, self-serving behaviors" (p. 25). The authors argue that stewardship is fostered by "the best interests of the group, and that it strives in organizational structures that facilitate and empower rather than monitor and control, and has intrinsic motivations" (p. 25). Stewardship is implemented within a highly participatory environment, with open communication that empowers stakeholders and establishes trust with those in the relationship as depicted in

Table 4. Additionally, stewards are said to identify with the wider group of stakeholders, and are therefore engaged in collective action that served the group while simultaneously meeting their own needs. The authors saw stewardship as an alternative to the individualistic, self-serving, and power-driven approaches of organizations under Jensen and Merkling's (1978) ***Agency Theory*** as depicted in Table 4.

In the context of water risk and this research, the RDT and NRBV theories indicate behavior of global corporations that are dependent on shared water resources can vary from internally-focused solutions controlling resources, to externally-focused, collaborative responses that reduce uncertainties or risks for the organization as well as partners. Corporations may gain sustained competitive advantage for strategies in response to environmental risks that are focused around a vision shared among the broader society, as also claimed in Davis, Schoorman and Donaldson's (1997***)*** ***stewardship theory,*** and this research.

Table 3: Hart's (1995) Sustained Competitive Advantage of the NRBV Theory

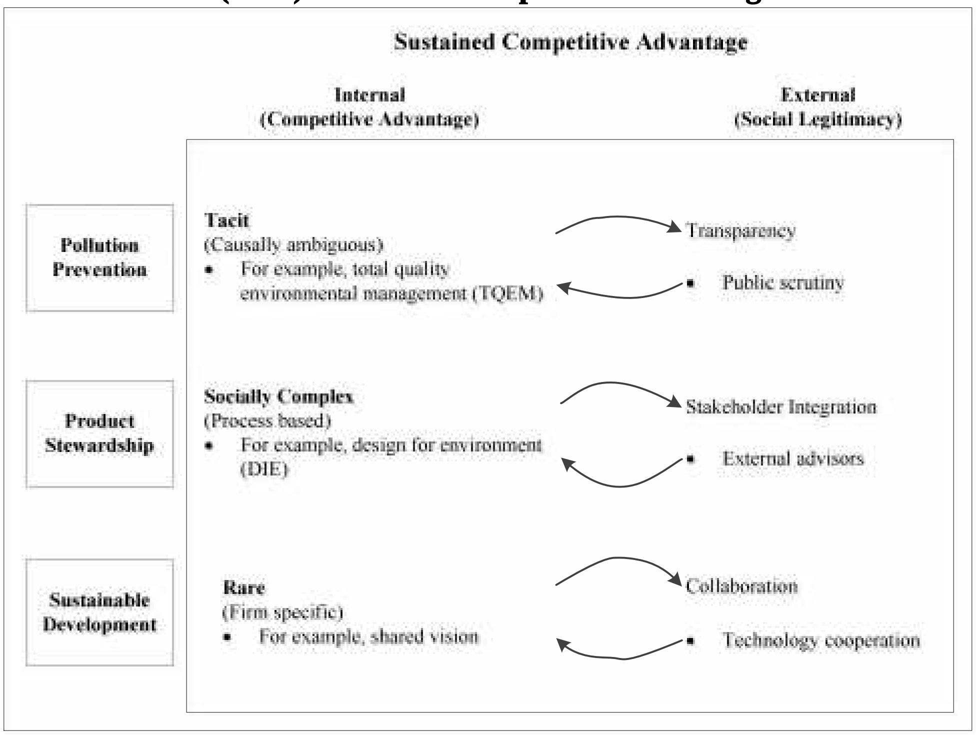


Table 4: Davis, Schoorman and Donaldson (1997) Stewardship Theory and Agency Theory Comparison

Comparison of Agency Theory and Stewardship Theory		
	Agency Theory	**Stewardship Theory**
Model of Man Behavior	Economic man Self-serving	Self-actualizing man Collective serving
Psychological Mechanisms		
Motivation	Lower order/economic needs (physiological, security, economic) Extrinsic	Higher order needs (growth, achievement, self-actualization) Intrinsic
Social Comparison	Other managers	Principal
Identification	Low value commitment	High value commitment
Power	Institutional (legitimate, coercive, reward)	Personal (expert, referent)
Situational Mechanisms		
Management Philosophy	Control oriented	Involvement oriented
Risk orientation	Control mechanisms	Trust
Time frame	Short term	Long term
Objective	Cost control	Performance Enhancement
Cultural Differences	Individualism High power distance	Collectivism Low power distance

Water Risk Response Frameworks

Enterprise Risk Management (ERM)

Corporate water risk is “the probability of an entity experiencing a deleterious water-related event” (CEO Water Mandate, 2014c; Schulte et al., 2011). It is also vulnerability to impacts from uncertainties related to water hazards on a corporations internal objectives or global Sustainable Development Goals (Knight, 2010; Kron, 2005; Purdy, 2 010).

Water stress and scarcity create water risk for all water users. Businesses experience physical, regulatory, and reputational water risks that are likely governed by a company’s risk management framework. ***Enterprise Risk Management*** (ERM) theory states that a continuously improving process of risk management provides a company with competitive advantage, and creates and protects value, among other things (Bissett, 2010; Nocco & Stulz, 2006; Purdy, 2010).

There have been numerous interpretations of risks and risk management (Ernst & Young LLP & Miami University, 2013; Essaides, 2013). Consistent among these interpretations are the factors for effective ERM. The first factor is that a company’s ERM should be based on the risk profile and tolerance of the organization. The second factor is that the ERM should be anchored in the values of the organization. The third factor is that it should take into account human, cultural and environmental factors of the organization in the achievement of objectives. The fourth factor is being stakeholder inclusive, and the fifth is commitment to continual improvement. The ERM process includes risk assessment and risk response/treatment (Ernst & Young LLP & Miami University, 2013; Essaides, 2013).

The risk management works cited above also indicate various risk response options based on the corporation's risk appetite. They suggest that corporations with lower risk appetite are likely to opt for risk avoidance. As the tolerance for risk increases, the treatment may change to conservative risk taking or risk reduction. Other corporations may opt for risk transfer, justified risk taking, i.e., accepting risk through informed decision-making and monitoring, or a combination (EisnerAmper, 2016; Kleindorfer & Saad, 2005; Purdy, 2010). ERM theorists further posit that as a firm's ERM program matures, there is progression from reactive to tactical to more strategic decisions aimed at long-term value creation and protection (Beasley, Clune, & Hermanson, 2005; Bissett, 2010; Liebenberg & Hoyt, 2003; Verbano & Venturini, 2011). Long-term strategic choices are usually more difficult and costly to implement and the value or return on investment while not necessarily less, are more difficult to quantify in monetary terms, according to these sources. This was reflected within the context or water risk by Larson and colleagues' (2012) Water Risk Response Spectrum.

Water Risk Response Spectrum

Larson, Freedman, Passinsky, Grubb, & Adriaens (2012) ***Corporate Water Risk Response Spectrum (WRRS)*** show that businesses responses to water risk may range from hedge mechanisms on the left to enhancing water supply on the right range as shown in Figure 4.

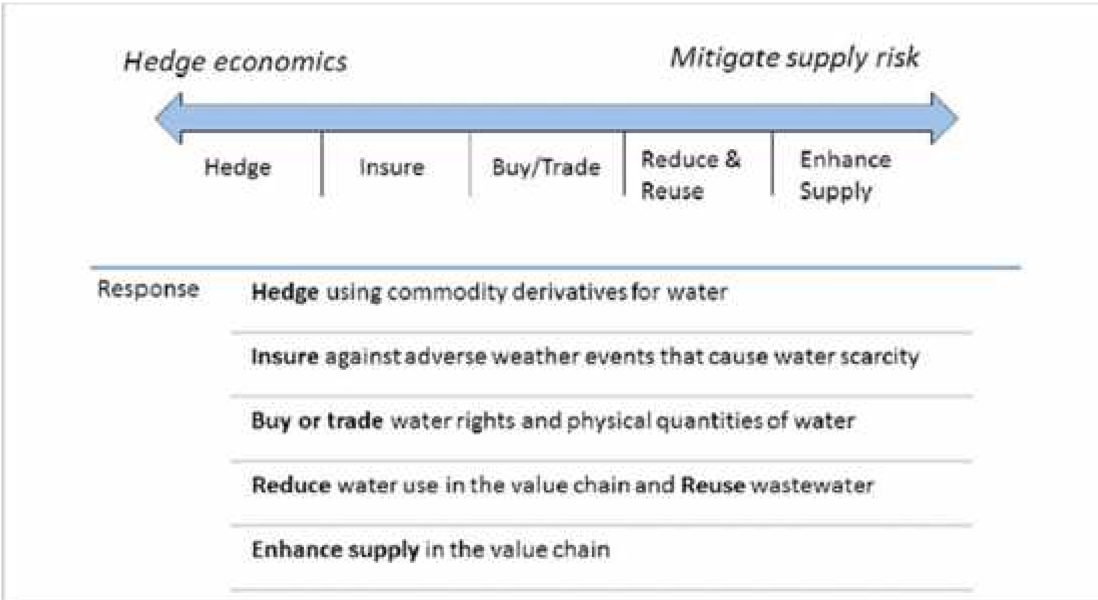


Figure 4: Larson et al. (2012) Corporate Water Risk Response Spectrum

The WRRS indicates that water risk response decision-making include risk avoidance to risk sharing using financial tools such as hedging and insurance as depicted in the left segment of the spectrum. The authors posit that for short-term risks, due to extreme events that disrupt business and profits, market-based mechanisms such as hedging, are common responses among businesses. One example is the use of weather derivatives to financially hedge against physical water risks, by optimizing growing seasons across a company's footprint, based on weather predictions. Weather derivatives instruments include the Chicago Mercantile Exchange with the Rainfall Index and Cooling Degree Day Index. Larson et al. (2012) however argue that while hedging is effective in mitigating financial risks (effect of changes in costs, harm from reduced water supplies or disruption in the supply chain), it does not protect economic productivity. They also argue that the uncertainties and variability in weather make it difficult to predict and price weather options.

Insurance is the second response option on the spectrum. Increases in extreme weather events necessitate new forms of insurance that protect against weather volatility, e.g., rainfall insurance based on rainfall amounts recorded for a specific location. Zeuli and Skees (2008) highlighted insuring against losses due to declines in the rainfall index within a geographic grid. The Rainfall Index Insurance - Pasture, Rangeland, Forage (RI-PRF) is one example of this response (as cited in in Larson et. al., 2012, p. 309). Larson et al. (2012) also pointed out that RI-PRF and other indices assist local farmers in forward pricing of water giving them the ability to plan and invest in water conservation technologies. The authors argue that while insurance protects against economic production losses, it does not mitigate long-term water scarcity and water sustainability. They further note that climate change impacts such as increases in extreme weather events, and the effects of El Nino Southern Oscillation (ENSO) on weather patterns make predictions difficult and increase the probability of errors.

In the middle of the spectrum is buying, selling or trading of water rights. This is identified by Easter (1999) as an economic response to scarcity to promote “a more efficient allocation of water among competing users” (as cited in Larson et al. (2012) p. 310). In this approach, users purchase rights and implement efficient water use practices so that they can trade these rights to other users. Larson et al. (2012) note that agricultural users in general are the sellers as they have “more generous water rights and pay less than municipal and industrial water users” (p. 310). Water trading is said to be effective in water scarce or stressed areas with increasing competition, as it enables a company to secure supply. Water trading is also known to incentivize water efficiency as users can profit from selling a part of their allocation. As an example, Larson and colleagues (2012) stated that water trading was found to be one of the key factors influencing investments in irrigated agriculture infrastructure in the Murray-Darling basin (MDB).

Similar to hedging and insurance, water trading does not provide "absolute protection" against water risk as trading is not possible if there is not enough water (Larson et. al. (2012) p. 311). Buying and trading water rights require a well-developed system of rights, and the institutional and legal capacity to enforce trades to ensure low transaction costs. These entrance criteria for efficient water rights training is a challenge for developing countries with no established water rights systems, and/or limited institutional and legal capacity. These countries are also more likely to have corrupt and unjust water trading regimes. Externalities to the market, such as the social and environmental implications of water trading, would also be difficult to incorporate, according to Larson et al. (2012). Issues of equity and trust, and the potential for conflict when reallocation negatively impacts the public and other users, are associated with water trading. Water trading is limited by geography, and is hence region-specific. It is believed that in regions with monopolistic or oligopolistic controls over water withdrawals, and weak governmental controls, a market mechanism would not be viable. Water allocations are often reduced in extreme droughts to levels below rights allocation leaving little to trade. This dearth in water allocations have been the source of conflict in the southwestern U.S. where the courts have decided cases between water rights and in-stream flow to protect endangered species (Benson, 2004).

The fourth option in the spectrum addresses water risk through internal, operational actions to reduce, recycle and reuse water and improve wastewater quality. Measures may include water efficiency and conservation, and operational changes to reuse water among others. This option is of highest utility for companies with high water risk where it is economically feasible (WWF Germany and DEG, 2011 in Larson et al., 2012). The problem with this approach is that it focuses on internal operations, while for many companies, indirect water use in their supply chains accounts for the largest proportion of their water footprint. This option involves demand-side initiatives and does not address supply-side water risks. Companies must go "beyond their fence" in order to effectively mitigate water supply risks and "ensure adequate resource to meet future needs" (CDP, 2013b; Larson et al., 2012; Money, 2014; WWF, 2013). There is evidence that many companies have begun to work with their suppliers to improve water practices, reduce demand, and improve wastewater quality throughout their value chain (CDP, 2013b; Larson et al., 2012).

At the far-right end of the spectrum are externally focused actions designed to "enhance overall water supply in the aquifer and watershed." These may be undertaken by the individual company, however Larson et al. (2012) noted that a stakeholder-inclusive process is the preferred approach, e.g., working with governments and policy makers to influence change at the regional or watershed levels. Engaging local communities and improving their access to water, e.g., Diageo's 'Water for Life' initiative and empowering communities with the knowledge and training on best practices and technologies are examples of actions in this response option. While this option is thought to be best for long-term outcome, there are also challenges associated with it. Companies may have little control over external stakeholders, identifying appropriate projects within the company's zone of influence can be difficult, and projects are generally time-consuming, long-term and costly. There is also the challenge of public perception, for example, that companies are "green washing" to mask their negative impacts. Building trust through transparency and accountability is therefore an important strategy for a company's social license to operate which is predicated on perceptions of the company (Davis et al., 1997; Schulte et al., 2014). Reducing internal demand and enhancing external water supply are consistent with the stewardship approach and will help overcome negative public perceptions. The Coca Cola Company's (TCCC) Replenish Project is an example of action at this end of the spectrum. Replenish is aimed at water conservation, community water availability, and restoration and enhancement of water quantity and water quality (TCCC, 2012 as cited in Larson et. al., 2012).

A water risk response decision-making framework presented with the WRRS suggests that water risk mitigation strategy is a function of:

- the objective of the company's short-term versus long-term goals and that the type of risk;
- the cost to implement the action;

- the effectiveness of the action in mitigating the risk (measured as a percentage of projected economic loss form water risk addressed by the response), and ;
- the feasibility of the action—level of difficulty and time required to implement (Larson et al., 2012).

The authors argue the following which were adopted in the CWRRS conceptual framework discussed above:

- When both water shortfall and value-at-risk are high, a more aggressive mitigation strategy towards stewardship should be pursued;
- When water shortfall and the value-at-risk are both small, hedging would be more appropriate;
- Multiple strategies are most effective when there are multiple risks and the differences in the cost, effectiveness and feasibility are not clear.

My analysis of the water risk response spectrum and the water risk decision framework show that the multi-pronged approach is likely the case where there are more than one type of risks (physical, regulatory, reputational), where water risks are high, and where risks are shared across multiple sectors (civil society, government). Similarly Larson et. al. (2012) argue that effective responses to short-term physical water risks would be targeted at internal actions while long-term water risk response would be geared towards the external stakeholder engagement and stewardship end of the spectrum. The issue with the latter is that while short-term risks and benefits are easily quantified, long-term risks and benefits are not. A standard return on investment based on implementation cost and amount of risk reduction would likely result in short-term reactive or tactical actions and not the strategic CWS response.

Corporate Water Stewardship Frameworks

CEO Water Mandate Framework for Action

The CEO Water Mandate ("The Mandate") established in 2007 by the United Nations Global Compact is one of the early proponents of corporate water stewardship. The Mandate was created to acknowledge global water challenges create risk for a wide range of industry sectors, the public sector, local communities, and ecosystems alike (CEO Water Mandate, 2015).

The Mandate is rooted in the belief that cross-sectoral collaboration amongst shared water goals is the most effective path to more sustainable water management, and that private sector participation can be a critical partner in this effort. Corporations endorse the Mandate by committing to implementing its six elements – (1) Direct Operations, (2) Supply Chain and Watershed Management, (3) Collective Action, (4) Public Policy, (5) Community Engagement, and (6) Transparency through individual and collective action.

The Mandate developed a *Framework for Action towards Stewardship,* which conveys a six-step water risk management process (Figure 5). The process starts with assessing water usage and discharge. The second step involves assessing external risks (value chain and watershed), followed by creating a plan of action to improving internal water use and discharge behavior. The fourth step involves collaborating with external stakeholders to mitigate water risks while the fifth and sixth steps are accountability and transparency through ongoing engagement and communication. A core message of the Mandate relevant to the current research is the notion that CWS actions must be aligned with broader global objectives, such as human rights and United Nations Sustainable Development Goals (SDGs). The Mandate and other proponents believe that through this alignment with the SDGs, CWS will contribute to mitigating water risks for all water users (both human and environment) (CEO Water Mandate, 2014b; CEO Water Mandate et al., 2015)

Figure 5: CEO Water Mandate (2014) Framework for Action towards Water Stewardship

Sarni's Water Stewardship Strategies

Another early work on CWS is Sarni's (2011a) *Corporate Water Strategies*. He argues that companies should consider water stewardship strategies that include assessing enterprise-wide water footprint, stakeholder engagement, direct and indirect water use reduction, revaluation of water costs to reflect its "true value, risk assessment and transparency in communications" (Sarni, 2011b). He proposed "a strategic combination of preservation, innovation and engagement" in interlocking spheres depicted in Figure 6. Preservation is aimed at reducing impact through watershed protection and water infrastructure repairs, while the other spheres involve engaging stakeholders outside of the company and creating or adopting new technologies to overcome water challenges through innovation (Sarni, 2013). Several examples of each are also depicted in the graphical depiction of stewardship strategies. Examples include Ecolab's dry conveyor belt lubricant that preserves water resources, and Ford's research partnership with Georgia Institute of Technology as a stakeholder engagement practice. He also highlights FEMSA's (Fomento Economico Mexicano, SA) initiative in Latin America that makes social investments in communities as the CWS case. FEMSA focuses on solutions that address conservation and sustainable use of water resources while improving the quality of lives for all.

In 2014, Sarni, in a presentation to the International Society for Sustainability Professionals (ISSP) highlighted that there is a link between water and business growth. He suggests that corporate strategy evolves from (1) no strategy to (2) a license-to-grow-strategy, to (3) a "social license-to-grow-grow" (Sarni, 2014). He noted that increasing the corporation's engagement in and leading collective action programs, in addition to investing in preservation and innovation, fosters maturing from second to the third stage. Sarni's work provided real world examples of water management and stewardship strategies and actions among corporations in response to water risks. This research will further explore corporate CWS actions and its relationship with water risk.

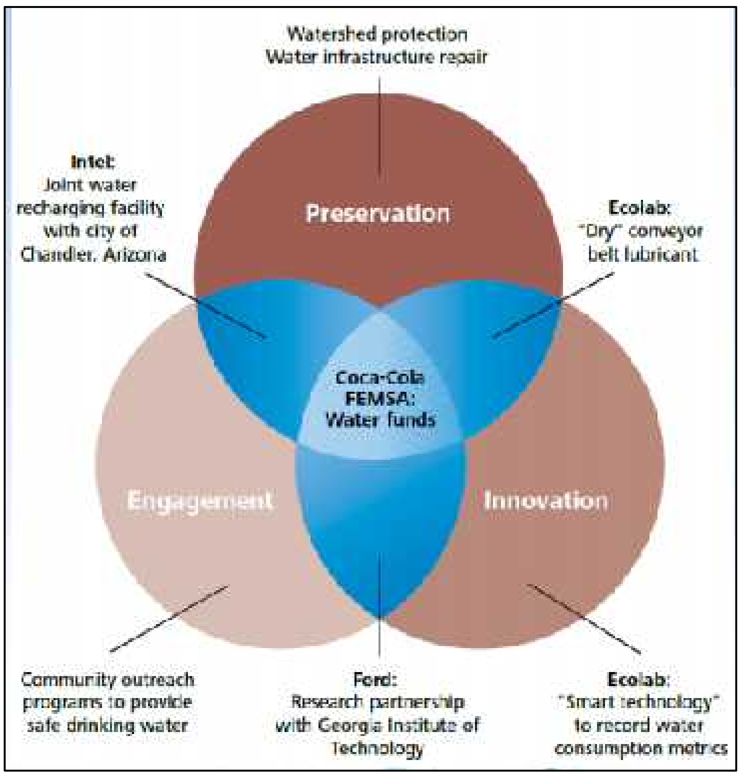


Figure 6: Sarni's (2013) Effective water stewardship strategies

World Wildlife Fund Water Stewardship Steps

Another depiction of CWS is the World Wildlife Fund for Nature (WWF) *Stewardship Steps: Theory of Change* (Figure 7). The WWF Stewardship Steps shows that stewardship is achieved in steps that progress from awareness to influencing governance, similar to the Mandate's steps to stewardship action (Orr et al., 2009; WWF, 2013). The WWF Stewardship Steps are also consistent with the NRBV's progression based on firm's capability and achieving the steps in the AWS Stewardship process.

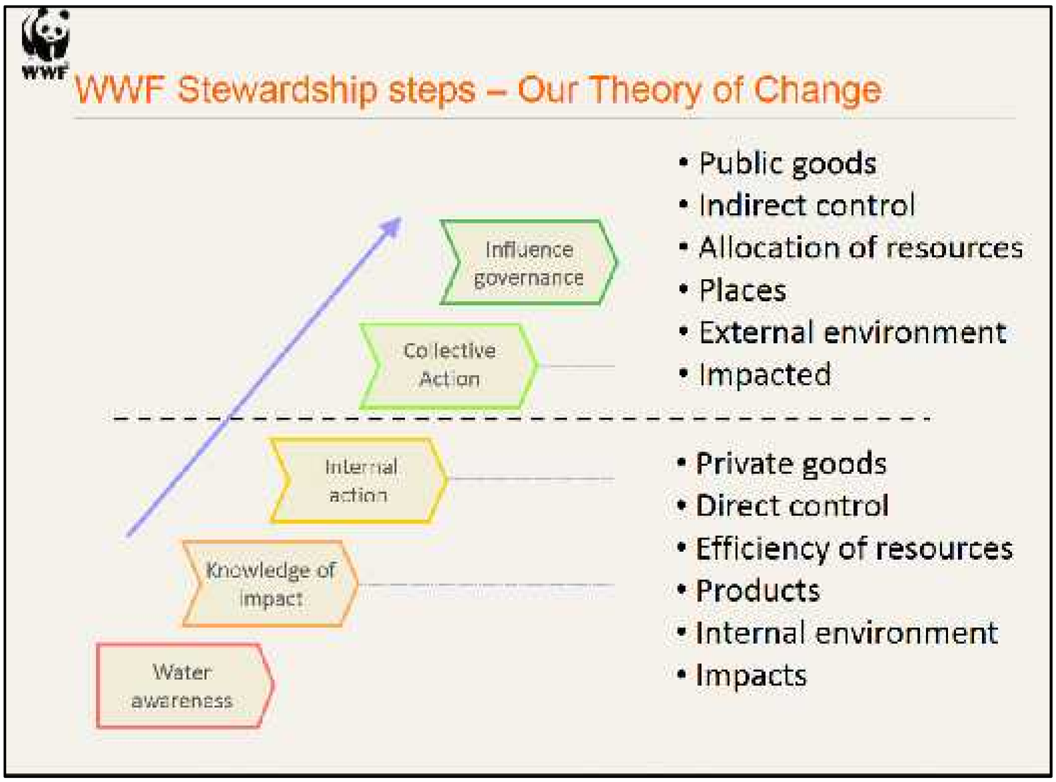


Figure 7: World Wildlife Fund Stewardship Steps, Adopted from (Orr, 2014)

The first step in the WWF strategy is awareness building. It is noted that this step leads to an understanding of water-related risks. Obtaining knowledge of the impact of the risk on the business is the second step which enables internal action to mitigate the risks (step three). These steps are noted to be in the direct sphere of influence of the company, assess the impacts the company has on water resources, and the efficiency of its operations. It is about the products individual companies source and sell, private goods and value created, and risks faced by these companies. Collective action (step four) involves engagement with external stakeholders and is evidence that the company thinks this is a necessary strategy. The fifth and final step is influencing governance, in which the company through stewardship, support the political, social, economic and administrative systems that develop and manage water resources, e.g., through advocacy and outreach. Steps four and five are outside the direct sphere of influence of the company. They focus on external water resources, its impact on the company, and the company's access to water. They involve public goods rather than private goods, consider shared risk, and the values of the wider public, and not just that of the company. WWF (2013) suggests that risk and uncertainty should be the primary motivating factor for a company's decision to engage in water policy, but cautioned that this in turn exposes the company to additional risks from public perception of policy capture or using their influence to gain at the expense of others. Transparency and judicious approach were recommended to overcome reputational risks associated with private sector action in water governance. This framework supports the current study's hypothesis that water risks influence CWS practice among global corporations.

Alliance for Water Stewardship (AWS) International Water Stewardship Standard

While the theoretical frameworks examined above define CWS and point to some characteristics of CWS within current global water context, the AWS International Water Stewardship Standard (AWS Standard), which was launched in April 2014, is the first framework to provide a comprehensive set of procedures, criteria and indicators for assessing and measuring CWS practice. The AWS Standard was developed to guide private and public sector entities committed to water stewardship. The Standard aims to achieve four outcomes, namely (1) good water governance, (2) sustainable water balance, (3) good water quality status, and (4) healthy status of important water related areas (IWRAs). It provides a detailed six-step guide to water stewardship based on a continuously improving model with a points-based performance rating system, shown in Figure 8 (AWS, 2014, pp. 9–11). The AWS Standard was also developed as the basis for conformance under AWS verification and certification system. This research is independent of the AWS' self-verification and certification system. The AWS identifies 14 registered sites currently undergoing verification for certification under the AWS Standard. In addition, there are three sites certified as fully conforming to the AWS Standard. Five of the corporations included in this study have certified or registered. Of these two companies have certified sites while an additional three different companies have six registered sites. Although a small number, this is further evidence of corporation's engaging in CWS. An overview of the steps and their importance to CWS is described below.

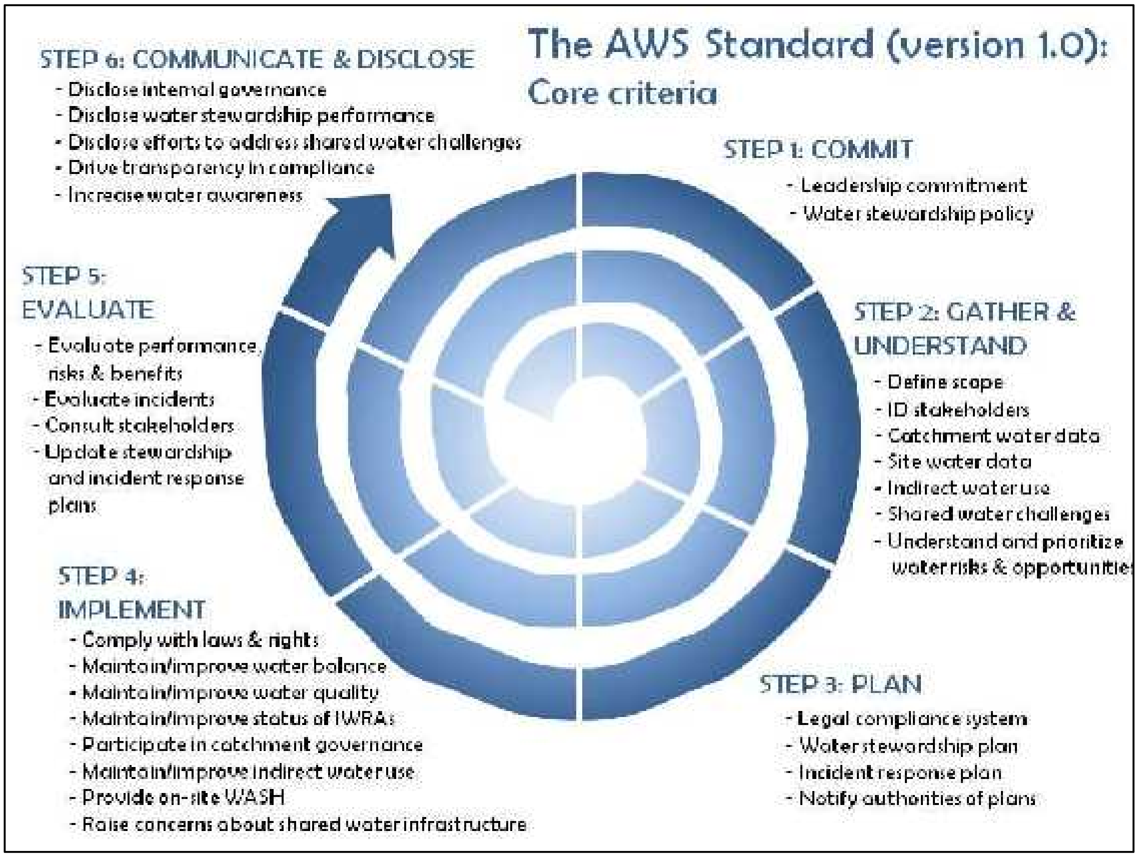


Figure 8: AWS Standard (version 1.0)

Step one of the Standard - ***Commit*** - is aimed at demonstrating commitment to CWS. The AWS Standard identifies having a water stewardship policy as one indicator of this commitment. The intent of such a policy is to serve as a guide to the company's stewardship approaches and resources (p. 52), and ensure consistency between sites. The stewardship policy should be in effect for multiple years.

Step two - ***Gather and Understand*** - has multiple components that enables corporations to understand their existing water behavior, risks and impacts, and identify opportunities to improve the status quo through a stakeholder-inclusive process. This is achieved through risk assessments by defined physical/geographical scope and enables companies to understand water resources and catchments that are affected by their operations, a critical element in water stewardship. At the site level, data on water withdrawal, consumption, discharge and recycling, must be collected.

An understanding of stakeholders water-related concerns and challenges, how the company affects stakeholders and vice versa, is incorporated into this step. This identifies the contextual issues of importance to stakeholders at the catchment level. This is crucial because stakeholder engagement and collective action are at the heart of CWS. Understanding shared water risks, collaborating and acting collectively to mitigate those shared risks, are required to effectively mitigate water risks and create shared value for all users (AWS, 2014, p. 95). At the catchment level, contextual issues such as current and future water regulatory frameworks, status of ecosystems and habitats, water availability, quality and implications for operations, and stakeholder conflict, are considered. "Understanding the corporation's water risk exposure through indirect water use in its value/supply chain is required," in order to mitigate risk and address the resultant redistribution of water risks to other catchments, namely, those where key inputs are sourced (p. 92)

The AWS Standard (2014) states that understanding the site's water risks, along with stakeholders' risks and challenges, provides opportunities to create shared value through collective action. Corporations and stakeholders should work together to achieve shared interests, such as sustainable water resources, and overcome shared challenges, such as water scarcity.

With an understanding of existing water-related issues and potential future scenarios at the site level as well as at the catchment basin gleaned through a stakeholder-inclusive process, companies can now develop a stewardship ***Plan*** (step three). This step is also multipronged. It involves establishing mechanisms that promote and evaluate water-related legal compliance. It requires developing a stewardship plan that when executed, will result in "the benefits of stewardship" (AWS, 2014, p. 95). Employees with direct responsibility for water within a company, including those communicating water stewardship information, are indicators of the company's commitment to water stewardship and proves capacity for engaging in collaborative action. It is anticipated that the employees in higher levels of management in the company, the greater the focus and resources available for executing stewardship actions. The stewardship plan is differentiated from the policy in that the plan has goals and targets against which progress is tracked, usually annually or more often. The plan is expected to outline the strategies for responding to shared water and impacts, and to harness shared water opportunities identified in step two.

The fourth step of the stewardship is to ***implement***, or take action on the policies, plans and strategies developed in the previous steps, in order to meet goals and targets. Compliance with water-related laws in many jurisdictions will mitigate regulatory water risk and support the company's license to operate. The implement step is assessed through fines for breaches levied on companies. Progress towards established targets for water quality, water balance and indirect water use are indicators that a company has been implementing their stewardship plan. Other targets highlighted in the AWS

Standard are access to safe water, sanitation and hygiene (WASH), improving water balance, improving water quality, and stakeholder engagement (AWS, 2014, p. 123). It is expected that water stewards meet some or all targets established towards goals that contribute to improving water balance on site and at the catchment level as well as increasing WASH and stakeholder engagement.

CWS is a process of continual improvement that builds on the existing programs and lessons learned from failure. There is also a need for adaptability to the dynamic complexities of shared water resources and evolving challenges, risks and opportunities. Evaluating performance is essential to this process. The AWS Standard identifies ***Evaluate*** is the fifth step. The evaluation process enables companies to reflect on the successes, effectiveness and efficiencies of their stewardship approaches. This entails reviewing the program from steps one to four and identifying areas that require change and adaptation. The information needed for this step is obtained through gathering and understanding process in step two, then evaluating performance against targets.

The final step in the AWS Standard is ***Communicate and Disclose***. Transparency and "communicating both positive and negative results of water stewardship plan is important to being a responsible steward" (p. 158). This also ties back to communication with stakeholders (internal and external) to facilitate knowledge sharing on shared risks, opportunities and collective action. Communication helps build awareness, understanding and positive trust relationships to mitigate water risks, especially in the case of reputational water risks. Feedback from stakeholders will help improve the approaches to shared water challenges and create shared water value, thus mitigating reputational and regulatory water risk.

The AWS Standard reflects the increasing work of international non-governmental organizations (NGOs) in advocating for collective action and collaborative governance for mitigating water risks and strengthening resource resilience. Measuring, understanding, and mitigating water risks are essential for business continuity, economic prosperity for corporations, as well as society. This is especially crucial in areas with water stress and scarcity and industries heavily dependent on water as a key business input. Global corporations have begun to identify and mitigate their water risks, and are disclosing actions taken. As key stakeholders that use a lot of water, discharge wastewater, and whose assets, products, and services are important to human development, the strategies, tools and resources corporations utilize are important to water governance. Understanding the corporate perspective on water risks, responses to those risks and how these actions fit into governance of water resources and mitigating water risks for all users will contribute to the promotion and advancement of CWS theory and practice.

Conclusion

Corporate water stewardship is a multi-pronged approach to water risks. It implicitly incorporates elements of the resource dependency, natural resource-based view of the firm, and stewardship theories. CWS reflects the far-right end of Larson and colleagues' (2012) water risk response and the ERM maturity spectrums, which are also the strategic responses and mitigation strategies for water risk reduction. CWS requires assessing the risks, quantifying the risks and implementing responses on-site (internal), within the company's supply chain and within the watershed catchment basin from which water is sourced or discharged. Integrating the WRRS and decision framework into the CWRRS framework provided insights into the expected relationship of water risks and CWS among global corporations as depicted in the CWRRS conceptual framework (see Table 2).

While the theoretical constructs of stewardship and CWS discussed above clearly define processes and its desired outcomes, empirical evidence is needed on how the theory is translated into practice by corporations. What factors influence corporations to engage in water governance, for example, which has traditionally been a government or public sector function? The RDT, NRBV and stewardship theories suggest that long-term strategic response, that involves collaboration and cooperative such as CWS, increases the firm's power over its resources, its legitimacy and position in the market, and create value for the firm as well as other stakeholders. However they also indicated that corporations could also gain control in non-cooperative ways and with short-term foresight that benefits only shareholders. Hepworth and Orr (2013); and Kurland & Zell (2010) called this "water securitization for corporations and their shareholders" at the expense of water securitization for all— a conflict with CWS. Corporations may also opt for water risk responses and mitigation strategies that are reactive or tactical and at less strategic end of the spectrum. This raises the question of how physical, regulatory and reputational water risks are related to the components of CWS practiced by global corporations. A deeper examination of the drivers of water risk and the drivers and deterrents of CWS in the following chapter provides some insights and the theoretical framework tested in this research.

CHAPTER THREE: WATER RISKS: DRIVERS, WHO IS AT RISK AND HOW DOES IT RELATE TO CORPORATE WATER STEWARDSHIP?

This chapter presents and discusses pertinent scholarship on water risk and corporate water stewardship, and seeks to gain further insights by exploring the underlying issues and themes related to CWS. First, the drivers of water risk within the context of the groups within society that are exposed to those risks and potential impacts are discussed. This is followed by a discussion of the arguments on how CWS can mitigate water risk. The drivers and deterrents of CWS close out the chapter.

Drivers of Water Risk?

Water stress, scarcity and pollution are examples of water risks. The CEO Water Mandate (2014) and Schulte and colleagues (2011) note that water risk is determined from two perspectives, (1) the basin (supply), and (2) the user (demand). Water risk from the basin perspective is driven by hydrologic, socio-economic, environmental, political and institutional contexts of the catchment basin from which users secure water and discharge wastewater (CEO Water Mandate, 2014b). Water risk from the user perspective is driven by unsustainable water behavior such as inefficient use, insufficient wastewater management, and increasing demands that outpace growth in supply increases water risk (Gassert et al., 2013).

Physical water risk is also referred to as operational water risk as it represents direct risk to operations and production due to exposure to changes in the quantity (too much or too little) and quality (polluted and unfit for use) of water (Hepworth & Orr, 2013; Reig et al., 2013; Schulte et al., 2011). Physical water risk is a function of the demand for water and hydrologic and environmental conditions within the basin. Furthermore, physical water resources are functions of the hydrological cycle, how ecosystems function, as well as the land use and land cover effects on these hydrologic dynamics as well.

Reputational water risk according to Sarni (2011a, 2011b) stems from increasing competition among water users resulting in potential conflict with the public regarding perceived or actual unsustainable use of water. Reputational water risks include abuse of water extraction rights and pollution of water. This is largely dependent on the socio-economic context, especially the community's access to water, as well as the political and institutional contexts. Reputational water risks affect a corporations "right or license to operate," its brand value and market share.

Regulatory water risk stems from the political and institutional contexts within a catchment basin. A driver of regulatory water risk is the inability of current public policy and regulatory initiatives— such as pricing changes, water rights, use/reuse standards and restrictions, and discharge standards— to address water issues (Gassert et al., 2013; Sarni, 2011a). Regulatory water risks also occur when policy and regulatory initiatives are inconsistent, ineffective and/or poorly implemented (Schulte et al., 2011). A key factor is the ability of governments and its institutions (institutional capacity and capital) to effectively manage water resources, water infrastructure and to develop and enforce effective policies and regulations. Hepworth and Orr (2013) argue that reputational water risk drives corporations to protect their legal license to operate through compliance with relevant legislation, and understanding and influencing policies and regulations that are applicable to their operations. Failure of these mechanisms is noted to be more prevalent in the global south of the developing world; however, the global north is not immune.

What is at risk and how are they impacted?

Water risks have social, economic and environmental impacts and the potential to disrupt businesses, governments and civil society or people's lives, as seen in Figure 9 (WWAP, 2012). Businesses, governments, communities and natural ecosystems all share this common pool resource and are jointly exposed to the risks associated with uncertainties in water availability, quality and water-related events. This notion of shared risk is the driving force for many global initiatives for collective action to mitigate water risks and a fundamental underlying principle for this research (CEO Water Mandate et al., 2015; Daniel & Sojamo, 2012; Hepworth & Orr, 2013; WWAP, 2012; WWF, 2013).

Corporate Water Risk: The scope and magnitude of corporations' influence on water resources through water use and discharge— both in its direct operations and throughout its supply chain— is significant. Their dependence on water exposes a large amount of value— in the form of physical infrastructure, products, and social capital— to physical, reputational and regulatory water risks. These, in turn, expose businesses to financial risks.

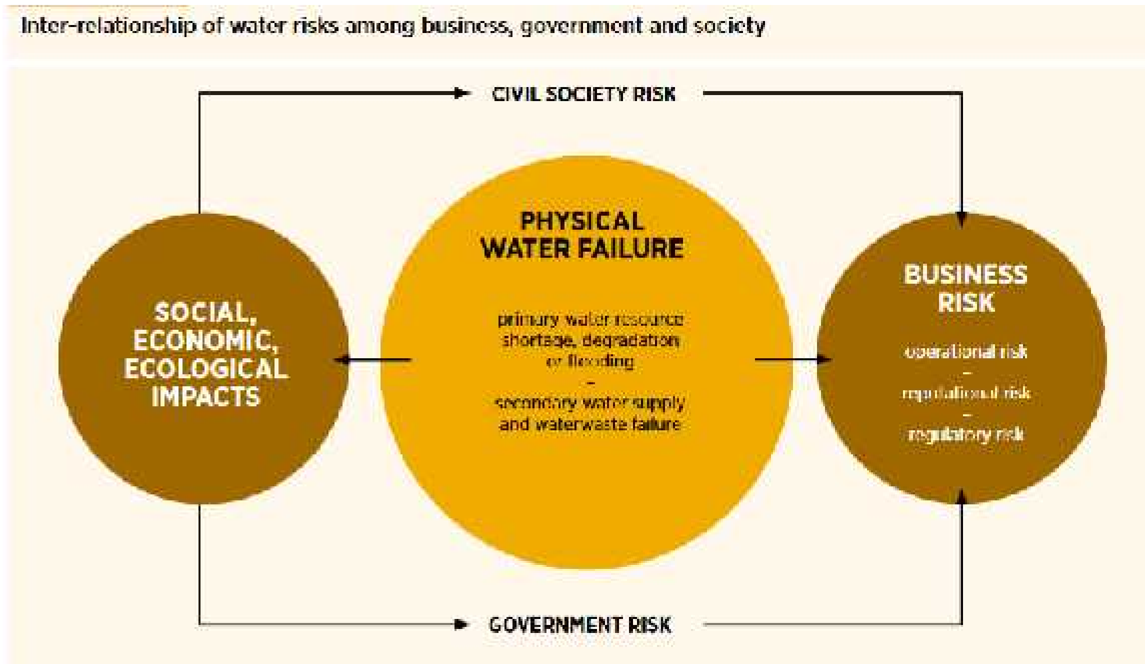


Figure 9: Shared Water Risk, Adopted from (WWAP, 2012) p. 62

Risks vary by industry and sector. Physical risk manifests itself in disruption of operations such as production delays and increased costs due to increased competition for scarce water, as an example (Sarni, 2011b; WBCSD, n.d.).

Sarni (2011b) and World Business Council for Sustainable Development (WBCSD) argue that the magnitude of a company's water risk is a function of its operations, products and services and its water use and discharge behavior. Inefficient water use, insufficient wastewater treatment, and water-intensive production and polluting products are noted to increase a company's water risk (CEO Water Mandate, 2014b). Physical risks are often realized during droughts, for example, water shortages in Texas, India and Brazil, which resulted in high cotton prices. Gap Inc.'s response was to cut production targets (Larson et al., 2012). Similarly, water pollution due to salinization of groundwater in Dar es Salaam impacted SABMiller's beer production (Hepworth, 2008 in Hepworth & Orr, 2013).

Reputational and regulatory risks may affect a company's social and legal license to operate, especially when competing with the community's water needs (public good) or when operations are adversely impact community water supplies. This was seen in India where PepsiCo's and Coca-Cola's bottlers' lost their licenses to use groundwater after community protest against the bottlers triggered by increased competition for local aquifers during drought conditions (Ceres, 2009) cited in (Schulte et al., 2011). In 2015, there was public outcry in California against companies bottling water in-state after residents were forced to reduce their water use after the fourth year of drought (Lobosco, 2015). The report noted that Starbucks bowed to public pressure and said that it would move their bottling operations from California to Pennsylvania. There were reportedly 110 companies bottling water California at the time.

Reputational and regulatory water risks may also result in decreased brand value and consumer loyalty. Companies may lose investors' confidence as well as access to competitive interest rates for capital and insurance premiums. There is also the risk of adverse regulatory responses, such as fees, fines, water reallocations, suspended withdrawal permits, and restricted use. Regulatory water risk also manifests itself in economic water scarcity. Economic water scarcity occurs when inadequate infrastructure —due to lack of capital or poor management practices— limits access to water (Sarni, 2011b; Schulte et al., 2014). This is the case in Jamaica, where water shortages due to poor infrastructure and uneven distribution of adequate water resources across demand centers result in water restrictions in the form of lock-offs in the capital city of Kingston (NWC, 2012, 2014).

There are risks to the health of employees and customers which may result in companies losing markets and products share to competitors, as highlighted by the World Business Council for Sustainable Development (WBCSD, n.d.). While a corporation has control over its direct or internal operations, there are external components of its value chain where a corporation has little to no control. A company's entire value chain may be exposed to water risk when raw materials production, suppliers, and customers are considered (CEO Water Mandate, 2014b). Similarly, at the basin level, there are external risks that are out of the control of corporations. Collaboration and collective action is therefore required to reduce these external water risks (Ansell & Gash, 2008; Araral & Wang, 2013; Franco-García & Bressers, 2010)

Government & Civil Society Water Risk: Governments and civil society are also susceptible to physical, regulatory and reputational water risks (Figure 5). Water risk has potential social, economic and environmental impacts that cut across all spheres of society. Societal water risk is perhaps best depicted through its potential to impact the Sustainable Development Goals (SDGs). While SDG 6 is dedicated to *ensuring water availability and sustainable management of water and sanitation for all*, other interdependent goals, for example, to end poverty and hunger, combat climate change, combat desertification and halt land degradation, and peaceful and inclusive societies, are all susceptible to water risks (CEO Water Mandate et al., 2015; UNDESA, 2015).

Water and wastewater management are essential to achieving a minimum standard of health and improving the lives of the poor and marginalized living in slums (Mehta, 2014; UN Water, 2014). SDG water targets also improve the wellbeing of women and girls. According to Mehta (2014), women and girls have the role of primary water collectors in many areas; traveling long distances to collect water reduces time spent on education and productive activities to improve their livelihoods. This, in turn, creates a risk to inclusive and equitable quality education for all (SDG 4). Educational activities may also be disrupted by water related events such as floods and droughts. In addition, unhealthy children, ill from water borne diseases, for example, will impact enrollment in schools and attendance.

Water risk is a global issue affecting global economy, trade and economic growth. There is growing consensus that international partnerships through collaboration and cooperation are required for implementing strategies and actions to achieve the SDGs (CEO Water Mandate et al., 2015; UNDESA, 2015). SDG 17 calls for global and multi-stakeholder partnerships that mobilize sharing of knowledge, expertise, technology and financial resources to support achievement of the SDGs in all countries (target 17.16). Another target of SGD 17 is to *"encourage and promote effective public, public-private and civil society partnerships, building on the experience and resourcing strategies of partnerships."* This sentiment is reflected in (Finger, Tamiotti, & Allouche, 2006) argument that collaboration and cooperation are effective in governing trans-boundary water resources, as well as recent calls for collective action and stewardship for addressing water issues.

Water risk also has implications for national security and international conflicts. As competition for declining water supplies increase, the potential for conflicts increase. Weak, ineffective policy and regulatory environment, actual or perceived inequity in access and rights to water, mistrust and power relations further exacerbate water risks and conflicts. A notable example was the Bolivia Water Wars in in the 1990s to early 2000s (Goodale, 2006; Haftendorn, 2000; Shultz, 2003). The conflict was spurred by the privatization of water service delivery which reduced access by the poorest segment of society. The conflict resulted in five years of political instability in the country. It was resolved when the government nationalized the water service delivery. Other notable conflicts are those in the Euphrates River watershed where Turkey, Syria, and Iraq have been in conflict since the 1960s (Finger et al., 2006). Conflicts between upstream and downstream water users, and between man and advocates for in-stream environmental flows, have also been litigated in the western U.S. despite a well-established system of rights and allocation (Benson, 2004; Hedman, 2008; Lourie & Schall, 2009). Mitigating water risks is therefore essential to national security, the stability of governments and the health and wellbeing of the population, and the natural environment.

Solutions are needed to assist policymakers and society in mitigating water risks and creating the enabling environment to facilitate this process. CWS has emerged as one mitigation strategy for companies that is also in the public's interest (CEO Water Mandate et al., 2015).

How does CWS mitigate water risks for all (risk response and mitigation)?

The CEO Water Mandate, WWF, and WaterAid (2015) collaborated in a cross tabulation of the elements of CWS with those of SDG 6 to assess the potential contribution of CWS to achieving the goal. They prepared a piece – *Serving the Public Interest: Corporate Water Stewardship and Sustainable Development*, in which they presented their main arguments. They pointed out that companies engaged in CWS are already directly contributing to the targets, and are active in many areas that affect the means of implementation of SDG6. They found that CWS practices of companies contribute to achieving SDG6 and mitigating water risks for all in several ways, as show in Table 5. By understanding basin context and impacts as stipulated in step two of the AWS Standard (Figure 8), companies contribute to data, monitoring and accountability in the implementation of SGD6.

A company's commitment to CWS —demonstrated through the development of a water strategy— builds awareness and capacity for mitigating water risk (AWS, 2014). The CEO Water Mandate et al. (2015) also argue that addressing issues in operations and leveraging their value chain for improvements, enables companies to mitigate water risks through financing, technology and innovation, technical training and public-private partnerships. Collective action may contribute to financing response strategies, building capacity at the community level through engaging multiple stakeholders, and community-level data collection and sharing. CWS via policy engagement aligns to capacity building through contributions to water governance, and sustainable trade policies. It also supports integrated water resources management (IWRM) and the human right for water and sanitation and fosters international alliances for water policy. Finally, communicating with external stakeholders about CWS practices and outcomes contributes to establishing economic value for ecosystem services, natural and social capital, technologies, as well as transparency, integrity and trust among stakeholders and measuring, monitoring progress against targets.

The role of companies was summarized in three key points by the NGOs, the (1) why, (2) how, and (3) what. The authors believe that companies will contribute to addressing the root-causes of water risk, reduce data collection efforts and improve measuring progress and sustainability reporting with harmonized global metrics. This, it was argued, is achieved through the development of clearer standards and benchmarks for CWS, and utilization of best practiced for integrity and transparency when engaging in public policy and collective action. This will also require understanding how CWS goals align with SDG6 targets; advocating for government and civil society involvement in water stewardship, and in high risk areas, engaging in collective action by jointly setting up initiatives.

Although the contribution of CWS to mitigating water risk for all users via SDG6 implementation can be expressed qualitatively, there is limited availability of quantitative measures of the real world impacts of collective action projects and executed CWS initiatives. Hence, information about the contribution of a company or industry to a region or national water goal is limited. To fill this information gap, the NGOs suggested that corporate disclosure should be analyzed and assessed against established CWS frameworks and guidelines. This will harmonize public and private sector metrics and disclosure related to SDG6 targets.

By exploring the linkages between companies' disclosure to the CDP on water risks and their water management and stewardship practices in response to those risks, and the AWS Standard that defines components of water stewardship, this research will contribute to filling this gap. Assigning a CWS score to companies' efforts will provide a quantitative index of their CWS practices that could be used as an indicator of risk mitigation. It also provides insights into the alignment of CWS disclosure and the AWS Standard. While CWS can and has begun to contribute to mitigating water risks for all, companies engaging in CWS also create additional risks for their companies (CEO Water Mandate et al., 2015; Hepworth & Orr, 2013). The following section discusses the underlying issues and themes related to CWS.

Table 5: SDG6 Means of Implementation and Elements of CWS (CEO Mandate et al (2015)

		SDG6 Means of Implementation						
		Finance	**Technology**	**Capacity Building**	**Trade**	**Policy & Institutional Coherence**	**Multi-stakeholder Partnerships**	**Data, Monitoring, and Accountability**
Elements of Corporate Water Stewardship	**Understanding basin, context and impacts**							Risk assessment, local context and impacts
	Developing a water strategy			Sustainability strategy, internal awareness				Product claims, sustainability stories
	Addressing operational issues	Capital expenditures, sustainability research & development	Manufacturing, process and product improvements	Technical Training			Conventional Public-Private Partnerships	Financial statements
	Leverage improvements in the value chain	Venture Financing	Accelerating innovation	Guidance and standards, access to water, sanitation, and hygiene in the workplace	Engagement In emerging markets		Empower suppliers and local stakeholders	Sourcing Data
	Water stewardship via collective action	Social enterprise, co-financing, water funds, philanthropy		Community engagement			Multi-stakeholder collective action	Community-level data collection, data sharing platforms
	Water stewardship via policy engagement			Contribution to water governance	Cross-functional support for sustainable trade policy	Align and support IWRM; respect and support the human right to water and sanitation	International and national alliances on water policy	
	Communicating with external stakeholders	Valuing ecosystem services, natural and social capital	Open-source technology for sustainability				Transparency, integrity in water-related collective action	Sustainability targets, monitoring and disclosure

Drivers of Corporate Water Stewardship (CWS)

Hepworth and Orr (2013) in their chapter titled *Corporate Water Stewardship: Exploring Private Sector Engagement in Water Security* in the EBook version of *Water Security Principles Perspectives and Practices*, described CWS as "the response to the mounting legal, financial, and political duty of care obligations faced by water users to ensure the sustainable use and equitable management of water both within and beyond the 'fence line' of their operations." They attribute corporate water risk as being the primary factor influencing CWS, noting that "water stewardship has become the primary vehicle through which corporate entities are responding to their own and wider societal water challenges".

In *Corporate Water Management*, Schulte et al. (2011) argued that environmentally and socially responsible water management is integral to business viability and reducing business risk, in addition to being a moral responsibility of the company given the environmental, political and social realities of this century. While they referred to corporate water management as a required component of CWS, they also incorporated elements of the more mature "supply chain water management" and most mature stage —"watershed and community water management and governance." For example, they identified risk identification and assessment within operations, operational and employee engagement, supply chain engagement, community engagement and policy engagement, partnership and disclosure as key components of the most mature stage. These components are also key elements of CWS. The arguments they proffer for causes of corporate water management should therefore hold true for CWS. They identified five primary factors motivating corporations to take the strategic decision to proactively manage their physical, regulatory and reputational water risks. These are (1) ensuring the company's legal or social license to operate a specific location; (2) preventing operational disruptions or crises from inadequate supply or quality of water or water-dependent inputs; (3) ensuring business continuity and profitability; (4) upholding corporate values and ethics on sustainable and equitable principles; and (5) gaining competitive advantage over competitors.

They further identified internal and external factors that are in determining the extent and type of risks. Internal factors include the water use and discharge practices of the corporation. They argued that the higher the volumes of water used and wastewater discharged that create impact, the greater the risks, the more likely the company will incur excessive costs, regulatory pressure and stakeholder discontent. The nature of the discharge was also a factor. External factors influencing risk include the hydrological context within which the company operates. Physical water availability creates lower risks as water is available for vital ecosystem services and functions as well as to meet the needs of industry and local communities. In addition to volume, the nature of discharge is also a factor. Water quality is also an external factor.

The environmental, social, political and institutional contexts were also identified as external risk factors. Environmental conditions relate to land use and land cover which influences the hydrological context, while the social context relates to community access to water. Another element of the social context is the perception or reality of a company having access to water when the community lacks access which may lead to reputational damage. Within the political and institutional context is the ability of public water policy and management to “deliver water services, manage their own water-related risks over the long-term, create effective allocation regimes and develop and enforce water-quality regulations” (Schulte et al., 2011, p. 30)

Other researchers such as Money (2014) and Sarni (2011b, 2013), non-governmental organizations and collaborative initiatives such as the 2030 Water Resources Group and CEO Water Mandate also support the notion that physical, regulatory and reputational water risks are primary motivating factors for corporations to engage in CWS (2030 WRG, 2014; CDP, 2013b; UNGC, 2013; WBCSD, n.d.; WWF, 2013).

Uncertainties such as those created by climate change are also drivers of CWS. Climate change is a determinant of physical water availability (volume and quality) and is therefore an important CWS factor. As previously discussed, climate change is expected to change the quantity, quality and availability of water, through changes in the global water cycle (IPCC, 2014; Peter H. Gleick et al., 2011). Renewable surface and groundwater resources are expected to significantly decline in most dry subtropical regions from increased frequency of droughts further intensifying stress. Alternately, flooding will increase in high latitude areas. Increased drought, flooding and sea level rise will reduce the quality of raw water due to interacting factors such as increased temperature and increase sediment, nutrient and pollutant loads. The IPCC (2014) specifically identifies several risks to water resources for which there is “high confidence” based on scientific evidence. These include:

- Breakdown of water supply infrastructure due to extreme weather events (droughts, floods) ;
- Insufficient access to drinking water and irrigation water, reduced agricultural productivity and food security, particularly in low income rural communities and semi-arid regions due to periods of drought ;
- Loss of terrestrial and freshwater ecosystems and the goods, services and functions they provide (including food and livelihoods;
- Small island developing states, other small islands and other low-lying coastal areas, are especially vulnerable to climate change due to storm surges, coastal flooding, seal level rise which will reduce the quality of raw water in these areas.

Although implied in the prior discussion, an overarching motivating factor for CWS and the wider societal water stewardship framework is water securitization for all (Hepworth & Orr, 2013). It has been argued that given the reach of corporations in terms of wealth, power, and geographic range of operations and potential impact on water resources in share volume of withdrawals or impacts from discharge, their engagement in CWS should be significant to water security for the corporation and society (BCtA, 2013; Cooley et al., 2014; Hepworth & Orr, 2013; Larson et al., 2012; Rozza et al., 2013; Sarni, 2011a; Schulte et al., 2014; UNEP, 2012; UNGC, 2013; WEF, 2014). Tregidga & Milne (2006) in their investigation of the organization-environment relationship and perceptions of sustainable development of a New Zealand Water Company, found that engaging in sustainable water management and reporting activities foster organizational change towards more general sustainable development practices. This evolution was noted as a progression over time from 1993 to 2003, and from sustainable resource management to sustainable development practices, suggesting that corporate CWS action benefits all society. The link between CWS and sustainable development is also embedded in the notion of corporate social responsibility (CSR) which is generally mentioned in the context of corporate values, legitimacy, and social licenses.

Corporations have been responding to water and other environmental challenges within the context of their corporate social responsibility (CSR) and sustainability frameworks (CDP, 2013b; Cone Communications & ECHO, 2013). In Carroll (1999) and Wood's (1991) conceptualization of CSR, corporations have four core responsibilities, namely (1) economic, (2) legal, (3) ethical and (4) discretionary/philanthropic, across three domains: (1) the social legitimacy or institutional, (2) public responsibility or organizational, and (3) managerial discretion or individual (**Table 6**). The economic responsibilities of the corporation span wealth creation for shareholders, producing goods, services and jobs for society while minimizing environmental impact. The legal responsibility speaks to regulatory compliance, innovation, and contribution to public policy. Ethical principles include product information disclosure and ethical code of operations, while philanthropic responsibilities embodies the notion of the corporation as a good citizen that contributes to enhancing the communities in which they operate and on which they depend (markets). Additionally, CWS reporting and disclosure is oftentimes contained within CSR and sustainability reporting for the corporation.

Table 6: CSR Model Outcomes (Wood, 1991)

Corporate Social Policy: Sample Outcomes of Acting on CSR Principles Within CSR Domains

	CSR PRINCIPLES		
Domains	Social Legitimacy (Institutional)	Public Responsibility (Organizational)	Managerial Discretion (Individual)
Economic	Produce goods & services, provide jobs, create wealth for shareholders.	Price goods & services to reflect true production costs by incorporating all externalities.	Produce ecologically sound products, use low-polluting technologies, cut costs with recycling.
Legal	Obey laws and regulations. Don't lobby for or expect privileged positions in public policy.	Work for public policies representing enlightened self-interest.	Take advantage of regulatory requirements to innovate in products or technologies.
Ethical	Follow fundamental ethical principles (e.g., honesty in product labeling).	Provide full and accurate product use information, to enhance user safety beyond legal requirements.	Target product use information to specific markets (e.g., children, foreign speakers) and promote as a product advantage.
Discretionary	Act as a good citizen in all matters beyond law and ethical rules. Return a portion of revenues to the community.	Invest the firm's charitable resources in social problems related to the firm's primary and secondary involvements with society.	Choose charitable investments that actually pay off in social problem solving (i.e., apply an effectiveness criterion).

Opportunities for the creation of shared value through mitigating shared risk are also important considerations. As a common pool resource, the shared risk associated with water is very easily understood and perhaps accepted. Shared value is less clear.

Porter and Kramer (2011) stated that "the concept of shared value is to recognize that societal needs, not just conventional economic needs, define markets" (Porter & Kramer, 2011, p. 65). They believe that for businesses to succeed, their communities, i.e., the infrastructure, the people that create and buy their products, the institutions and the environment, must also succeed. They argue that shared value provides strategic advantage to businesses. This implies that, in accepting that water related risks are shared, there should be utility that corporations could perceive and accept that CWS creates shared value for all water users, as well as having long term strategic value to the corporation.

Deterrents to CWS

CWS involves engaging internal and external stakeholders' collective action and influencing governance (Hepworth & Orr, 2013). Private sector engagement in public policy and public decision-making about water can create further risks internally to corporations and externally to other water users. One risk articulated by Buzan (2001) and Turton (2003) is the risk of water securitization for corporations and their shareholders through use of power to gain and/or maintain control of the resource. This is referred to as "policy capture," and is depicted on the left hand side of Larson and colleagues' (2012) water risk response spectrum as shown in Figure 4. The act of or perception of corporations' policy capture, or using their influence to gain at the expense of others, create or exacerbate reputational risks to corporations.

At the core of these issues are concerns about social equity and fear of corporations' obligations to their shareholders, investors and their bottom line overcoming their drive for collective action for the greater good (Hepworth & Orr, 2013; WWF, 2013).

Corporations are not obligated to engage in water risk management beyond their direct sphere of influence or their "fence line." Going beyond may expose corporations to additional risks and costs which conflict with profit maximization goals (WWF, 2013). There are also concerns about the emotional, spiritual, and cultural connections that society makes to water. These fears and concerns are underpinned by general lack of trust and power struggles and corruption. These concerns and mistrust are not unfounded as various authors found inequities at local and international scales (Gaard, 2001; Huber, Viscusi, & Bell, 2008; Jorgenson, 2007; Kurland & Zell, 2010). They found that corporations with money, technology, and power were able to eliminate water pollution in their communities leaving those without exposed. Developing countries with limited financial resources and less mature regulatory and legislative systems had higher instances of water pollution.

The depth of issues of mistrust and power and the negative implications are perhaps most evident in issues related to water privatization. While the context relates to private corporations whose business is water production and distribution, the potential for reputational risks could be similar within CWS contexts. Water privatization has been noted to increase efficiencies in managing and operating water utilities, and reducing corruption, thus the experiences have been one of inequity, social injustice, mistrust ,and power struggles (Assies, 2003; Finnegan, 2002). This was evident in the Bolivia Water Wars which were triggered by privatization of water in Cochabamba, and the ensuing rising water rates. Subsequent water shortages resulted in the poor having no infrastructure and no access to water. Also, those with power were the beneficiaries of state subsidies. This resulted in five years of conflict, with the company losing its license to operate. Similarly, real or perceived situations in which corporations have access to limited water resources while local communities lack adequate access may result in conflicts or corporations losing their social and legal access to water. Unstable political and social situations are also deterrents to CWS (Kelly, Kamp, Gregory, & Rich, 1991; Retzky, 1995).

While more prevalent in the global south, it was also found that developed countries in the North also face this dilemma in relation to water rights and water shortages and its impacts, for example, - Native Americans' water rights in the Western United State (Thebaut, 2009).

Water-related risks have been identified as the primary motivating factor for CWS. However, CWS may also present additional risks to corporations. Interestingly CWS also presents an opportunity for corporations to overcome these reputational issues. This can be achieved through engaging and empowering stakeholders, establishing trust and working toward the collective goal of sustainable water resources for all users and being transparent (Davis et al., 1997; Haboucha, Ambrose, Sarni, & Dray, 2013; WWF, 2013).

CHAPTER FOUR: RESEARCH DESIGN

This chapter provides an overview of the research design. Included in this chapter are the research questions and the hypotheses tested, description of the data and sources, and summaries of the procedures used in the data collection and preprocessing phases and the methodology used in the data analysis. More specific methodology for each phase of the analysis is included in subsequent chapters. Description of the study participants, and selected characteristics relevant to the study are presented at the end of the chapter.

Research questions and hypotheses

The primary aim of this research was to examine the most important factors related to corporate water stewardship (CWS) practice among global corporations. In order to achieve this aim, several research questions were explored. The main research question and hypothesis for this study are:

RQ: What are the most important factors related to corporate water stewardship among the Full Disclosers to the 2014 CDP-IWP?

H: Physical, regulatory, and reputational water risk will explain a significant amount of variance in CWS

The subsidiary questions examined are:

RQ1: **W**hat water risks types (physical, regulatory, reputational) are most prevalent among the Full Disclosers?

RQ2: How are physical, regulatory, and reputational water risks related to company characteristics such as number of facilities at water risk; company revenue; number of employees; sector; and headquarter country economic classification?

RQ3: How are the components of CWS practiced by the Full Disclosers to the 2014 CDP-IWP related to physical, regulatory and reputational water risks?

Data Sources

Publicly disclosed survey data from the Carbon Disclosure Project's (CDP) Investor Water Program (CDP-IWP) was obtained for the study. Each year the CDP targets the largest listed companies in the world as determined by market capitalization, in sectors which water is a material issue (CDP, 2014). *Water Information Requests* are sent to companies listed on several indices including Global 500, S&P 500 and FTSE 100 as well as the largest companies in Australia, Japan and South Africa, annually with responses submitted through the online response system. The 2014 questionnaire was reportedly designed to obtain information aimed at helping corporations and their investors better understand water risks in corporations, in their supply chains, and how these risks are being addressed. The questionnaire was organized into four main themes — (1) current state; (2) risk assessment; (3) water accounting; and (4) response— with more than 50 closed and open-ended questions. See Appendix 1 for a copy of the questionnaire. The CDP (2014b) *Global Water Report* highlighted that that the information obtained from the water disclosure would catalyze more targeted and effective corporate action to safeguard water resources and address the global water crises. The 2014 water information request was sent to 2,200 companies. The CDP reported that 1,064 companies responded to the request, of which 394 companies made responses that were partially public, 327 companies responses were fully public, 144 companies submitted responses that were not made public, and the remainder did not respond or declined to participate (Table 7). Only the Full Disclosers to the CDP-IWP were included in this study. The Full Disclosures represents 31% of participating companies and 15% of 2,200 companies to whom the CDP sent the original survey requests (CDP, 2014b). The data used in this study was sourced by the George Mason University Library in March, 2015.

The CDP open data portal which includes responses to selected questions from 721 companies, was subsequently established in 2016. This data was used to characterize the smaller set of the Full Disclosers, and determine how different or representative of the Partial Disclosers they were from the Full Disclosers (CDP, 2014c, 2014d).

The CDP data was used to compute the physical, regulatory and reputational water risk and the components of CWS – commit, gather and understand, plan, implement, evaluate and communicate and disclose.

Table 7: Completion statistics, 2014 CDP water disclosure survey based on CDP Global Water Report and open data portal

Types of Responses	Number	Response Rate
Number of responses received by the CDP	1,064	
Answered questionnaire but only selected questions made public in open data portal (the Partial Disclosers)	394	37%
Answered questionnaire with full public disclosure, and data available for analysis in this study (The Full Disclosers)	327	31%
No response/declined to participate	199	19%
Answered questionnaire but response was not made public (data not available)	144	14%

Another data source was Gassert, Reig, Luo, & Maddocks' (2013a) *Aqueduct country and river basin rankings* for baseline water stress and the WRI's (2011) Aqueduct Atlas. This data was used to validate companies' claims to water risk exposure in water stress river basin. The lists of river basins within which companies reported having facilities were cross-referenced with Gassert, Reig, Luo, & Maddocks' (2013a) Aqueduct country and river basin rankings for baseline water stress. The number of facilities within river basins confirmed in The Aqueduct Atlas was used to assess the relationship between water risk type and facilities at risk.

Other key variables used in the study were 2014 annual revenue (millions of U.S. dollars), and number of employees by companies. These data were obtained from two main sources, namely *Compustat Global –Fundamentals Annual database* managed by the WRDS-Wharton Research Data Services (2016), and *Mergent Online Company USA and International database* (2016). Gaps in the data were filled, and data were validated by text analysis of 2014 Annual Reports, and SEC company filings. Reports were accessed via web searches. Finally, *the AWS International Water Stewardship Standard*: version 1.0 provided the requirements for measuring CWS (AWS, 2014).

Data Preparation Procedures, Creation of Company Water Risk and CWS Dataset and Data Analysis

The CDP water disclosure data was provided in a Microsoft Excel workbook containing 52 spreadsheets with the data organized by responses, sections, questions and sub questions. Companies were classified by industry and global market index (FTSE 100, S&P 500, Global 500, etc.). The selection of survey questions used in this research was based on the linkages between the CDP water disclosure and the *AWS International Standard for Water Stewardship*, discussed in Chapter 2. A copy of the questions and corresponding AWS requirements is provided in Appendix 2. Specific analyses for each research question are also provided in subsequent chapters.

Description of participating companies

A total of 327 organizations provided full public responses to the 2014 CDP_IWP water questionnaire and are included in this study. As mentioned, 144 companies submitted responses that were not made public, and 394 companies submitted responses that were made partially public on the CDP open data portal. Variables that were common to the group of companies with partially public responses were compared to those with full public responses for characterization.

Organizations in this study belong to 10 sectors, 22 industry groups and 52 industries (Table 8). Materials and consumer staples are the most represented sectors accounting for 20% and 15% of responding companies, respectively. Information technology (14%), industrials (13%), consumer discretionary (11%) and healthcare (11%) rounded off the top five represented sectors. The industry groups with highest representation are materials (20%), food beverage and tobacco (11%), capital goods (11%), technology hardware & equipment (8%), and pharmaceuticals, biotechnology and life sciences (8%). When number of organizations by sector in this study is compared to the companies with partially public responses in the open dataset, the top four represented sectors were the same though in different order. In the partially public dataset consumer discretionary accounted for 30% of organizations followed by consumer staples (29 %) and Materials (19%). Industrials (11% and Information Technology (4%) completed the top five sectors represented in the open dataset (Table 9). Consumer staples and consumer discretionary sectors are underrepresented among The Full Disclosers' responses with differences of 14% and 19%, respectively (CDP, 2014d). Materials and financials sectors are equally represented in both datasets while the remaining five sectors are overrepresented in the public responses dataset. The number of companies by industry group and industries were not included on the open data portal. A chi-square test of association was performed to determine whether or not there were significant differences between the datasets based on sector. A significant relationship was observed between sector and the type of responses submitted to the CDP, indicating that the there are differences between the two groups, χ^2 (9, N=659) = 114.93, $\rho<0.001$.

Table 8: GISC Sector and Industry Group of 2014 CDP-IWP Full Disclosers

GICS Sector	Percent Sector	GICS Industry Group	Percent Industry Group
Materials	20%	Materials	20%
Consumer Staples	15%	Food, Beverage & Tobacco	11%
		Household & Personal Products	2%
		Food & Staples Retailing	2%
Information Technology	14%	Technology Hardware & Equipment	8%
		Software & Services	3%
		Semiconductors & Semiconductor Equipment	3%
Industrials	13%	Capital Goods	11%
		Transportation	1%
		Commercial & Professional Services	1%
Consumer Discretionary	11%	Automobiles & Components	4%
		Retailing	2%
		Consumer Durables & Apparel	2%
		Consumer Services	2%
		Media	1%
Health Care	11%	Pharmaceuticals, Biotechnology & Life Sciences	8%
		Health Care Equipment & Services	3%
Energy	7%	Energy	7%
Utilities	7%	Utilities	7%
Financials	1%	Banks	0.3%
		Real Estate	0.3%
Telecommunication Services	1%	Telecommunication Services	1%
To be Categorized	0.3%	To be Categorized	0.3%
Total	100%		100%

Table 9: Percent of Full and Partial Disclosers by Sector

GICS Sector	Percent of Full Disclosers (n=327)	Percent of Partial Disclosers (n=333)
Materials	20%	19%
Consumer Staples	15%	29%
Information Technology	14%	4%
Industrials	13%	11%
Health Care	11%	2%
Consumer Discretionary	11%	30%
Energy	7%	2%
Utilities	7%	0%

GICS Sector	Percent of Full Disclosers (n=327)	Percent of Partial Disclosers (n=333)
Financials	1%	1%
Telecommunication Services	1%	1%
To be Categorized	0.3%	0%
Total	100%	100%

The Full Disclosers were headquartered in 31 countries compared to 45 countries among the Partial Disclosers. However the countries common to both datasets represent 90% of the Partial Disclosers and 100% of the Full Disclosers. There were four countries represented in the study data that were not represented among the Partial Disclosers. The reverse scenario had 18 countries with headquarters of the Partial Disclosers not represented among companies that made Full Disclosers. The United States of America (USA), Japan and the United Kingdom were the three most represented countries accounting for 61% of the Full Disclosers compared to 33% of the Partial Disclosers (Table 10).

The response rates for this study varied by headquarter countries as shown in Table 11. For the purposes of this study, the headquarter countries were also characterized based on the United Nation's *World Economic Situation and Prospects' (WESP)* classification of the economies of the countries (United Nations, 2016). The data show that companies with headquarters in developed countries were more likely to make full public disclosure about their water use and stewardship behaviors than those with headquarters in developing or transitioning economies. This was evident in the distribution of country headquarters by their economic status. Eighty four percent of the full Disclosers had headquarters in developed economies compared to 59% of the Partial Disclosers. Companies with headquarters in developing countries account for 16% of the Full Disclosers while less than one percent (1%) had headquarters in transitioning economies. Among the Partial Disclosers, developing economies accounted 41% of companies, while less than one percent was in transitioning economies. The differences between the partial and full Disclosers were significant, χ^2 (2, N=659) = 54.20, $\rho<0.001$.

Companies were also categorized by the market index and other water groups on which they are listed. Fifty four percent of companies were listed on the Global Water 500 (29%), Global S&P 500 (25%), while 14 percent were listed as self-selected companies (Table 9). CEO Water Mandate Endorsers, Water Japan, FSTE 100, Water South Africa, Water Australia and Water India were other indices to which companies belong.

Exposure to water risks was reported by both groups of companies. Sixty five percent (65%) of the Full Disclosers reported being exposed to water risk in their operations and supply chain and/or direct operations compared to 31% of the Partial Disclosers. Similar to sector and headquarter country economic status, chi-square showed significant differences in exposure to water risk based on the type of disclosure, $\chi2$ (4, N=580) = 76.38, $\rho<0.001$.

Examination of the companies that participated in the 2014 CDP-IWP showed that companies can be categorized based on the type of responses. Data were available for two groups of companies, those that submitted full public responses and companies for which only responses for a limited number of question were provided in the CDP open data portal. Comparison of the two data sets based on common variables showed significance differences between companies with full public responses and those with partially public responses. It is assumed that companies that provided non-public responses would also be different. The data required for a robust investigation were only available for the Full Disclosers. This research was hence limited to only the Full Disclosers.

Table 10: Headquarter Country of 2014 CDP Water Participating Companies (Full and Partial Disclosers)

Country	Percent of Full Disclosers N=327	Percent of Partial Disclosers N=394	Country	Percent of Full Disclosers	Percent of Partial Disclosers N=394
USA	40%	24%	Singapore	1%	0.3%
Japan	13%	5%	Indonesia	1%	0.3%
United Kingdom	8%	4%	Israel	1%	0.3%
South Africa	7%	3%	Portugal	1%	0.3%
India	4%	7%	Hong Kong	0.0%	0.3%
Australia	4%	1%	Colombia	0.0%	0.3%
France	3%	2%	Turkey	2%	0.0%
Canada	2%	4%	Austria	1%	0.0%
Switzerland	2%	3%	Korea	1%	0.0%
Germany	2%	5%	Egypt	1%	0.0%
Spain	2%	4%	Denmark	1%	0.0%
Netherlands	2%	1%	Malaysia	1%	0.0%
Ireland	1%	0%	Argentina	1%	0.0%
Brazil	1%	3%	United Arab Emirates	1%	0.0%
Finland	1%	1%	Greece	0.3%	0.0%
Belgium	1%	0.3%	British Virgin Islands	0.3%	0.0%
Taiwan	1%	6%	Philippines	0.3%	0.0%
Mexico	1%	2%	Slovakia	0.3%	0.0%
Italy	1%	2%	Paraguay	0.3%	0.0%
Russia	1%	0.3%	Luxembourg	0.3%	0.0%
Bermuda	1%	0.0%	Oman	0.3%	0.0%
Norway	1%	0.0%	Thailand	0.3%	0.0%
China	0.3%	8%	Vietnam	0.3%	0.0%
South Korea	0.3%	3%	Chile	0.3%	0.0%
Sweden	0.3%	1%			

Table 11: Number of Companies by Country of Headquarter (Public Responses and Open Data)

Country	Number of Partial Disclosures N = 394	Number of Full Disclsoures N = 327	Total (All Open Data) N = 721	Country	Number of Partial Disclosures N = 394	Number of Full Disclsoures N = 327	Total (All Open Data) N = 721
USA	96	131	227	Singapore	3	1	4
Japan	20	44	64	Indonesia	2	1	3
United Kingdom	16	27	43	Israel	2	1	3
South Africa	10	23	33	Portugal	2	1	3
India	26	12	38	Hong Kong	0	1	1
Australia	3	12	15	Colombia	0	1	1
France	6	11	17	Turkey	8	0	8
Canada	15	8	23	Austria	5	0	5
Switzerland	11	8	19	Korea	5	0	5
Germany	21	6	27	Egypt	3	0	3
Spain	14	6	20	Denmark	2	0	2
Netherlands	5	5	10	Malaysia	2	0	2
Ireland	1	4	5	Argentina	2	0	2
Brazil	10	3	13	United Arab Emirates	2	0	2
Finland	2	3	5	Greece	1	0	1
Belgium	1	3	4	British Virgin Islands	1	0	1
Taiwan	25	2	27	Philippines	1	0	1
Mexico	9	2	11	Slovakia	1	0	1
Italy	7	2	9	Paraguay	1	0	1
Russia	1	2	3	Luxembourg	1	0	1
Bermuda	0	2	2	Oman	1	0	1
Norway	0	2	2	Thailand	1	0	1
China	32	1	33	Vietnam	1	0	1
South Korea	11	1	12	Chile	1	0	1
Sweden	4	1	5				

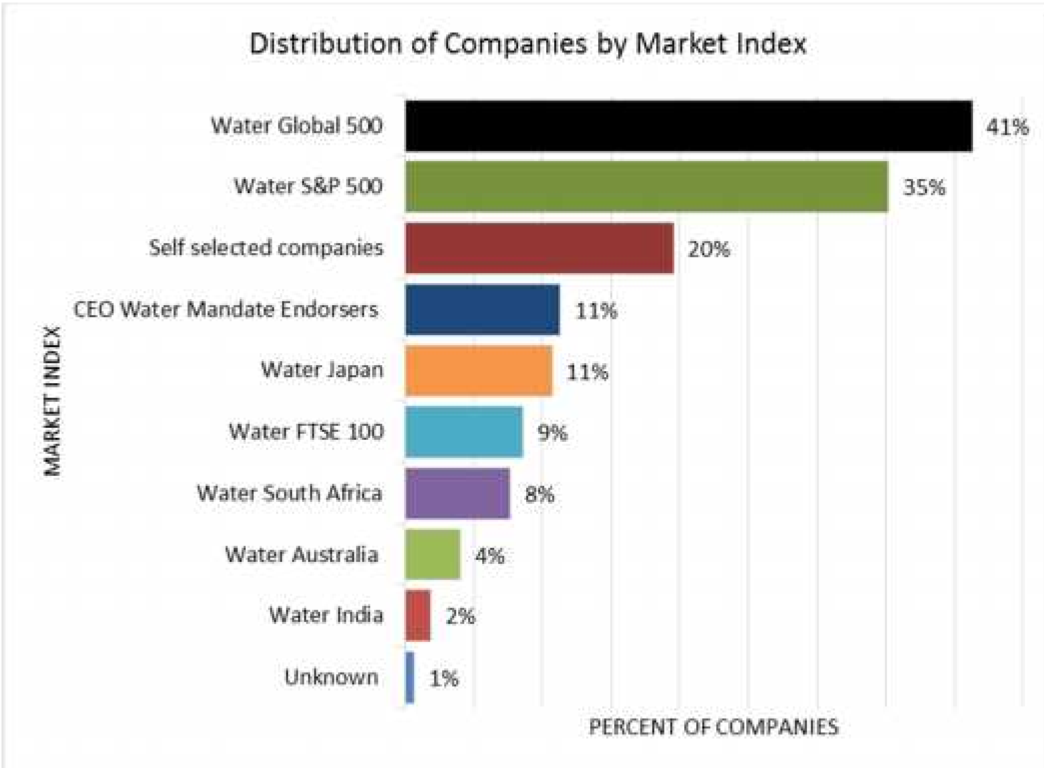


Figure 10: Distribution of Organizations by Market Index
May not total 100% as some organizations were listed on more than one index.

CHAPTER FIVE: WATER RISKS RECOGNIZED BY CORPORATIONS

Global water crises have the potential to significantly impact all sectors of society (WEF, 2016). In the past five years there has been an uptick in public discourses on water risks faced by businesses, their impacts and how businesses are responding (CDP, 2013b; Schulte et al., 2014). The literature highlighted three main types of water risks to which companies are exposed – physical, regulatory and reputational water risks (Schulte et al., 2011, 2014). As introduced in Chapter 1, ***physical water risk*** is exposure to changes in the quantity and quality of water that may impact water availability ("too much or too little") and access ("inaccessible or unfit for use") (Orr et al., 2009, p. 27; Schulte et al., 2011, pp. 26–28). ***Regulatory water risk*** is exposure to changing, ineffective or poorly implemented public water policy and/or regulations. ***Reputational water risk*** is associated with potential conflict with the public regarding perceived or actual unsustainable use of water by corporations (Orr et al., 2009; Schulte et al., 2011).

Global corporations have begun to recognize that exposure to physical, regulatory and reputational water risks could generate a substantive change in business, operations, revenue or expenditure in the present and/or future (CDP, 2013a, p. 9). Many of these corporations have been reporting their water risks and responses to those risks to voluntary reporting and disclosure initiatives such as that Carbon Disclosure Project (CDP). The aim of this phase of the research was to investigate water risks the Full

Disclosers to the 2014 CDP Investor Water Program (CDP-IWP) and how risks relate to other company characteristics. The following research questions (RQ) were explored:

RQ1*: What water risk types (physical, regulatory, reputational) are most prevalent among the Full Disclosers to the 2014 CDP-IWP?*

RQ2*: How do physical, regulatory and reputational water risks relate to company characteristics such as number of facilities at water risk; company revenue; number of employees; sector; and headquarter country economic classification?*

Background

Water risk is a function of several factors as depicted in the Corporate Water Risk, Response and Stewardship (CWRRS) conceptual framework, introduced in Chapter 2. The CWRRS conceptual framework is a synthesis of several theories and frameworks that conceptualize the relationship between water risk exposure, and treatment in the form of risk reduction and mitigation strategies such as corporate water stewardship. This framework brings together Larson, Freedman, Passinsky, Grubb, & Adriaens' (2012) Corporate Water Risk Response Spectrum (WRRS), enterprise risk management, Pfeffer and Salancik's (1978) resource dependency theory, Hart's (1995) natural resource based view of the firm, and corporate water stewardship frameworks (AWS, 2014; Bissett, 2010; CEO Water Mandate, 2012; Davis et al., 1997; Nocco & Stulz, 2006; Sarni, 2011b; WWF, 2013). The CWRRS framework indicates that water risk among companies is a function of the company's dependence on water resources. This dependence varies based on the operations of the company, its water use and discharge which are also functions of the sector to which the company belongs. The literature also suggested that sector may influence water risk as water is more of a material issue for some sectors more than others (CDP, 2014d, para. 1). The CWRRS also highlights that there are uncertainties associated with water availability, quality due to water stress, water and flooding. This was supported by Reig et al. (2013) who noted that corporations with operations located in areas with high water stress or those that sourced raw materials from these areas were exposed to higher levels of physical, regulatory and reputational risks. This suggests that the value of the assets a company has exposed to the water risk (value at risk or VAR) determines the magnitude of potential impact and hence would be an influencing factor to the company's water risk.

Schulte et al. (2011) posited that there were several factors— both internal company performance, and external environmental, social and political conditions— that determine the extent of water risk to which a company was exposed. Internal factors highlighted included the company's water use, costs, regulatory pressures, and the impact of their discharge on water resources. They also suggested that company that are able to invest in technology to improve efficiency, discharge and design more water efficient products, were able to influence their water risk. As investment is also a factor of a company's revenues and cash flow, company revenue was selected as factor for this research. The authors argued that the political and institutional context within which a company operates is also a factor of its water risk. As such, "the ability of the public water policy and management to deliver water services, manage their own water-related risks such as water scarcity and climate change over the long term, create effective allocation regimes, and develop and enforce water quality regulations" may influence a company's water risk exposure (Schulte et al., 2011, p. 30). They also noted differences between the global north (developed) and south (developing), suggesting that the countries in the south were more likely to have political and institutional problems and hence have greater risk. These differences suggest that there may be differences in the water risk among companies with headquarters and/or operations in developing versus developed countries.

Methodology

To assess water risk among companies that participated in the 2014 CDP investor water program (RQ1), responses to the question— "is your organization exposed to water risk, either current and/or future, that could generate a substantive change in your business, operations, revenue or expenditure?"— was extracted from the dataset (CDP, 2013a, p. 9). See Appendix 1 for a copy of the full questionnaire. Whether companies' direct operations, supply chain or both were exposed to water risk was also explored. Of the 327 organizations that provided public responses to the CDP, 319 organizations were included in the analysis, representing a 98% response rate.

To determine the prevalence of physical, regulatory and reputational water risk among companies, the question that asked participants to "list the inherent water risks that could generate a substantive change in your business, operations revenue or expenditure?" was used (CDP, 2013a, p. 10). Companies selected applicable indicators referred to as risk drivers to indicate exposure to three water risk types (physical, regulatory, and reputational) as well as an option to identify other indicators to the participating companies. Companies were able to identify multiple physical, regulatory, reputational water risk indicators, for example, a company may select flooding, pollution of water supply as physical water risks, regulatory uncertainty-regulatory water risk, and litigation and changing consumer behavior as reputational water risk indicators to which the company is exposed. A count of the number of indicators for each risk type was used to assess the level of exposure to each risk type. In the example above, the company exposure to each water risk type would be physical -2, regulatory-1, reputational-2 and total 5. Prevalence was measured by the proportion of organizations exposed to each risk type. One hundred and ninety seven (197) of organizations that reported exposure to water risk also identified specific risk indicators, a response rate of 62% (n = 319). Outcome variables in this analysis are described in Table 12. Analysis for RQ1 involved the use of descriptive statistics to measure prevalence represented by percentage rates of water risk types.

Table 12: Description of dependent variables

RQ1 Outcome Variable	**Variable description**	**Descriptive Statistics**					
		N	**Mean**	**SD**	**Median**	**Min**	**Max**
PHYS – Physical water risk	Continuous measure	197	2.6	2.1	2	0	11
REG – Regulatory water risk	Continuous measure	197	1.12	1.3	1	0	6
REP – Reputational water risk	Continuous measure	197	0.28	0.1	0	0	4
Other	Continuous measure	197	0.04	0.2	0	0	1
ALLRSK – All water risks (PHYS,	Continuous measure	197	2.4	3.1	1	0	16

RQ1 Outcome Variable	Variable description	Descriptive Statistics					
		N	Mean	SD	Median	Min	Max
REG, REP and Other)							

Key company characteristics were selected from literature and examined for significant relationships with water risk. The first characteristic selected was number of facilities in water stress river basins. Data on the number of facilities located in river basins exposed to water risk (facilities at risk) were obtained from the CDP responses (CDP, 2013a, p. 9). To validate companies' claims to water risk exposure in water stress river basin, the lists of river basins reported were cross-referenced with the Gassert, Reig, Luo, & Maddocks' (2013a) *Aqueduct country and river basin rankings* for baseline water stress. A total of 101 number of facilities identified by companies were listed in the river basin rankings and were used in this analysis.

Annual revenue for 2014 in millions of U.S. dollars, and number of employees were also included in this analysis. Data were obtained from two main sources, namely *Compustat Global –Fundamentals Annual database* managed by the Wharton Research Data Services (WRDS), and *Mergent Online Company USA and International database*. The gaps in the data were filled, and data were validated by searching 2014 annual reports and SEC filings of companies. Other outcome variables used in the analysis were GICS sector and country of company headquarters, data obtained from CDP responses, as well as the economic classification of the country in which companies' headquarters are located. The economic classification of companies' headquarter country, i.e., developed, developing, and transitioning were based on the United Nations World Economic Situation and Prospects (UN WESP) Country Classification (United Nations, 2016).

The data were pre-processed in Microsoft Excel, and then merged to create one dataset for analyses in SPSS. Given the high amount of variability between the minimum and maximum values, the variables facilities at risk, annual revenue, and number of employees, data were grouped into four categories based on quartile intervals. Box plots were generated to show the overall distribution of water risk in relation to the outcome variables. Box plots and Interquartile Range (IQR) analyses were used to assess the variability in water risks as “IQR is less sensitive to outliers than other methods such as the variance and standard deviation summary statistics (Handel & John McConnell, 2009; Scibilia, 2013; UCLA: Statistical Consulting Group, n.d.). Mean range at the 95% confidence level were calculated. To measure the strength of the relationship between each water risk type and each independent variables, Pearson’s correlation coefficient was used (Kreutzwiser et al., 2011) for the continuous variables. For the categorical variables- sector and headquarter country, Kruskal-Wallis test was used for the analysis. Independent variables are described in Table 13.

Table 13: Description of independent variables in RQ2

			Transformed Variable	
Dependent Variables/ Factors	**Description of original data**	**N**	**Categories**	**Frequency**
Number of facilities in water stress river basins (facilities at risk)	Continuous measure Range 0 to 413	101	< 4	26
			5 - 9	27
			10 - 17	24
			> 17	24
Annual revenue	Continuous measure	322	$0 - $5,454	80

			Transformed Variable	
Dependent Variables/ Factors	**Description of original data**	**N**	**Categories**	**Frequency**
	Range US $0.10 million to US$358,678 million		$5,455 - $12,794	81
			$12,795 - $25,489	81
			> $25,489	80
Number of employees	Continous measure Range 0 to 592,574	322	0 - 10,475	80
			31,420 - 77,345	81
			10,476 - 31,419	81
			> 77,325	80
Sector	Nominal	326		
Economic classification of headquarter country/ Country of headquarters	Nominal	327	Developed	274
			Developing	51
			Transitioning	2

Results

Exposure to physical, regulatory and reputational water risk

Exposure to water risk: Sixty four percent (N=319) of companies in this study reported that that they were exposed to water risk (Figure 11). Thirty six percent (36%) of these companies were exposed to water risk both in their direct operations and supply chain. Twenty-five percent (25%) reported exposure only in their direct operations while 3% reported exposure only in their supply chain. This is not consistent with the distribution observed in the CDP open dataset which published selected questions online. Exposure to risk among companies in the open dataset, at 31% (N=281), was markedly lower than the proportion observed among companies in this study. Of those exposed, 13% were exposed in their direct operations only, 13% in direct operations and supply chain and 5% in supply chain only (CDP, 2014c).

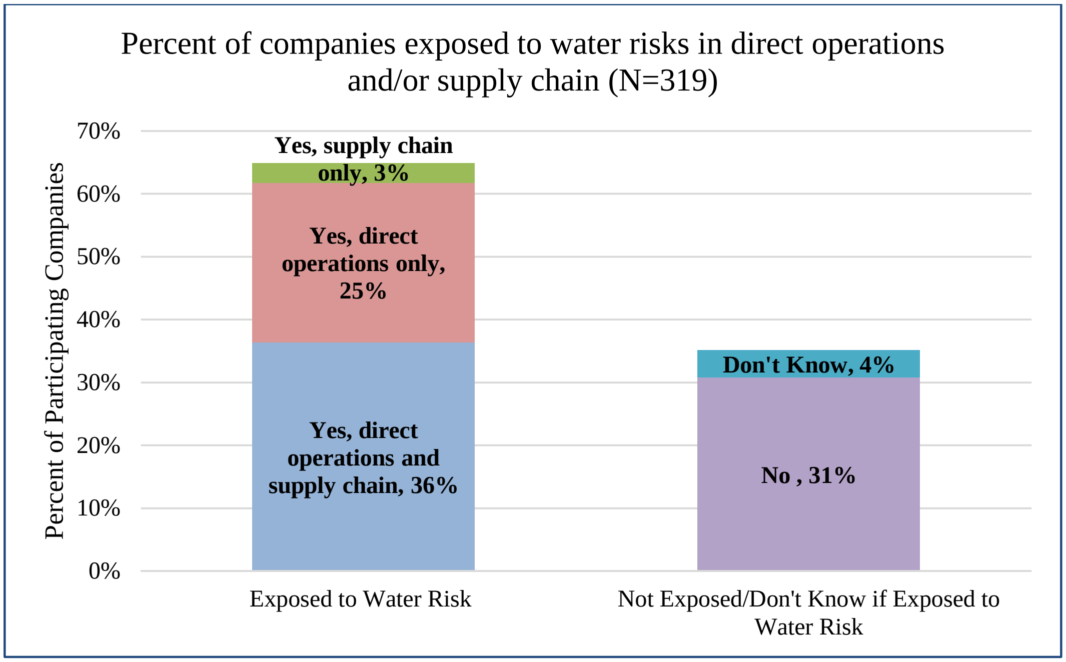


Figure 11: Percent of companies exposed to water risk in direct operations and/or supply chain

Water risk types: When asked to identify the inherent water risks that could generate a substantive change in their business, corporations identified indicators for physical, regulatory, reputational water risks, as discussed below. Physical water risk indicators were the most common risk type, identified by 87% of companies (Figure 12). Regulatory water risk indicators were second, reported by 60% of corporations, while 22% indicated exposure to reputational water risks. Four percent of corporations reported exposure to other water risks (for example, “cumulative impacts”, “current and projected water stress, plus possible reputational risk”; “current and projected water stress, plus projected regulatory and possible reputational risk”) (CDP, 2014). Box plots in Figure 13 show the distribution of physical, regulatory and reputational water risk and aggregate (all) water risks including the other category.

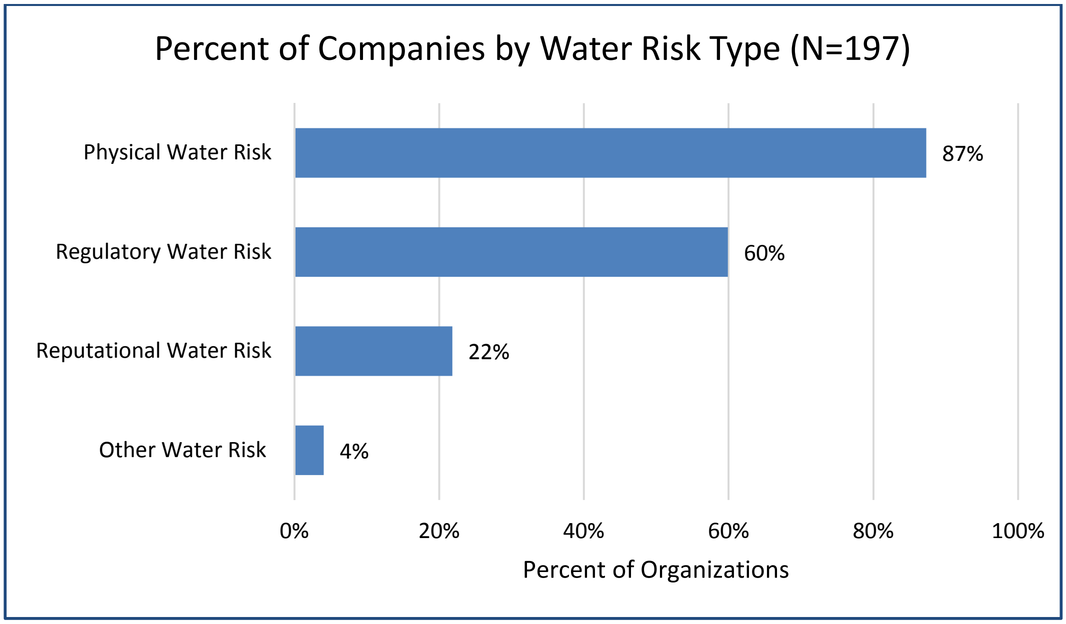


Figure 12: Percent of Companies by water risk type

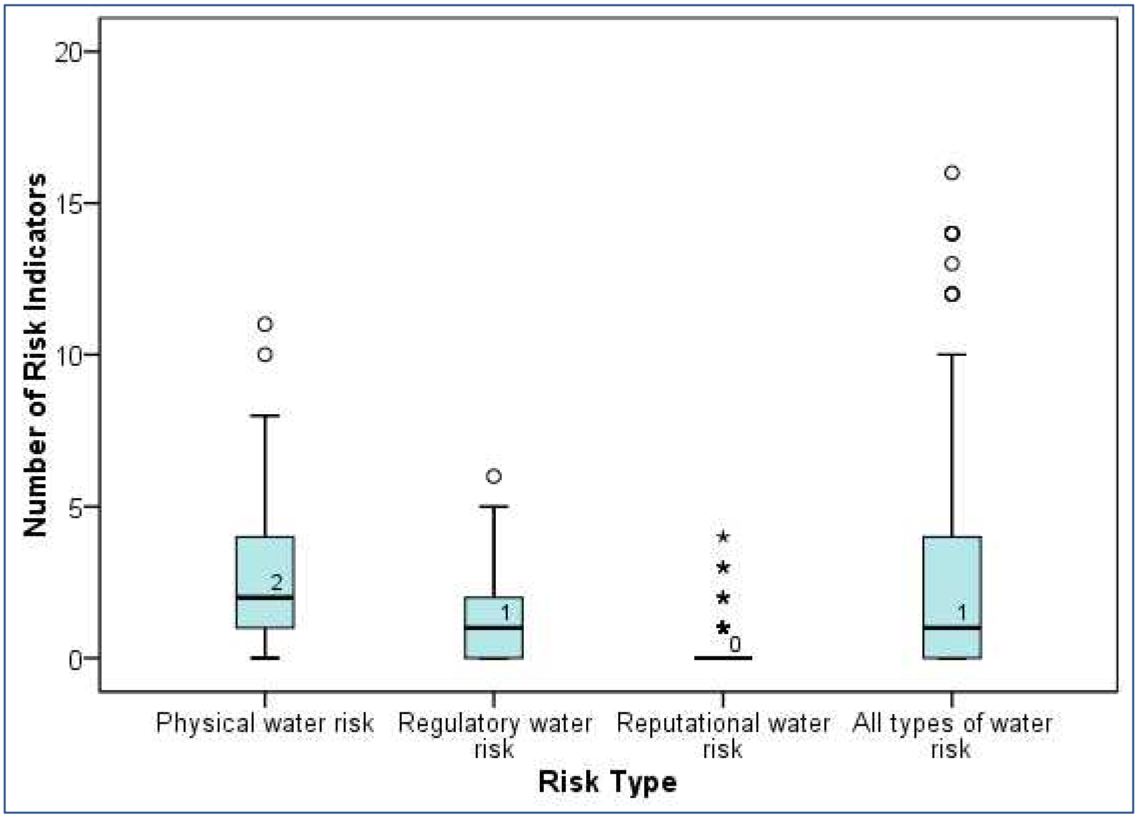
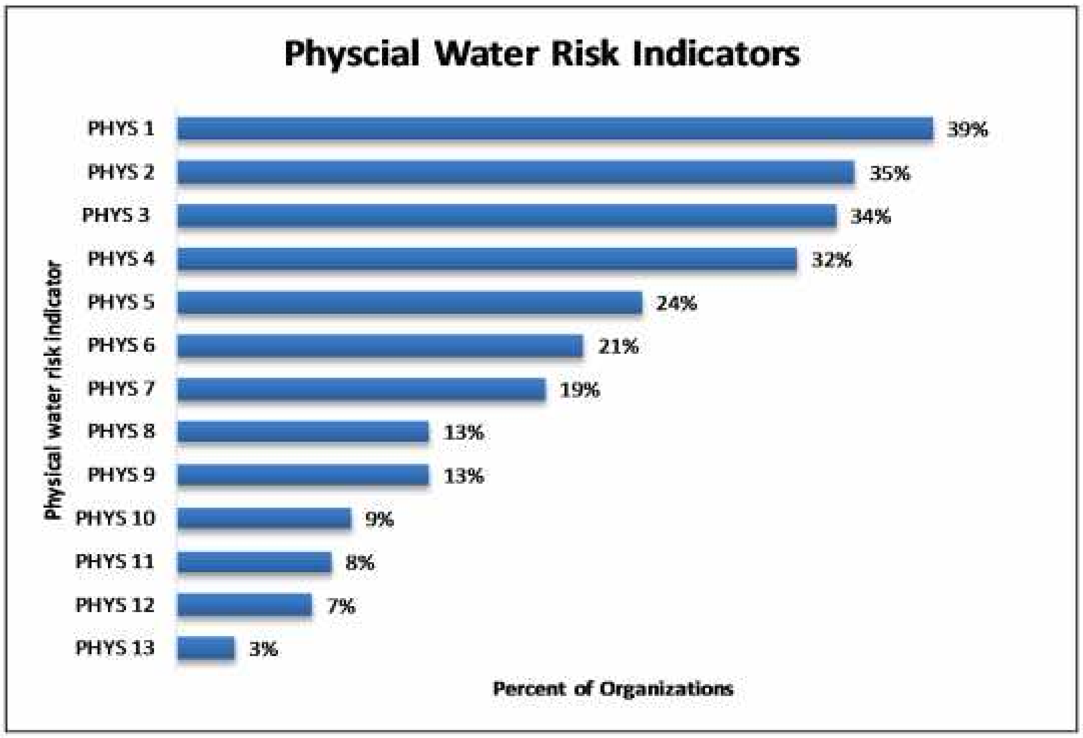


Figure 13: Distribution of physical, regulatory, reputational and all water risks
The box represents the middle 50% of the data points, with the central horizontal line representing the median. The whiskers represent the lowest and highest values no greater than 1.5 times the interquartile range (IQR). Outliers are designated with (1) a circle and represent data points that are more than 1.5 times the IQ, or (2) an asterisk for extreme values, which represent data more than 3 times the IQ range.

Physical water risk. Of 13 indicators presented for physical water risks, the data show that flooding (39%), pollution of water supply (35%), increased water stress (34% and projected water scarcity and stress (32%) were the physical water risks to which corporations were most exposed (Figure 14). Dependency on hydropower (3%) and ecosystem vulnerability (7%) were the physical risks with lowest representation among corporations. Examination of the overall distribution of physical water risks among participating companies show that companies were exposed to between 0 and 11 physical water risk indicators. Median number of indicators was 2.0, and IQR was 3.0 indicating that 50% of companies were exposed to 1.0 and 4.0 indicators (Figure 13).



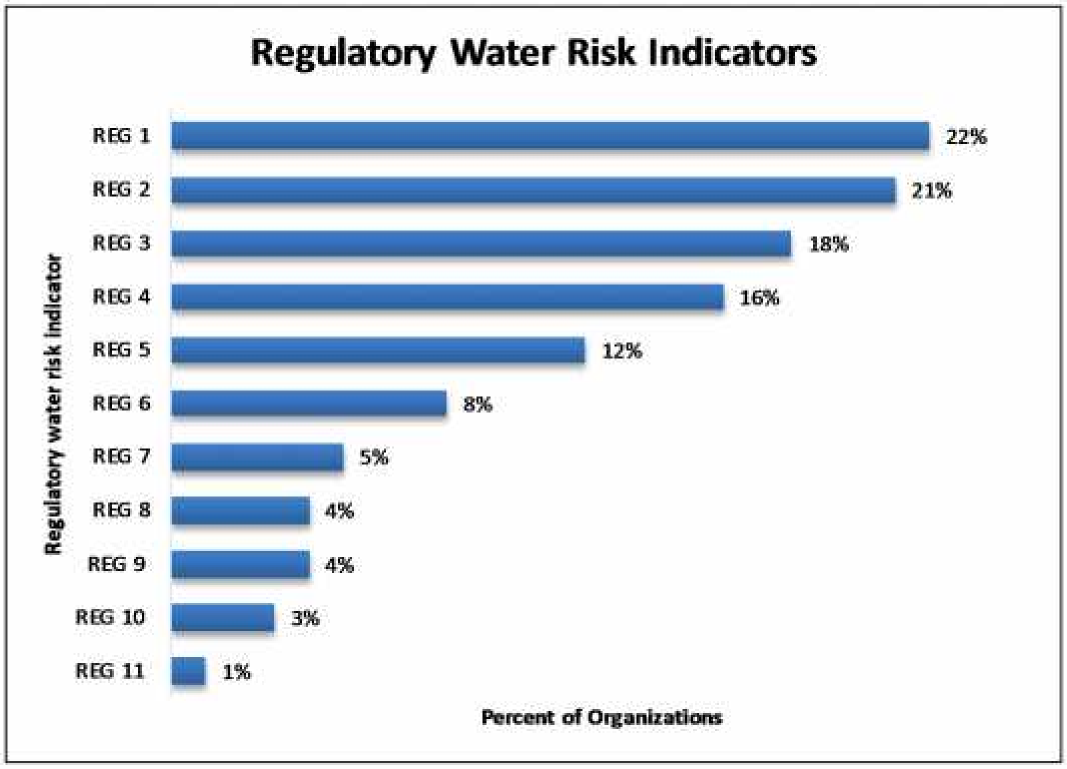
Physical Water Risk Indicators			
Indicator	**Description**	**Indicator**	**Description**
PHYS 1	Flooding	PHYS 8	Inadequate infrastructure
PHYS 2	Increased water scarcity	PHYS 9	Other physical water risk
PHYS 3	Increased water stress	PHYS 10	Seasonal supply variability/inter-annual
PHYS 4	Projected water scarcity and	PHYS 11	Pollution of water supply
PHYS 5	Declining water quality	PHYS 12	Ecosystem vulnerability
PHYS 6	Drought	PHYS 13	Dependency on hydropower
PHYS 7	Climate change		

Figure 14: Physical water risk indicators by percent of organizations

Regulatory water risk. Of the 11 regulatory risk indicators identified, organizations were most commonly exposed to higher water prices (22%), regulatory uncertainty (21%), regulation of discharge quality and quantity volumes (18%), and statutory water withdrawal limits or changes to water allocation (16%). As seen in Figure 15, poor coordination between regulatory bodies (1%) and poor enforcement of water regulations (3%) are the regulatory risks to which the lowest proportion of corporations were exposed. Examination of the overall distribution of regulatory water risks among participating companies showed that companies were exposed to between zero and six regulatory water risk indicators. Median number of indicators was 1.0, and IQR was 2.0, indicating that 50% of companies were exposed to 0 and 2.0 indicators (Figure 13).

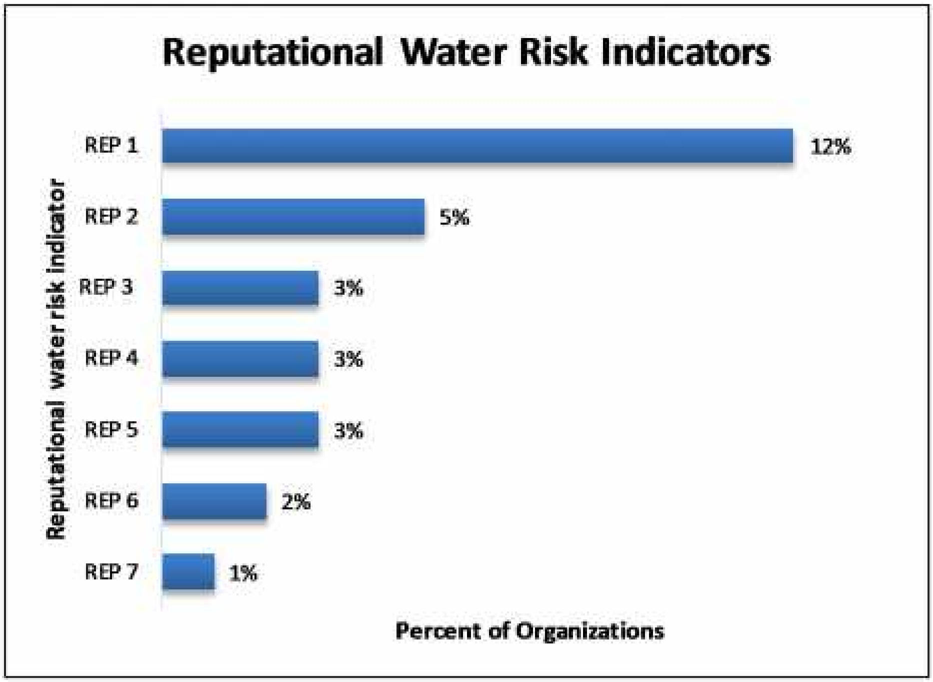
Reputational water risk. Of the seven reputational water risk indicators, community opposition (12%) and negative media coverage (5%) were the two most common (Figure 16). Examination of the overall distribution of reputational water risks among participating companies showed that companies were exposed to between 0 and 4.0 regulatory water risk indicators. Median number of indicators was 0 and IQR was 0. Approximately 18% of companies were exposed to 1.0 regulatory risk indicator.

Aggregate water risks: When all risk indicators were aggregated, there were 32 in total. The data showed that companies were exposed to between 0 and 16 water risk indicators. Median was 1 and IQR 3 with 50% of companies exposed to 0 and 4.0 indicators (Figure 13).



Regulatory Water Risk Indicators			
Indicator	**Description**	**Indicator**	**Description**
REG 1	Higher water prices	REG 7	Other
REG 2	Regulatory uncertainty	REG 8	Unclear and/or unstable
REG 3	Higher compliance costs	REG 9	Limited or no river
REG 4	Statutory water withdrawal limits/changes	REG 10	Poor enforcement of water
REG 5	Increased difficulty in obtaining operations	REG 11	Poor coordination between
REG 6	Mandatory water efficiency, conservation		

Figure 15: Regulatory water risk indicators by percent of companies



Reputational Water Risk Indicators	
Indicator	**Description**
REP 1	Community opposition
REP 2	Negative media coverage
REP 3	Inadequate access to water, sanitation and hygiene (WASH)
REP 4	Changes in consumer behavior
REP 5	Other
REP 6	Litigation
REP 7	Cultural and religious values

Figure 16: Reputational Water Risk Indicators

Water risk and selected company characteristics

Number of facilities at risk: Approximately 50% of participating companies (N=327) reported having one or more facilities located within river basins exposed to water risk (FacRsk). When the river basins identified were cross-referenced with Gassert and colleagues' (2013a) *Aqueduct country and river basin rankings* (*Aqueduct Risk*

Atlas) for baseline water stress, 101 companies were confirmed as having a total of 1,974 facilities in water stress river basins. Box plots showed the distribution of number of facilities at risk in relation to company characteristics (Figure 18). Examination of the box plots showed variability in physical water risk (PHYS) based on the number of facilities at risk (FACRsk) for a company. There appeared to be variability in PHYS among companies with < 4.0 facilities at risk (Median = 2, IQR = 1), compared with companies with 10-17 facilities at risk (*Median* = 3, *IQR* = 2), and those with >17 facilities at risk (*Median* = 4, *IQR* = 2). There were statistical differences between groups as determined by one-way *ANOVA* (3,97) = 8.985, $p < .01$). The Tukey post hoc test revealed that statistically significant variance between the group of companies with >4 FACRsk compared to the 10-17 ($p < .05$) and >17 ($p < .01$) groups, while the 5-9 group had significant variance compared with the >17 group ($p < .05$). A Pearson's correlation additionally demonstrated a strong positive relationship between physical water risk and number of facilities at risk, $r = .466$, $p < .01$.

When regulatory water risk (REG) was examined by FACRsk, variability was observed between companies with <4 FACRsk and those with >17 FACRsk. Variance was significant as determined by one-way *ANOVA* (3,97) = 3.275, $p < .05$). The Tukey post hoc test revealed that statistically significant variance between the group of companies with >4 FACRsk and those with >17 ($p < .05$). Pearson correlation showed that reputational water risk increased with increase in the number of facilities at risk, $r = .299$, $p < .01$.

When reputational water risk (REP) was examined by FACRsk, no variability was observed. One-way ANOVA showed no significant variance.

When the aggregate of all water risks (ALLRSK) was plotted against FACRsk, the pattern was similar to that of PHYS and REG. One-way *ANOVA* $(3,97) = 9.264$, $p < .01$. A positive Pearson's correlation showed that ALLRSK increased with the number of facilities at risk, $r = .471$, $p < .01$ (Table 14).

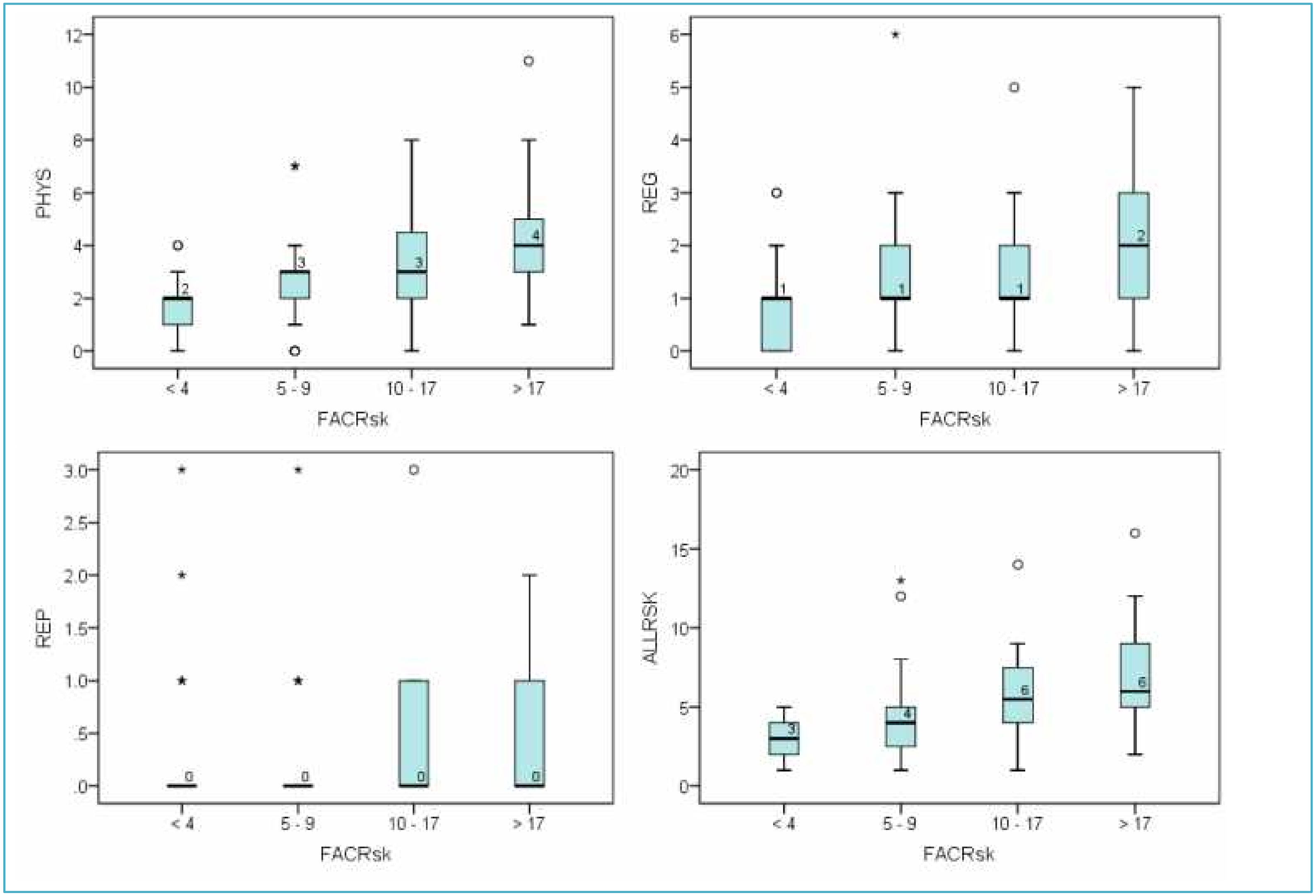


Figure 17: Box plots of PHYS, REG, REP and ALLRSK and number of facilities (FACRsk) in Aqueduct Atlas' water stress river basin showing median water risk

Annual revenue: Companies were divided into four groups based quartile interval of total annual revenue reported in 2014, then compared with exposure to each water risk type for this analysis. Box plots showed little variation in exposure to PHYS, REG, REP and ALLRSK among participating companies based on annual revenue (Figure 19). One-way *ANOVA* showed no significant variance. However, when the aggregate of all water risks were considered, a positive, weak and significant correlation was observed, $r = .117$, $p < .05$ (Table 14). No significant correlations were observed between annual revenue and PHYS, REG or REP.

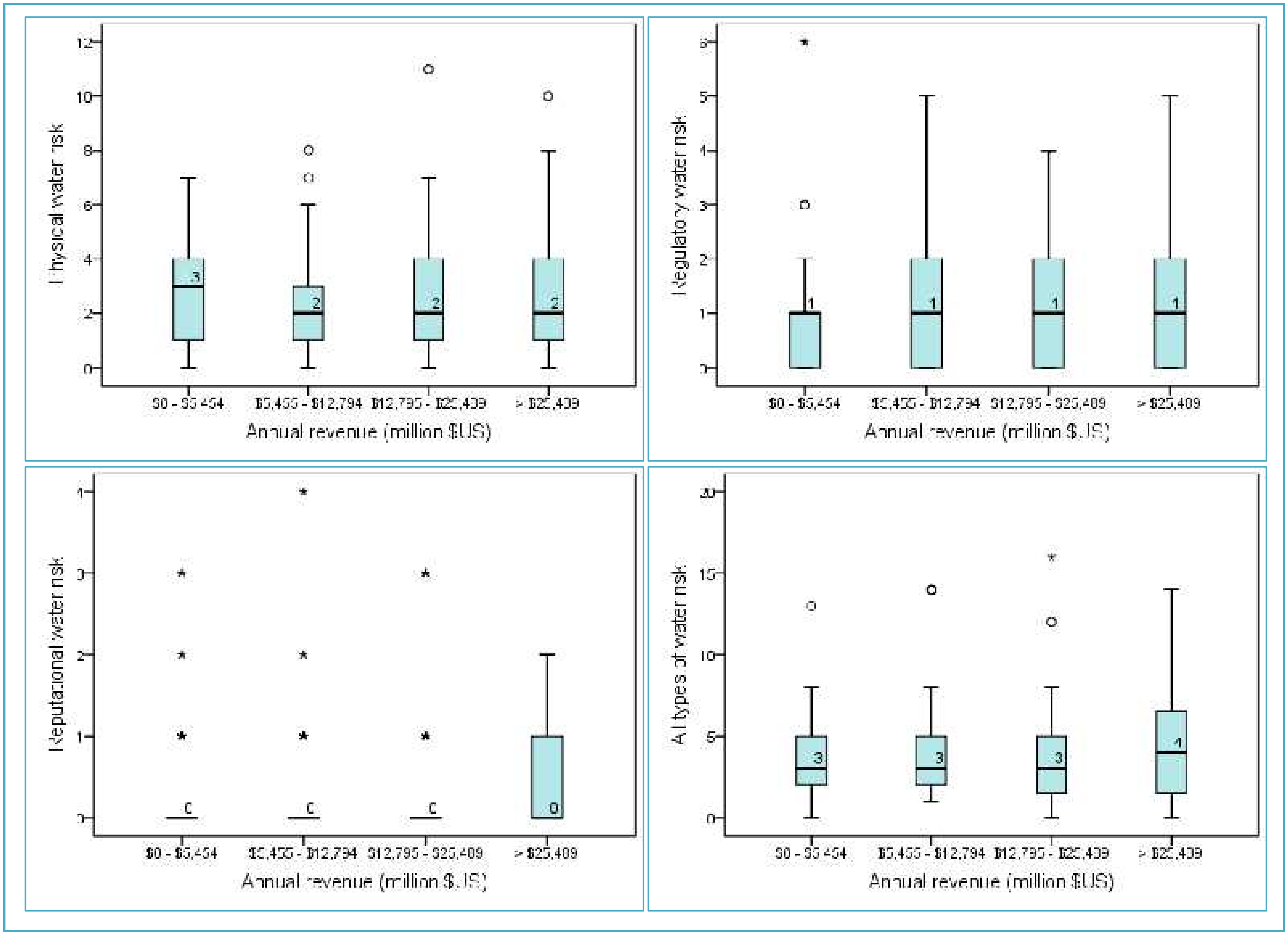


Figure 18: Box plots of PHYS, REG, REP and ALLRSK and annual revenue in millions $US showing median water risk

Number of Employees: Box plots showed little variation in water risk exposure among participating companies based on the number of employees (Figure 20). No significant variance or correlations were observed (Table 14).

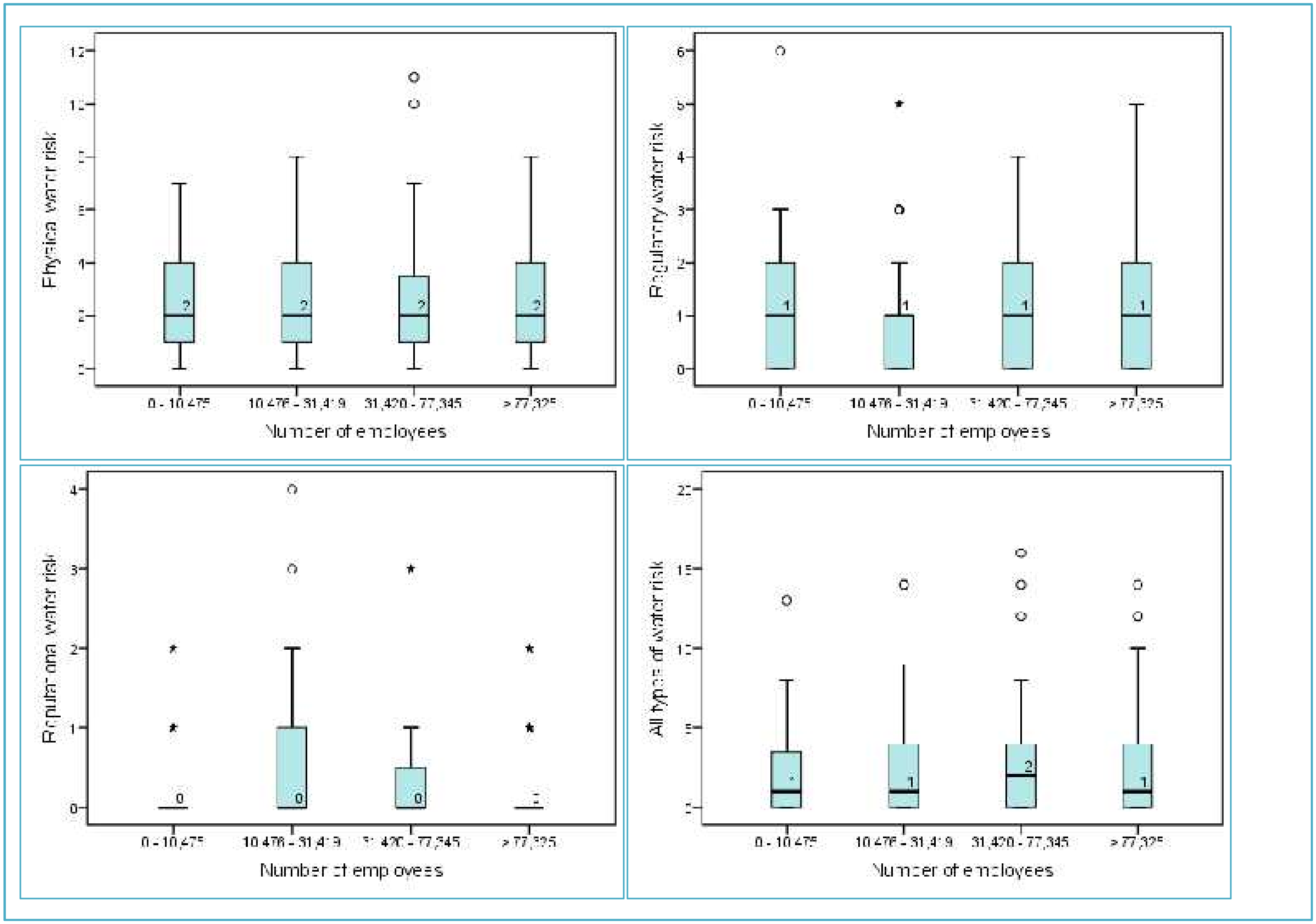


Figure 19: Box plots of PHYS, REG, REP and ALLRSK and number of employees showing median water risk

Sector: Companies in the study belonged to 10 sectors. When exposure to the PHYS was compared across sectors there appeared to be some variability in PHYS and REG water risk Figure 21. A Kruskal-Wallis test showed that there was a statistically significant difference between ALLRSK and sector, $X^2(8) = 32.242$, $p < 0.01$ (Table 15). Mean rank score was highest for the materials sector at 65. Consumer staples had mean rank score of 50 while information technology and industrials were 45 and 43, respectively. No significant differences by sector were observed with individually for PHYS, REG or REP water risk.

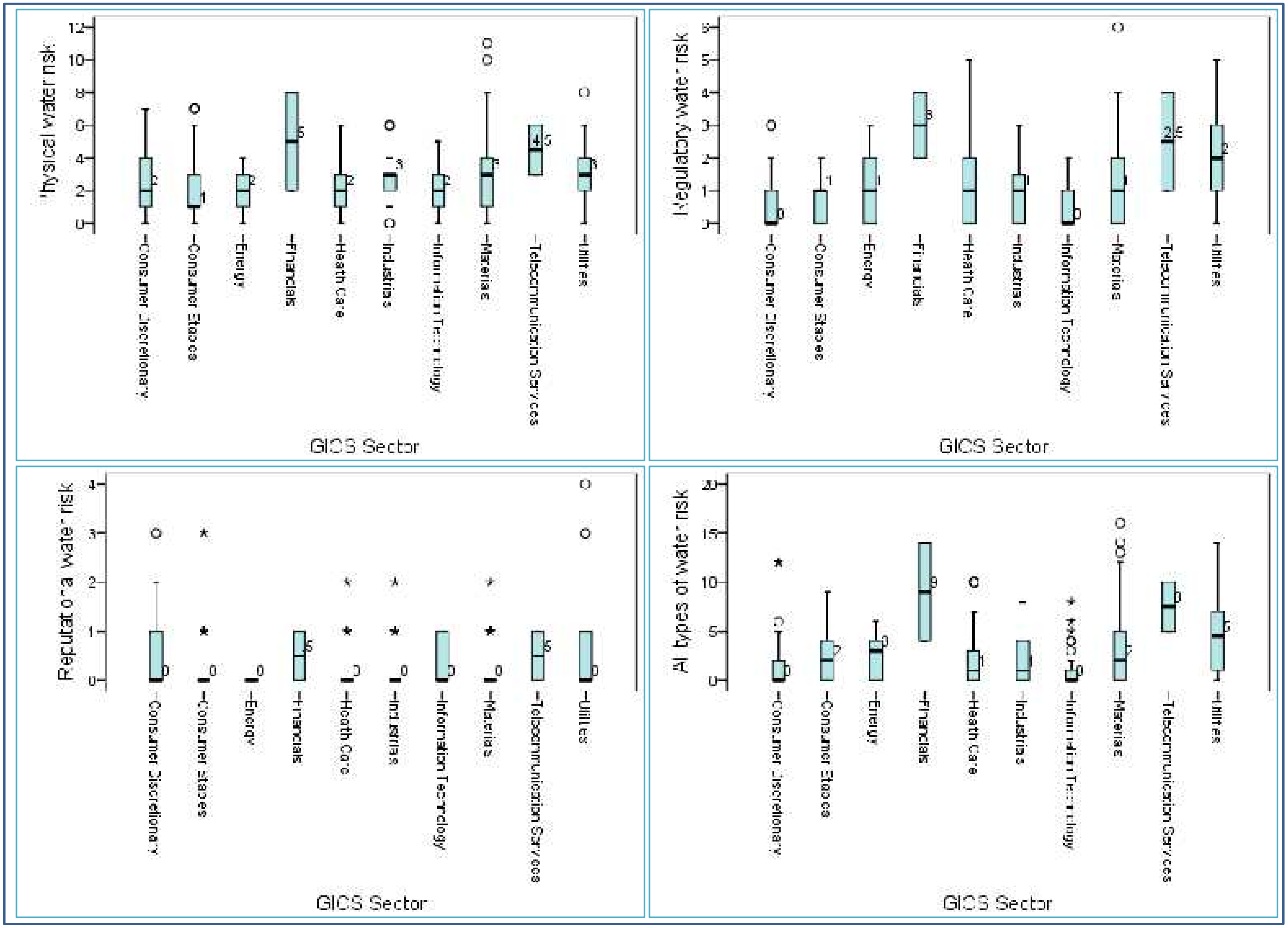


Figure 20: Box plots of PHYS, REG, REP, and ALLRSK and sector showing median water risk

Economic status of country where the company headquarters is located: Companies in the study belonged to 32 countries of which 56% are developed, 41% developing and 1% transitioning economies. The company representation by economic status of headquarter country was however skewed towards developed countries which represented 84% of the 327 companies in the study. Sixteen percent of companies had headquarters in developing economies while 1% was headquartered in a transitioning economy. Box plots of PHYS, REG, REP and ALL water risk types showed little variation in water risk based on the economic status of headquarter country (Figure 21). For ALLRSK, companies in developed economies had higher ranges in risk exposure. The two companies representing the transitioning economy reported exposure to only PHYS. Although, Kruskal-Wallis H test showed that there was a statistically significant difference between ALLRSK and sector, $X^2(2) = 7.08$, $p < 0.05$ (Table 15). Mean rank ALLRSK score was 158.8 for developed, 193.94 for developing and 116.5 for transitioning countries. No significant differences were observed in PHYS, REG and REP water risk by economic stats of corporate headquarters country.

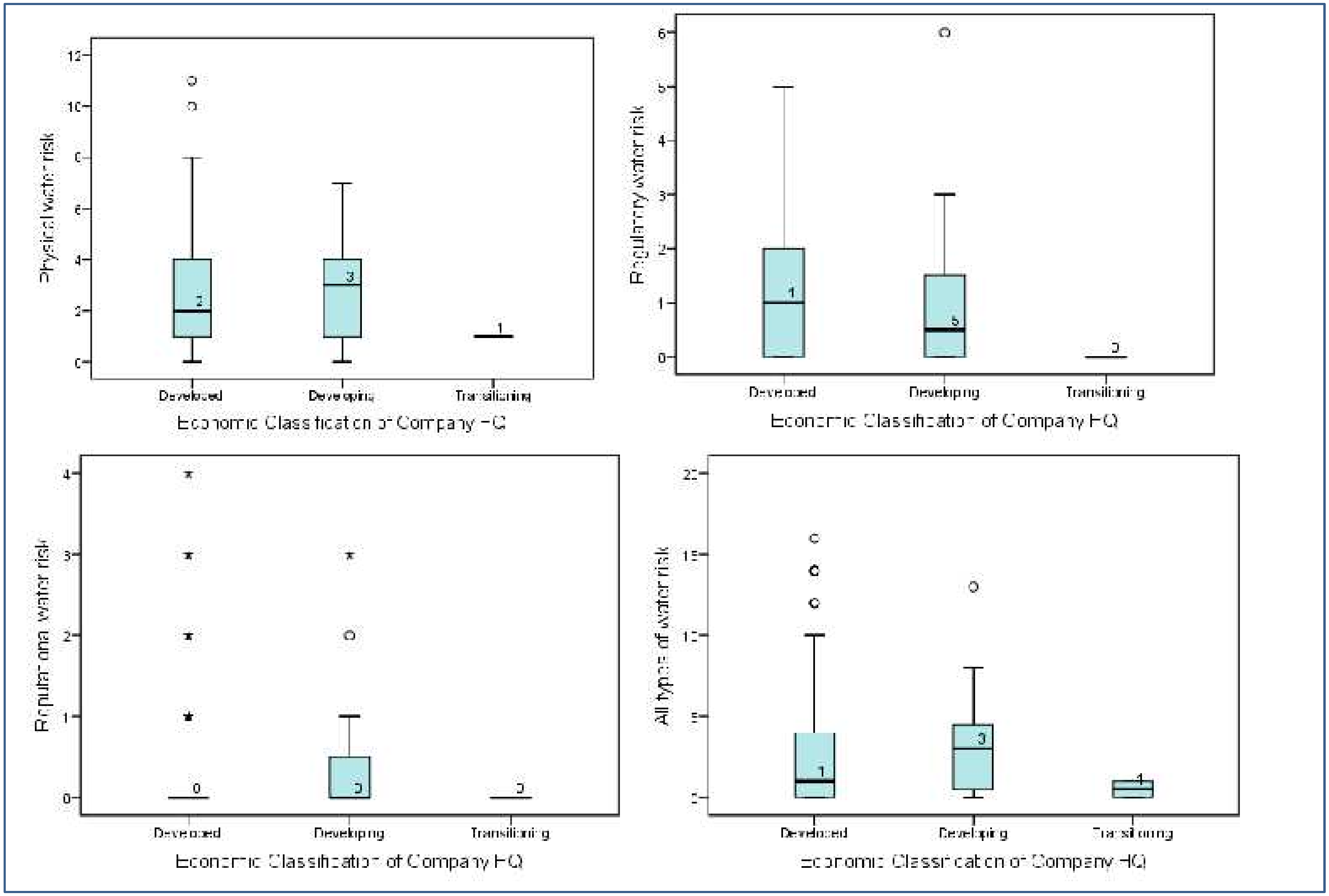


Figure 21: Box plots of physical, regulatory, reputational and all water risks and economic status of headquarter country showing median water risk

Table 14: Correlations between water risk type and number of facilities, revenue, employees, sector, headquarter country and country

	PHYS	**REG**	**REP**	**ALLRSK**
FACRsk (N=101)	**.466****	**.299****	0.114	**.471****
Annual revenue (million $US) (N=194)	0.061	0.062	0.016	**.117***
Number of employees (N=322)	0.08	0.046	0.079	0.049
PHYS (N=197)	1	**.433****	**.257****	**.890****
REG (N=197)		1	**.292****	**.755****
REP N=(197)			1	**.491****
ALLRSK (N=322)				1
** p < 0.01 level (2-tailed) * p < 0.05 level (2-tailed)				

Table 15: Kruskal-Wallis Test of differences in water risk types based on GICS Sector

Test Statistics[a,b]	**PHYS**	**REG**	**REP**	**ALLRSK**
Chi-Square	11.812	9.185	13.14	32.242
Df	8	8	8	8
Asymp. Sig.	0.16	0.327	0.107	**0.000**
[a] Kruskal Wallis Test				
[b] Grouping Variable: Economic Classification of Company HQ				

Table 16: Kruskal-Wallis Test of differences in water risk types based on economic classification of headquarter country (developed, developing, transitioning)

Test Statistics[a,b]	**PHYS**	**REG**	**REP**	**ALLRSK**
Chi-Square	1.063	3.218	0.56	7.084
df	2	2	2	2
Asymp. Sig.	0.588	0.2	0.756	**0.029**
[a] Kruskal Wallis Test				
[b] Grouping Variable: Economic Classification of Company HQ				

Discussion and Conclusion

It is evident from the analysis that companies recognized physical, regulatory and reputational water risks as having the potential to generate substantive change in their business operations, revenue or expenditure. Physical water risk emerged as the most prevalent type of water risk to which companies were exposed. This was reflected in the percentage of companies exposed to physical water risk – 87% compared to 60% for regulatory and 22% for reputational water risk. When individual indicators of each risk type were assessed, the prevalence of physical water risk was also evident. Thirty nine percent of companies were exposed to flooding, the most common physical water risk indicator, compared to 22% for the most common regulatory risk (higher water prices) and 12% for the highest reputational risk (community opposition). The average percentage rate of companies' exposure across all 13 physical water risk indicators was 20% compare with 10% for all 11 reputational and 4% for seven reputational water risks.

Water risk is a factor of a (1) hazard – physical, regulatory and reputational water risk, (2) vulnerability – value at risk in operations and supply chain, and (3) impact (Reig et al., 2013; UN-Water, 2013b; WWAP, 2012). It was therefore expected that water risk type would vary by the number of facilities located within river basins exposed to water risk, annual revenue, company size, sector and economic status of company headquarter country. The results showed significant variance in PHYS, REG and ALLRSK based on number of facilities at risk, sector and the economic status of the company headquarters country. Higher number of facilities located in river basins exposed to risk was expected to be associated with increased exposure to water risk. This was confirmed by positive correlations with PHYS (r=.466, p <.01), REG, (r=.299, p<.01) and ALLRSK (r=.471, p<.01).

It was also hypothesized that larger companies with higher revenues would have also have higher exposure to water risks. The data showed that there was no significant relationship with PHYS, REG or REP, however when the ALLRSK was considered a small but positive association was observed. Number of employees had no significant relationship with water risk. When water risk was examined against sector significant variance was observed in ALLRSK only.

CHAPTER SIX: COMPONENTS OF CORPORATE WATER STEWARDSHIP PRACTICED BY CORPORATIONS AND HOW THEY RELATE TO WATER RISK

Background

Theories on corporate water stewardship (CWS) converge on the notion that CWS practice constitutes a multi-pronged approach that involves a continually improving process (AWS, 2014; Larson et al., 2012). CWS was posited as a strategic response to mitigating water risks for corporations as well as for the wider community and water users (CEO Water Mandate et al., 2015; Hepworth, 2012). CEO Water Mandate (2015) went even further, asserting that CWS is critical to meeting the United Nations (UN) Sustainable Development Goal for ensuring available and sustainable management of water and sanitation for all (SDG 6), which is also fundamental to all other SDGs. The *AWS International Water Stewardship Standard* (AWS[6] Standard) has defined a course for corporations to take to mitigate water risk within and beyond their fences. This course involves the six steps in CWS implementation discussed in Chapter 2 – (1) Commit, (2) Gather and Understand, (3) Plan, (4) Implement (5) Evaluate, and (6) Communicate and Disclose (AWS, 2014). The AWS Standard also provided a guide to linkages between reporting disclosure initiatives such as the Carbon Disclosure Project (CDP) and the Global Reporting Initiative (GRI). The aim of this portion of the research was to assess CWS practice among the Full Disclosers to the 2014 CDP-IWP and the

[6] AWS refers to the Alliance for Water Stewardship

relationship between CWS and physical, regulatory and reputational water risks individually and collectively. The research question that was explored in this part of the study is:

> ***RQ3:*** *How are the components of CWS practiced by Full Disclosers to the 2014 CDP-IWP related to their reported physical, regulatory, and reputational water risks?*

Methodology

To determine the prevalence of CWS among companies, I assessed which CWS practices were most frequently practiced in companies that publicly disclosed information to the 2014 CDP-IWP. While the linkage between the AWS Standard and the CDP water disclosure questionnaire was not a direct one-to-one match for all criteria, linkages were identified in all six components of stewardship to generate data for a robust analysis (see Appendix 2 for CDP and AWS linkages examined in this research). Each step in the AWS Standard was analyzed as separate variable, then aggregated to generate a CWS score (Table 17). The AWS Standard states that all steps are required for an entity to qualify as a steward. As such, the subset of companies that pursued action in all six CWS steps (*N*=191) were also examined as a group, as well as those that pursued action in less than six steps.

The independent variables were generated by aggregating the number of risk indicators for physical (PHYS), regulatory (REG) and reputational (REP) water risk types, as discussed in Chapter Five. Companies that indicated that they were not exposed to water risk were included in the analysis as having exposure to zero water risk. An *ALLRSK* category was used to incorporate all three risk types in addition to other water risk indicator category in the dataset (Table 18). Descriptive statistics were used to explore distributions. Pearson correlations were used to asses significant relationships between each pair of dependent and independent variables (Kreutzwiser et al., 2011).

Table 17: Characteristics of dependent variables

			Population Parameters					
Corporate Water Stewardship Steps	**Variable description**	**N**	**Mean**	**Std. Deviation**	**Median**	**Min**	**Max**	**Mean scores on 0-1 Scale**
Commit	Categorical Yes (1) - 207 No (0) - 120	327	0.6	0.48	1	0	1	0.63
Gather and Understand	Continuous measure	327	7.4	3.22	7	1	15	0.49
Plan	Continuous measure	306	2.5	0.91	3	1	4	0.63
Implement	Continuous measure	325	1.7	0.63	2	1	4	0.28
Evaluate	Continuous measure	327	2.6	0.52	3	1	3	0.88
Communicate and Disclose	Continuous measure	327	2.5	0.93	2	1	4	0.621
CWS Score (All companies)	Continuous measre	327	17.1	4.93	17	7	29	0.59
CWS Score (6 CWS steps)	Contnuous measure	191	18.5	4.57	18	10	29	0.63
CWS Socre (< 6 CWS steps)	Contnuous measure	136	15.24	4.79	15	7	26	0.53

Table 18: Characteristics of water risk variables

Water Risk Type	Variable description	N	Mean	Std. Deviation
Physical Water Risk	Continuous measure, Range 0 to 11	327	1.54	2.03
Regulatory Water Risk	Continuous measure, Range 0 to 6	327	0.68	1.12
Reputational Water Risk	Continuous measure, Range 0 to 4	327	0.17	0.51
All Water Risk Aggregates (physical + reputational + regulatory + Other)	Continuous measure, Range 0 to 16	327	2.41	3.13

Results

Components of Corporate Water Stewardship

Frequency distribution and descriptive statistics of each CWS step are shown in Table 17 and Figure 23. The key findings were:

- **Commit:** 63 % of companies (*N*=327) met the criteria for the CWS commit step. One CDP criteria was used to demonstrate corporations' commitment to CWS – the existence of a water policy that sets out clear goals and guidelines. Mean score was 0.63 of maximum score of 1.0. Median was 0.65 and *IQ*R was 1.0.
- **Gather and understand**: All companies pursued actions in the gather and understand step. This step involved the highest number of actions with a maximum score of 15 (Table 17). Mean score achieved by companies was 7.4. The median score was 7.0 with an *IQR* of 5.0 with the middle 50% of companies achieved scores ranging from 5.0 to 10.0.
- **Plan**: 94% of all participating *companie*s (*N*=327) pursued requirements for this step (21 missing responses). Four components were used to derive scores for the

plan step. Corporations obtained mean scores of 2.5. Median score was 3.0 and *IQR* was 1.0. The middle 50% of companies obtained scores between 2.0 and 3.0 (Table 17; Figure 23).

- **Implement:** All but two companies pursued action in implementing CWS in their organizations (*N*=327). However levels of implementation were low as indicated by mean score of 1.7 of a maximum of 6.0 points. Median score achieved was 2.0 with an *IQR* of 3. The middle 50% of companies had scores between 1.0 and 2.0.
- **Evaluate:** All companies evaluated their CWS activities to some degree. Mean score obtained was 2.6 of a maximum of 3.0. Median score was 3.0 and *IQR* was 1.0. The middle 50% of companies had scores between 2.0 and 3.0.
- **Communicate and Disclose:** All companies communicated and disclosed their CWS activities. This is by virtue of their participation in the CDP along with other criteria for disclosing water risks internally and externally within their organizations. Mean score achieved by companies was 2.5 of the maximum 4.0 points required in this step. Median score was 2.0 and *IQR* was 2.0 with the middle 50% of companies scoring between 2.0 and 4.0 points in this step.

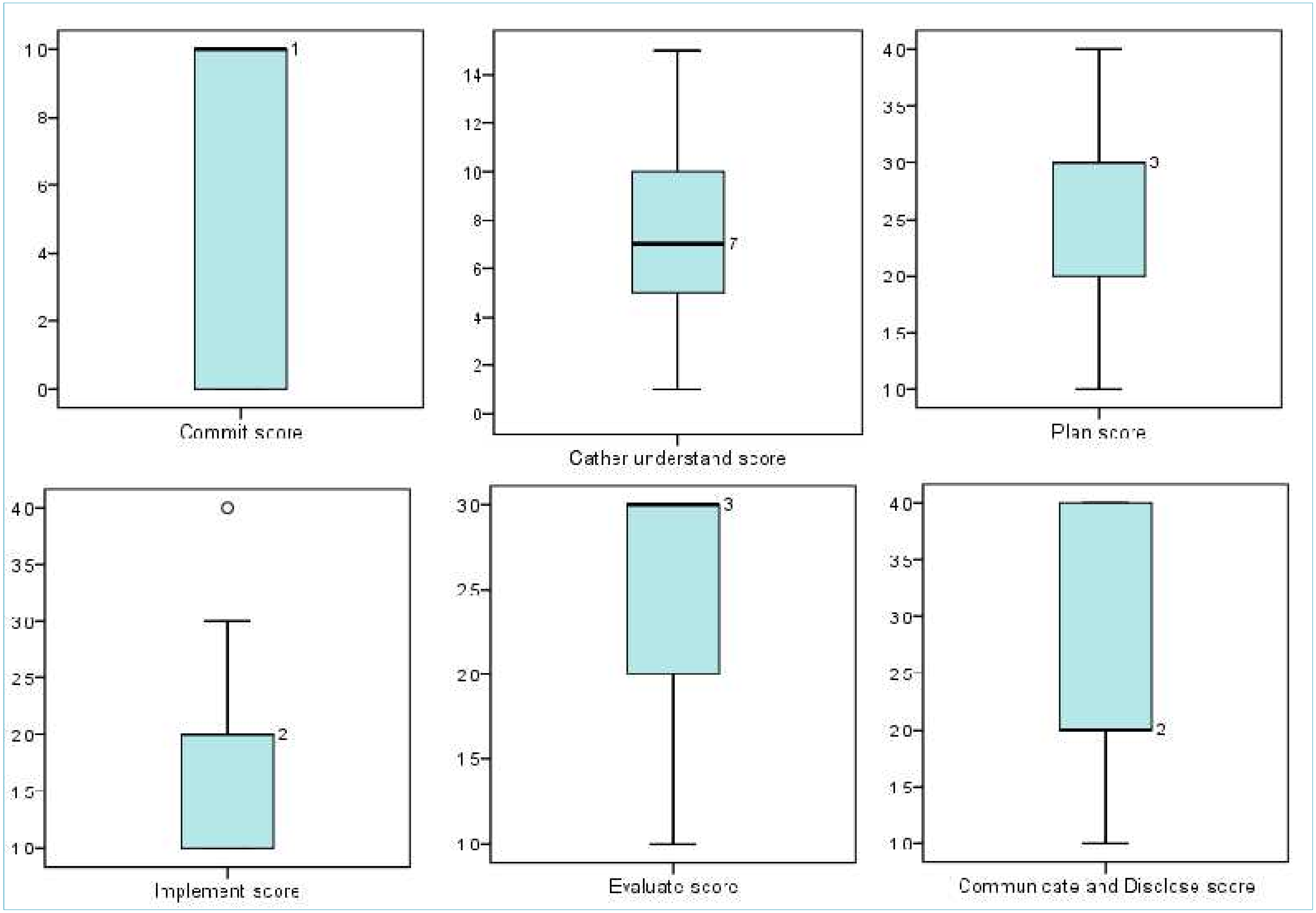


Figure 22: Box Plots of CWS steps: Commit, Gather and Understand, Plan, Implement, Evaluate and Communicate and Disclose scores showing median scores

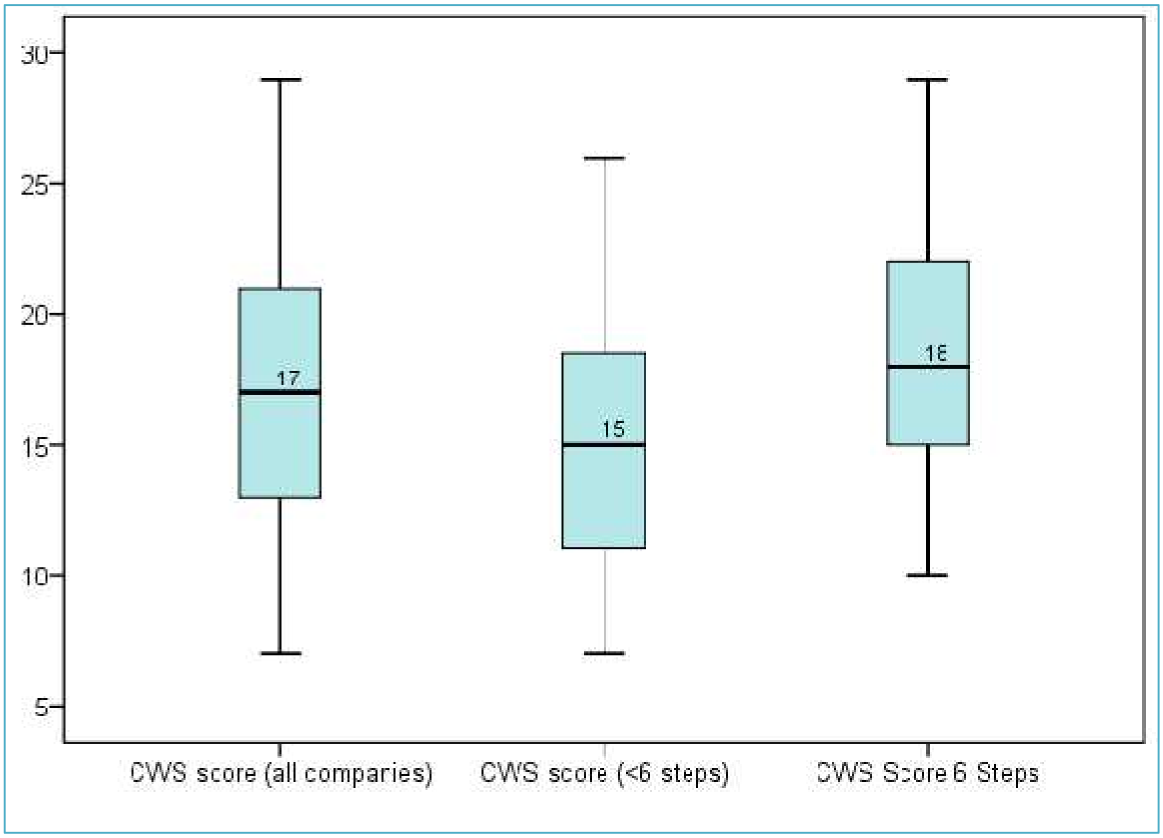


Figure 23: Box Plots of CWS scores for all companies, companies that pursued action in all six steps, less than six steps, and median score for each

CWS: All 327 companies that participated in the 2014 CDP Investor Water Program pursued one or more CWS steps. Mean CWS score for all companies was 17.1 of a maximum of 29 points. Median score was 17.0 with an *IQR* of 7.0. The middle 50% of companies achieved scores between 14.0 and 21.0 (Figure 23).

CWS 6 Steps: 58% of companies had action in all six CWS steps (*N* = 327). Mean CWS score among this cohort of companies was 18.5 of maximum score of 29.

Median score was 18.0, *IQR* was 7.0 with the middle 50% of companies scoring between 15.0 and 22.0.

CWS<6 Steps: 42% of companies had activities in up to five of the six CWS steps— 40% pursued five steps while 2% pursued four steps. Mean CWS score among this group was 15.2 of a maximum of 26. Median score was 15 and *IQR* was 8.0 with the middle 50% of companies achieving scores between 12.0 and 20.0.

Relationship between water risk and CWS Steps

To answer RQ3, the relationship between CWS and physical (PHYS), regulatory (REG), reputational (REP), and all water risks (ALLRsk) described in Table 18 water risk was explored. Pearson's correlation coefficient (r) was used to assess the strength of the relationship between each dependent and independent variable (Field, 2013). The results showed significant positive relationships of medium strength between physical water risk and CWS, $r = .484$, $p < .01$, and between regulatory water risk and CWS $r = .416$, $p < .01$ (Table 19 and Table 20). The relationship with reputational water risk was also significant though weaker than physical and regulatory water risk. Significant correlations were observed between all water risks and CWS, $r = .512$, $p < .01$. When scores for companies in the CWS 6 steps group were considered, small but significant correlations were observed with all water risk types. For companies that pursued less than six CWS, a small, negative relationship, r = -.140, $p < .05$ was observed between reputational water risk and CWS; no other significant correlations emerged among those companies.

Table 19: Correlation of physical, regulatory, reputation and aggregate water risk to aggregate CWS scores

Correlation				
	PHYS	**REG**	**REP**	**ALLRsk**
CWS score (all) (N = 327)	**.484****	**.416****	**.253****	**.512****
CWS Score 6 Steps (N = 327)	**.230****	**.180****	**.244****	**.258****
CWS Score <6 Steps (N=327)	0.017	0.036	**-.140***	0
** *p* < .01 level (2-tailed) * *p* < .05 level (2-tailed).				

Significant correlations were also observed when risk types were correlated with the various CWS steps. As seen in Table 20, three of the six CWS steps—Gather and Understand, Plan and Communicate and Disclose—had significant correlations with the three water risk types examined. The relationships were positive and varied in strength. Gather and Understand had strong correlations with physical, regulatory and smaller correlation with reputational water risk (r = .250, p <0.01). The Plan step had medium strength correlation to physical water risk (r = .345) and small correlations to regulatory (r = 212, p <.01 and reputational (r = .180, p <.01) water risk. The Communicate and Disclose step had medium strength correlations with physical and regulatory water risk and a small correlation with reputational water risk. Both the Commit and Implement steps had small correlations to only one water risk type, reputational water risk in the case of the Commit step and physical water risk in the case of the Implement step. No significant correlations were between water risk and the evaluate step.

Table 20: Correlation of physical, regulatory, reputation and aggregate water risk to CWS steps: commit, gather and understand, plan, implement, evaluate, communicate and disclose

Pearson Correlation				
	PHYS	**REG**	**REP**	**ALLRsk**
Commit score (*N*=327)	0.037	0.029	.144**	0.06
Gather understand score (*N*=327)	**.496****	**.434****	**.250****	**.526****
Plan score (*n* =306)	**.345****	**.212****	**.180****	**.336****
Implement score (*n* = 325)	**.119***	0.073	0.077	**.119***
Evaluate score (*N* =327)	-0.098	0.035	0.002	-0.053
Communicate and Disclose score (*N* = 327)	**.365****	**.324****	**.117***	**.379****
** $p < .01$ level (2-tailed). * $p < .05$ level (2-tailed).				

Discussion and Conclusion

In identifying the components of corporate water stewardship practiced by corporations in the study, it was seen that all six steps in the AWS Standard were being practiced to varying degrees by corporations in the study. The commit step had the lowest level of participation among companies at 63%. The results also showed that companies that were exposed to reputational water risk were more likely to establish water policy with performance standards and targets, which is an indication of their commitment to CWS.

The gather and understand CWS step included the largest number of individual requirements compared to the other steps. Among the activities reported by companies, engaging stakeholders to better understand contextual issues of importance at the catchment level, and valuing water quality and quantity, were the activities practiced by most corporations. Another common activity was the understanding of opportunities for creating shared value through CWS. Reporting detrimental impacts and supply chain risk and risk mitigation activities, were among the activities least practiced in this step. The results showed that companies were more likely to gather data if they were exposed to physical, regulatory and reputational water risks. Of all the significant correlations observed between each water risk type and each of the six CWS steps, gather and understand had the strongest relationships (r = 0.250 to 0.496). According to the AWS Standard, this step was intended to help companies understand their water risks and opportunities both in their operations and supply chain (AWS, 2014). It is therefore understandable that companies reporting water risk would have gathered information on their exposure to risk.

Having personnel responsible for managing water coupled with a plan with quantitative targets and qualitative goals were key activities in the Plan step. Analysis of the relationship between this step and water risk showed that companies' activity in the plan step increased with exposure to physical, regulatory and reputational water risks as seen in significant correlation coefficients ranging from 0.180 to 0.345.

The implementing CWS step is critical in mitigating water risk as it involves implementing the CWS plan with key outcomes to reduce negative water related impacts and improve water balance at the site and catchment basin levels. Actions included in this step were regulatory compliance, and maintaining or improving site and catchment area water balance, quality. The latter was measured through reported achievements in meeting targets related to water withdrawal, consumption, intensity and pollution. Another action included in this step of note was the provision of access to safe drinking water, adequate sanitation, and hygiene awareness (WASH) for workers on-site and to off-site communities. Regulatory compliance was the most commonly practiced activity reported by 97% of companies. More than a third of companies met their targets to reduce water intensity and pollution while 26% met their targets to reduce water withdrawal and consumption. Less than 1.0% of companies however engaged in WASH activities on-site or off-site. The data showed that companies exposed to physical water risk were more likely to implement their CWS plans than those exposed to regulatory and reputational water risks.

The evaluation step involved assessing the data collected in the gather and understand step to better understand risks, and the performance of CWS programs to identify additional risks, impacts and opportunities within the organization's operations and at the catchment basin, all through a stakeholder-inclusive process. Two thirds of companies engaged in all three elements included in this step while 31% percent engaged in two of the three activities. Evaluation was not significantly correlated to water risk among participating companies.

In assessing the CWS step communicate and disclose, results show that almost all companies were transparent about their regulatory compliance as 97% of companies responded to the related question, though not all were in compliant. Communicating shared water challenges and the risk response strategies employed to mitigate these challenges were also actions in this step undertaken by companies. Participation in the CDP enabled all corporations in the study to obtain at least one point for this step. The highest proportion of companies obtained two points for this step. Results showed that increase in physical, regulatory and reputational water risks was likely to have a corresponding increase in CWS communicate and disclosure step.

Actions taken in the six steps determined a company's CWS performance. The results showed that all companies engaged in CWS actions with 58% having had action in all six steps while 42% had action in four to five steps. The results were consistent with Hepworth & Orr's (2013) claims that water risk that physical, regulatory and reputational water risks are primary drivers of CWS. When companies were considered as one group, it was found that exposure to physical, regulatory and reputational water risk were likely to result in an increase in CWS. This was also the case for companies that pursued all six CWS steps. However, for companies that pursued less than six steps, significant correlation was observed only with reputational water risk. This relationship was small and negative–for every unit of increase in reputational water risk, there was a 1.4 unit decrease in CWS. While reputational water risk was highlighted in the literature as a primary driver for CWS, this risk was directly related to the company's social license to operate and predicated on secondary drivers such as community perception (Hepworth & Orr, 2013). A related viewpoint was that corporate engagement in CWS may increase reputational risk due to the public's distrust of companies' motivation for engaging in water management and governance outside of their fence (Hepworth & Orr, 2013). Further examination of these companies showed that they had low commitment to CWS (16% compared to 100% of companies that pursued all six CWS steps). They also had lower scores in the gather and understand step suggesting that they may not have full understood their water risks, shared water challenges and opportunities for mitigating water risks. Furthermore, they also tended to have lower averages for exposure to physical, regulatory and reputational water risk compared to companies with action in all six CWS steps.

CHAPTER SEVEN: PREDICTORS OF CORPORATE WATER STEWARDSHIP

Background

As corporate water stewardship (CWS) continues to evolve as a solution to complex global water challenges, there is a need to better understand what factors are related to CWS practice among global corporations and how to predict CWS behavior and outcomes (Hepworth & Orr, 2013). While the AWS has defined a standard with clear defined steps and guidelines for water stewardship and others have developed frameworks of corporate water stewardship and public disclosures, little research has been done on exploring the linkages between the established requirements and company actions as reported through voluntary disclosure initiatives, to enable practitioners, policymakers, researchers and companies to predict corporate CWS behavior and its outcomes. The aim of the final analysis of this study is to contribute to filling that gap by answering the following research question:

> ***RQ****: What are the most important factors related to corporate water stewardship among Full Disclosers to the 2014 CDP-IWP?*

Research in CWS indicated that water risk and certain company characteristics such number of facilities exposed to water risk, company revenue and sector are influential factors for corporations engaging in CWS (Hepworth & Orr, 2013; Larson et al., 2012, 2012; Rozza et al., 2013). It was therefore hypothesized that:

H1: *Physical, regulatory and reputational water risk will explain a significant amount of variance in CWS*

Methodology

To identify the predictors of CWS among the Full Disclosers, I ran three hierarchical regressions. The dependent variables were CWS scores, while the predictor variables were physical water risk (PHYS), regulatory water risk (REG), reputational water risk (REP), number of facilities in water stress river basins, annual revenues, economic classification of companies' headquarters, and Global Industry Classification (GICS) sector of the companies as the predictors were run to test the hypotheses. Separate models were run using the three CWS scenarios—(1) CWS all companies, (2) CWS steps (CWS 6 steps) to represent only companies that took action in all six CWS steps as defined by the CDP-AWS linkage parameters, and (3) CWS <6 steps to represent companies that pursued up to five CWS steps— as dependent variables with the same predictors. It was important to consider both CWS 6 steps and CWS <6 steps groups as CWS is a continually improving process and companies may be at varying stages of maturity in their CWS programs. Correlations of all variables in the models are located in Appendix 3.

Measures of water risk. In order to identify the types of water risk organizations were exposed, companies were asked to identify water risks that generate a substantive change in their business, operations, and revenue or expenditure—question w3.2b. Respondents were provided a list of indicators that represented physical, regulatory reputational risks, and asked to specify others types not listed. Respondents could select multiple indicators. The sum of the number of indicators within the physical, regulatory, and reputational reported by respondents was used as a continuous measure of each water risk type. Companies that identified no risk indicators were coded as having zero water risks (CDP, 2013a, p. 9). A copy of the questionnaire is located in Appendix 1.

Measures of company characteristics. The selection of variables to measure company characteristics in the analysis in chapter 5 of this dissertation and the regression model discussed in this chapter, was informed by the CWRRS framework and other pieces discussed in chapters two and three. The characteristics used in the regression model are number of facilities within river basin exposed to water risk, annual revenue, sector and the economic status of participating companies' headquarter country. The sources of the data for these variables and techniques used to measure each are described below.

Measures of number of facilities. One question on the CDP questionnaire addressed the number of facilities at risk. Organizations were asked to provide information on the country, river basin, number of facilities within the river basin exposed to water risk, reporting metric, and the proportion of the chosen metric that could be affected within the river basin. The number of facilities reported by companies was as a continuous measure of a predictor variable in the models.

Annual revenue. Data on the annual revenues of organizations included in this research study were obtained from two main sources, namely Compustat Global – Fundamentals Annual database managed by the Wharton Research Data Services (WRDS), and Mergent Online Company USA and International database. Gaps in the data were filled, and data validated by also searching 2014 annual reports and SEC company filings. All revenue numbers were converted to millions of U.S. dollars for the analysis.

Sector. Participating companies belonged to 10 GICS sectors. To reduce the number of variables in the model, sectors were collapsed into three groups as summarized in Table 22. I collapsed sectors based on the type of industry subsectors. Industries that appeared to be more consumer-facing such as consumer discretionary and healthcare were grouped as the S1. Sectors that tended to be more manufacturing and industrial oriented were grouped as S2, and utilities and energy grouped as S3. The frequency distribution of the three sector groups was assessed and S2 which represented the largest percentage of organizations, was used as the base sector for the regression analysis (Field, 2013).

Economic status of headquarter country. The economic classification of companies' headquarter country, i.e., developed, developing, and transitioning was based on the United Nations World Economic Situation and Prospects (UN WESP) *Country Classification* (United Nations, 2016). Developing and transitioning were collapsed into one variable for comparison against the base category—developed country classification—in the regression model.

The first stage of the model (model 1) included water risk types (physical, regulatory and reputational). The number of facilities companies reported having in river basins exposed to risks was added in second tier (model 2). All other variables were added in the third model.

Table 21: Description of dependent variables

Dependent Variables	**Description**	**N**	**Mean**	**Standard Deviation**
CWS –all (all companies)	Continuous measure Range 0 to 29	327	17.1	4.93
CWS 6 steps (pursued all 6 CWS steps)	Continuous measure Range 10 to 29	191	18.5	4.57
CWS < 6steps (pursued up to 5 CWS steps)	Continuous measure Range 7 to 26	136	17.14	4.79

Table 22: Characteristics of predictor variables with continuous measure - water risk, facilities at risk and annual revenue

Independent Variables/ Predictors	**N**	**Description of original data**	**Parameter**	
			Mean	**Standard Deviation**
PHYS	327	Continuous measure Range 0 to 11	1.54	2.03
REG	327	Continuous measure Range 0 to 6	0.68	1.12
REP	327	Continuous measure Range 0 to 4	0.17	0.51
OTHRsk	327	Continuous measure Range 0 to 1	0.03	0.15
Number of facilities in water stress river basins	327	Continuous measure Range 0 to 413	7.66	27.12

Independent Variables/ Predictors	N	Description of original data	Parameter	
			Mean	**Standard Deviation**
Annual revenue	322	Continuous measure Range US $0.10 million to US$358,678 million	$23,944	$35,874

Table 23: Characteristics of predictor variables- sector and economic classification of headquarter country showing data transformations

Independent Variables/ Predictors	N	Description of original data	Transformed Variable for Regression model	
			Categories	**Frequency**
Sector	326	Nominal		
		Consumer Discretionary	S1-ConFinHC vs IndusMatITTelc	125
		Consumer Staples		
		Financials		
		Health Care		
		Industrials	S2-IndusMatITTelc	155
		Information Technology		
		Materials		
		Telecommunication Services		
		Utilities	S3-UtilEnergy vs IndusMatITTelc	46
		Energy		
Economic classification of headquarter country	327	Nominal:		
		Developed		274
		Developing,	HQ in Dev'g and Trans'g. vs Dev'd country	53
		Transitioning		

Analysis of Bias: A first run of the model was done and assessed for violations of assumptions (errors, multicollinearity, bias in cases and assumptions). Durbin-Watson statistic was used to assess for independence of errors (Field, 2013). Variance inflation factors (VIF) and tolerance statistics were used to assess multicollinearity. Cook's distance, average leverage, Mahalanobis distances and covariance ratio were used to identify outlier cases that may influence the model. Twenty three cases were identified as outliers and were excluded from the final regression. This represented 7% of all cases. There were five missing responses, which were also excluded.

Results

Predictors of Corporate Water Stewardship

Regression results showed that water risk, number of facilities located in river basins exposed to water risk, annual revenue, headquarter country's economic classification and sector were significant predictors of CWS.

Corporate water risk (all companies): When CWS for all companies (*N*=299) was regressed against physical, regulatory and reputational water risk, facilities at risk, annual revenue, country classification and sector, physical water risk (β = .378, p< .001), and regulatory water risk (β = .220, p< .001) were the strongest predictors (Table 24). Companies in S1 compared to those in S2 (β = .168), p< .05) and facilities at risk (β = .149, p< .05), and annual revenue (β = .121 p< .05) were also significant predictors of CWS. The final model explained 37.7% of the variance in CWS scores (R^2 = .377, F(8, 298) = 21.916, p< .001)

Corporate water risk (6 steps): When the dependent variable was changed to CWS Score 6 steps to reflect only companies that took action in all six CWS steps (*N*=170), the predictors remained the same except for annual revenue which was no longer a significant predictor (Table 25). Physical water risk (β = .309, p< .001) and regulatory water risk (β = .195, p< .05) were the strongest predictors followed by sector

(β = .177, *p*< .05) and facilities at risk (β = .173, *p*< .05). The final model explained 36.8% of the variance in CWS 6 steps (R^2 = .368, $F(8, 169)$ =11.714, *p*< .001).

Corporate water risk (<6 steps): When CWS scores of companies that did take action in all six CWS steps was the dependent variable (*N*=129), physical and regulatory water risk and facilities at risk were the significant predictors. Physical water risk (β = .319, *p*< .001) was the strongest predictor followed by facilities at risk (β = .241, *p*< .05) and reputational water risk (β = .218, *p*< .05). Annual revenue showed as a significant predictor (β = .174, *p*< .05) in the original model however, bootstrap sample results returned a significance level of p=.053. The final model explained 43.2% of the variance in CWS <6 steps (R^2 = .432, $F(8, 128)$ =11.414 *p*< .001).

Table 24: Hierarchical regression with CWS (all companies) as dependent variable

Corporate Water Stewardship score - all (*N* = 299)			
	Standardized Coefficients		
	Model 1	**Model 2**	**Model 3**
PHYS	**0.378*** **	**0.328*** **	**0.315*** **
REG	**0.220*** **	**0.182** **	**0.193** **
REP	0.090	0.068	0.053
Number of facilities within river basin exposed to water risks (Faccilities at risk)		**0.162** **	**0.149** **
Annual (2014) revenues (USD)			**0.121** **
HQ in Dev'g vs Dev'd country			0.095
S1-ConFinHC vs IndusMatITTelc			**0.168** **
S3-UtilEnergy vs IndusMatITTelc			-0.024
R^2	0.309	0.328	0.377
ΔR^2	**0.309*** **	**0.019** **	**0.049*** **
df	3(298)	4(298)	8(298)
F	**44.001*** **	**35.872*** **	**21.916*** **
*** *p* < 0.001 ** *p*< .01 * *p*< .05			

Table 25: Hierarchical regression with CWS (6 steps) as dependent variable

Corporate Water Stewardship score - 6 steps (N = 170)			
	Standardized Coefficients		
	Model 1	Model 2	Model 3
PHYS	**0.381****	**0.317****	**0.309****
REG	**0.208****	**0.158***	**0.195***
REP	0.102	0.063	0.044
Number of facilities within river basin exposed to water risks		0.187*	0.173*
Annual (2014) revenues (USD)			0.079
HQ in Dev'g vs Dev'd country			0.109
S1-ConFinHC vs IndusMatITTelc			**0.177***
S3-UtilEnergy vs IndusMatITTelc			-0.071
R^2	0.294	0.316	0.368
ΔR^2	**0.0294*****	**0.022****	**0.052****
df	3	4	8
F	**23.032*****	**19.035*****	**11.714*****
*** $p < 0.001$ ** $p < .01$ * $p < .05$			

Table 26: Hierarchical regression with CWS (<6 steps) as dependent variable

Corporate Water Stewardship score – <6 steps (N = 129)			
	Standardized Coefficients		
	Model 1	**Model 2**	**Model 3**
PHYS	**0.397*****	**0.330****	**0.319****
REG	**0.270****	**0.227***	**0.218***
REP	-0.056	-0.085	-0.092
Number of facilities within river basin exposed to water risks		**0.233****	**0.241****
Annual (2014) revenues (USD)			**0.174***
HQ in Dev'g vs Dev'd country			-0.010
S1-ConFinHC vs IndusMatITTelc			0.116
S3-UtilEnergy vs IndusMatITTelc			-0.017
R^2	0.343	0.385	0.432
ΔR^2	**0.343*****	**0.041****	0.047
df	**3**	**4**	8
F	**21.789*****	**19.396*****	**11.414*****
*** $p < 0.001$ ** $p < .01$ * $p < .05$			

Discussion and Conclusion

Understanding companies' CWS actions and the factors that influence those actions is important in pursuing opportunities for corporations to contribute to water risk mitigation and water security for all. This research showed that physical and regulatory water risks, number of facilities at risk, revenue and sector were important predictors of CWS among global corporations that fully disclosed to the 2014 CDP-IWP. Physical and regulatory water risks were the strongest predictors of CWS. This held true for companies that participated in all six steps and those that participated in only four or five CWS steps. This finding partially supports claims in the literature that physical, regulatory and reputational water risks are primary drivers of CWS among large global corporations (Hepworth & Orr, 2013; Schulte et al., 2011). Reputational water risk was however not a significant predictor of CWS. The literature described reputational water risk within the context of CWS as a two-edged sword. While engaging in CWS may reduce water risk, it was also argued that public misconceptions about the motivations of private companies' engagement in CWS could also heighten those risks (Hepworth & Orr, 2013).

It appears that size matters in CWS. In addition to the number of risk indicators to which corporations were exposed, the number of facilities at risk also proved to be a significant predictor of water risk, as was company revenue in some scenarios. Positive coefficients showed that companies with higher number of facilities exposed to water risk and higher annual revenues were likely to be more active in CWS. This was not surprising as CWS has largely been driven by large corporations. Some argued that large corporations have resources available to enable them to assess and understand their risks, identify opportunities and commit to innovative and potentially more costly solutions to complex water challenges globally (CEO Water Mandate et al., 2015; Hepworth & Orr, 2013; Larson et al., 2012). Findings here seem to support such assertions.

The sector to which a company belonged was also an important predictor of CWS. When companies that belonged to the consumer staples, consumer discretionary, financial services and health care sectors were combined into one group (S1) and compared to companies belonging to the industrial, materials, information technology and telecommunications sectors (S2), S1 significantly predicted CWS. S1 predicted CWS only for companies that engaged in all six CWS steps. This was an interesting finding that raises the question of how much of a role brand value, customer perception and corporate social responsibility and sustainability mandates plays in motivating CWS engagement in consumer facing sectors such as those in S1 group. Had reputational water risk been a significant predictor of CWS, it would be easier to surmise that these factors would be important. However that was not the case.

This research is a significant contribution in filling the gap in empirical research of CWS engagement required to "navigate the new paradigm of CWS" that Hepworth & Orr (2013) highlighted in their book chapter: *Corporate Water Stewardship*. This research provides evidence of CWS performance and its relationship with water risk to further understanding of how shared value created from CWS can mitigate water risk for all.

CHAPTER EIGHT: CONCLUSION

Corporate water stewardship is an opportunity for corporations to mitigate physical, regulatory and reputational water risks to their operations, supply chain and society amidst global water crises and climate change (CEO Water Mandate et al., 2015; Hepworth & Orr, 2013). The complexities of CWS as it evolves necessitate understanding CWS in theory and practice and the factors that drive corporations' engagement in CWS. The primary aim of this research was to examine the most important factors related to CWS among the Full Disclosers to the 2014 CDP-IWP, in an effort to increase this understanding of CWS.

Water risks recognized by global corporations

The increase in public discourses in CWS has been attributed to large multinational corporations, NGOs, bilateral and multilateral aid agencies, among others. A key factor was that multinational corporations recognized physical, reputational and regulatory water risks to which their operations and supply chains were exposed, as seen in this research. The results of this study show that over a third of companies in the study recognized exposure to water risks in both their direct operations and supply chain. This is indicative that companies are recognizing water risk outside of the direct sphere of influence of the corporation, where the control necessary to reduce the risk may be lacking (Money, 2014). In recognizing risk in the supply chain, companies can begin to develop strategies and collaborative partnerships to mitigate those risks for their company, other entities and important water-related areas.

Corporations were also able to identify the types of water risks to which they were exposed. Companies were exposed to multiple physical, regulatory and reputational water risks simultaneously, however physical water risk was the most prevalent water risk type among companies in the study. Regulatory water risk was also prevalent among companies. Several risk indicators were identified by over 20% of companies including flooding, pollution of water supply, increased water stress, projected water scarcity and stress, declining water quality and drought which are physical water risks, and higher water prices, regulatory uncertainty which are regulatory water risks. In comparison, the most recognized reputational water risk indicators were community opposition and negative media coverage recognized by 12% and 5% of companies, respectively. In looking at the risk indicators, it is likely that physical risks are more prevalent as there are more established tools for identifying and quantifying these indicators compared to regulatory and reputational water risks (Reig et al., 2013; UN-Water, 2013b; WWAP, 2012). It is also likely that the potentially negative implications of disclosing regulatory and reputational water risks which are tied to regulatory compliance, brand value, public perception and the firm's social license to operate, contributed to lower disclosure of these risks (Hepworth & Orr, 2013; Schulte et al., 2011, 2014).

Factors influencing water risk

Risk management theory indicates that higher value at risk corresponds with higher levels of risks (Knight, 2010; Purdy, 2010). Larger companies with larger number of facilities and larger revenue were therefore expected to have higher exposure to water risk. Similarly, water risk is also a factor of a company's operations such as water use and discharge which varies by sector. Other company characteristics explored were country of the company headquarters and if the country was a developed or developing country. When river basins where companies reported having facilities exposed to water risk were cross-referenced with the Gassert et al. (2013) *WRI Country and River Basin Ranking*, 101 river basins were confirmed. Number of facilities located in these river basins had significant associations with physical water risks, as expected. It was found that and increase in the number of facilities was associated with increase in physical water risk. While the river basin ranking included regulatory and reputational water risks, the prevalence and ease of measuring and quantifying physical water risk indicators were likely factors influencing this finding. The revenue of the company, the sector or the headquarter country and its economic status were not significantly associated with physical, regulatory or reputational water risks individually, however, when examined as aggregate water risk, representing all types, annual revenue and headquarter country's economic status had small but significant relationships.

Corporate Water Stewardship (CWS) in practice

Before the 2014 launch of the AWS Water Stewardship Standard, CWS was described as having "few clear norms or guidance" (Hepworth & Orr, 2013, sec. 5848).

Despite this, CWS has emerged as a strategic approach for corporations to mitigate long-term and shared water risk with sustainable water for all being an outcome (AWS, 2014; Larson et al., 2012). In exploring the linkages between the 2014 CDP water questionnaire and the AWS Standard, this study provides insights into the practice of CWS among global corporations. The results of the study indicate that all companies in the study were engaged in CWS to varying degrees. The AWS Standard stipulates six steps in stewardship—commit, gather and understand, plan, implement, evaluate and communicate, and disclose. Fifty eight percent (58%) of companies pursued activities in all six CWS steps, while 39% had activities in five and 2% in four of the six steps.

Of the six steps the commit step had the lowest level of representation among companies at 63%. The gather and understand step was the most involved step as it involved gathering data on water risk, opportunities, response strategies both in operations and supply chain and within certain parameters for measuring and validating. This step is fundamental to CWS and risk mitigation, all companies took action to identify and understand their water-related present and future circumstances. Once companies have an understanding of their water risks and opportunities, they are better able to develop a plan of action to leverage opportunities to mitigate those risks. The plan step embodies this notion and was pursued by 94% of companies. Implementation of the plan was however lacking. While all but two companies engaged in activities that qualified for the implement step, the level of implementation was low evident in mean scores of 1.7 and median of 2.0 of the maximum 6.0 score. The evaluation and communicate and disclose steps were also prevalent with all companies in the study engaged in activities in these steps. Aggregated scores for all steps were used to determine the CWS performance of companies in the study. All 327 companies included in the study obtained scores for CWS performance. Mean and median CWS scores were higher among companies that pursued all six CWS steps. Features of companies that pursued less than six CWS steps were low commitment and low levels of activity in the gather and understand steps were of note.

When relationships between CWS with water risk were assessed, the significant relationships were observed between the gather and understand, communicate and disclose and plan steps with physical, regulatory and reputational water risk. Significant relationships were observed between companies that were committed to CWS and those exposed to reputational water risk only, while those who implemented their plans were more likely to be exposed to physical water risk. Companies engaged in all six steps were also significantly correlated with those exposed to all water risk types, while companies that engaged in <6 steps were significantly and negatively correlated to reputational water risk.

Predictors of Corporate Water Stewardship (CWS)

This research showed that physical and regulatory water risks, number of facilities at risk, revenue and sector were important predictors of CWS among global corporations that participated in the 2014 CDP Water Disclosure. When all companies were considered, physical and regulatory water risk, companies belonging to consumer-facing sectors (S1) including consumer staples, consumer discretionary, financials and healthcare) compared to industrial sectors (including industrials, materials, information technology and telecommunications), number of facilities located in river basins exposed to water risk, and annual company revenue—were significant predictors of CWS. However, when companies that engaged in all six steps were considered, physical and regulatory water risk, and sector (S1) were significant predictors of CWS. On the flip side, among companies that pursued activities in <6 steps, physical and regulatory water risk, number facilities in river basins exposed to risk, and annual revenue were the significant predictors. For all variables, the coefficients were positive indicating an increase in CWS with increase in these predictors.

Limitations

There were several limitations in this study. Among them was the use of the small, unique population of companies that made full disclosures. This may limit the inability to make statistical generalizations of the results beyond the population of the Full Disclosers to the 2014 CDP-IWP (Tabachnick & Fidell, 2007) in (Mertler & Vannatta, 2010; Polit, 2010). It may be argued however, that the consistency of the findings with the broader constructs of theories related to CWS and water risks, meets the criteria for what Polit & Beck (2010) referred to a *Firestone's analytic generalization*. Further, there is the potential for the findings to be applicable to future Full Disclosures. The CDP reported an increase in disclosures to the 2015 IWP to 1,226 and increase of 15% compared to the 1,064 that disclosed in 2014 (CDP, 2015). At least 83% of the Full Disclosures studied in this research also answered the questionnaire for the 2015 CDP-

IWP survey. This is a positive indication that the study can be replicated using a larger number of participants.

The reliance on discretionary and voluntary self-disclosed information by corporations may be another limitation. Clarkson, Fang, Li, & Richardson (2013) and Villiers & van Staden (2011) argued that corporations that considered themselves high environmental performers were more likely to disclose and will disclose in larger volumes to gain legitimacy with stakeholders during crisis. There was also potential for excluding information, embellishing information, loss through attrition among other things. A sample skewed towards high performers in CWS was however deemed an advantage to this research as the aim was to predict the actions of corporate water stewards and contribute to the field through an understanding of the water risk factors influencing CWS (Auberbach & Silverstein, 2003; Money, 2014).

Finally, the research was limited to the variables common to both the 2014 CDP-IWP questionnaire and the AWS Standard. This resulted in the exclusion of actions required for CWS, but not tracked by the CDP. Despite this, commonalities between the sources were adequate to identify actions in all six steps to enable a robust investigation.

Future Research

Several areas for future research emerged from this study:

- Further investigation into company's engagement in the additional requirements of the AWS Standard is needed to fully understand CWS behavior among corporations.

- More detailed analysis of the individual CWS steps would also be beneficial in learning about CWS behavior at various levels.
- The AWS Standard is relatively new as it was launched in 2014. There are opportunities for longitudinal studies on corporations' progression as the Standard becomes more socialized and reporting of CWS activities becomes more mature. There will likely be opportunities to expand the research to a larger population of Full Disclosures as more companies participate.
- The CWRRS conceptual framework developed in this study presents several research opportunities. This study focused on the water risk exposure, response types and stakeholders components of the framework. There are several other factors that may influence corporations' water risk responses. Selected factors related to risk and the response were also examined. Several other factors that may influence corporations' water risk and response type may also be explored. For example, the relationship between duration of exposure to risk and treatment option and implementation cost. There is also opportunity for detailed analysis of the relationship between risk treatment strategy and risk and CWS.
- There is also need for further investigation into the impacts and outcomes of CWS and how those outcomes contribute to mitigating water risks for all users.
- Outlier cases identified in the regression analysis phase of this study were not included in this study. More detailed examination of these cases should be undertaken in a future study.

Contributions and Policy Implications

This research is a significant contribution in filling the gap in empirical research of CWS engagement required to "navigate the new paradigm of CWS" that Hepworth & Orr (2013) highlighted in their book chapter: *Corporate Water Stewardship*. The study provides empirical evidence of CWS practice that aligns to elements of the AWS Standard among corporations. The findings also provide evidence of the most important factors related to CWS, such as water risk.

These results have several benefits for policymakers engaged in water resource management and water governance. For instance, the study provides insights into risks recognized by corporation and how responses to those risks align to water stewardship. This data can be used by policymakers to identify areas for engaging corporations in collaborative and collective actions for sustainable water resources management and governance.

The research also demonstrates that corporate disclosure is a source of data on water risks and corporate water stewardship. This data is required for risk assessment as well as assessing and monitoring progress against internal company goals and external societal goals, for example at the catchment level. The ability to model and predict CWS practice based on water risk type has value for companies' risk management strategies. Companies have the opportunity to make evidence-based decisions when setting targets developing and action plans to mitigate their water risks. Finally, this research increases knowledge of how shared value created by CWS can mitigate water risk for all.

APPENDIX 1: CDP'S 2014 WATER INFORMATION REQUEST

CDP's 2014 Water Information Request

The following set of questions form CDP's 2014 water information request. Companies are asked to answer these question in the Online Response System (ORS) provided by CDP through its website. As such, this document is a representation of the request and whilst the questions will remain the same, the format may differ online particularly where drop down options and tables have been included for ease of response. Guidance is available on the CDP website from December 2013 which details all of the options available and provides screen shots of the ORS to aid companies in completing the request.

We request a reply to the following questions by 30 June 2014.

Please respond to the information request using our Online Response System (ORS). This is the same ORS as is used for CDP's 2014 climate change and forests information requests. In early February 2014, instructions on how to access the ORS will be sent to you by email. If you are unable to respond via the ORS, please email respond@cdp.net.

We encourage companies to consult CDP's 2014 water reporting guidance at https://www.cdp.net/en-US/Pages/guidance.aspx as well as refer to the guidance within the ORS. Please answer the questions as comprehensively as possible. CDP's signatories are requesting this information to increase their confidence that you are aware of the water risks your organization faces as well as working to develop comprehensive risk mitigation strategies whilst realizing greater strategic advantage. Where you do not have all of the information requested, please respond with what you have as this is more valuable to your investors than no response at all.

Please note that the reporting period and the reporting boundary (i.e. the companies, entities or group) for which you will be providing data will be collected on a page of the ORS prior to the start of the questionnaire.

Current state

W1. Context

W1.1 Please rate the importance (current and future) of water quality and water quantity to the success of your organization

Water quality and quantity	Importance rating	Please explain
Direct use: sufficient amounts of good quality freshwater available for use across your own operations	• Not important at all • Not very important • Neutral • Important • Vital for operations • Have not evaluated	[open text: 500 characters max]
Direct use: sufficient amounts of recycled, brackish and / or produced water available for use across your own operations Indirect use: sufficient amounts of good quality freshwater available for use across your value chain		
Indirect use: sufficient amounts of recycled, brackish and / or produced water available for use across your value chain		

W1.2 Have you evaluated how water quality and water quantity affects /could affect the success (viability, constraints) of your organization's growth strategy?

- Yes, evaluated over the next 1 year
- Yes, evaluated over the next 5 years
- Yes, evaluated over the next 10 years
- Not evaluated
- Other

If Yes and substantive risks are identified, please report these in section 3. Implications.

If yes; if Other

W1.2a Please explain how your organization evaluated the effects of water quality and water quantity on the success (viability, constraints) of your organization's growth strategy? [open text with 2,400 characters max]

If not evaluated:

W1.2b What is the main reason for not having evaluated how water quality and water quantity affects/could affect the success (viability, constraints) of your organization's growth strategy, and are there any plans in place to do so in the future?

Main reason	Current plans	Timeframe until evaluation	Comment
• Judged to be unimportant • No instruction from management • Other, please specify	• Yes • No	• Next reporting period • Next 24-36 months • Other, please specify	[open text: 500 characters max]

Current state

W1.3 Has your organization experienced any detrimental impacts related to water in the reporting period?

- Yes
- No
- Don't know

If Yes:

W1.3a Please describe the detrimental impacts experienced by your organization related to water in the reporting period

Country	River basin	Impact indicator	Impact	Description of impact	Overall financial impact	Response strategy	Description of response strategy
[Country drop down list]	[River basin drop down list] Not known Other, please specify	Physical • Climate change • Declining water quality • Dependency on hydropower • Drought • Ecosystem vulnerability • Flooding • Inadequate infrastructure • Increased water scarcity • Increased water stress • Pollution of water supply • Projected water scarcity • Projected water stress • Seasonal supply variability/inter annual variability Regulatory • Changed product standards • Higher water prices • Increased difficulty in obtaining operations permit • Lack of transparency of water rights • Limited or no river basin/catchment management • Mandatory water efficiency, conservation, recycling or process standards • Poor coordination between regulatory bodies • Poor enforcement of water regulation • Regulation of discharge quality/volumes leading to higher compliance costs • Regulatory uncertainty • Statutory water withdrawal limits/changes to water allocation • Unclear and/or unstable regulations on water allocation and wastewater discharge Reputational: • Changes in consumer behavior • Community opposition • Cultural and religious values • Inadequate access to water, sanitation and hygiene • Litigation • Negative media coverage Other: please specify	• Brand damage • Closure of operations • Decrease in shareholder value • Delays in permitting • Higher operating costs • Fines/ penalties • Litigation • Loss of license to operate • Property damage • Supply chain disruption • Transport disruption • Other, please specify	[open text: 500 characters max]	[open text: 500 characters max]	• Alignment of public policy positions with water stewardship goals • Strengthen links with local community • Engagement with customers • Engagement with public policy makers • Engagement with other stakeholders in the watershed • Engagement with suppliers • Infrastructure investment • Infrastructure maintenance • Greater due diligence • Increased capital expenditure • Increased investment in new technology • New products, markets • Supplier diversification • Establish site-specific targets • Tighter supplier performance standards • Water management incentives • Other, please specify	[open text: 500 characters max]

Current state

If Don't know:

W1.3b Please choose the option below that best explains why you do not know if your organization experienced any detrimental impacts related to water in the reporting period and any plans you have to investigate this in the future

Primary reason	Future plans
• Detrimental impacts related to water are not recorded at the corporate level • No instruction from management • Other, please specify	[open text: 500 characters max]

Risk assessment

W2. Procedures and requirements

W2.1 Please select the option that best describes your procedures with regard to assessing water risks

- Water is integrated into a comprehensive, company-wide risk assessment process incorporating both direct operations and supply chain
- Water is integrated into a comprehensive, company-wide risk assessment process incorporating direct operations only
- Water is integrated into a comprehensive, company-wide risk assessment process incorporating the supply chain only
- Water risk assessments undertaken independently of other risk assessments incorporating both direct operations and supply chain
- Water risk assessments undertaken independently of other risk assessments across some direct operations
- Water risk assessments undertaken independently of other risk assessments across some parts of the supply chain
- Water risks are not assessed
- Other

You will be required to answer questions W2.2-W2.4a if you select any option from the drop down menu with the exception of 'Water risks are not assessed' in which case you will proceed to question W2.5. All organizations are required to answer question W2.1a.

W2.1a You may provide additional information about your approach to assessing water risks here [open text: 1000 characters max]

W2.2 Please state how frequently you undertake water risk assessments, what geographical scale and how far into the future you consider

Frequency	Geographic scale	Timeframe
[open text: 500 characters max]	• Country • Region • River basin • Business unit • Facility	[open text: 500 characters max]

W2.3 Please select the methods used to assess water risks

- FAO/AQUASTAT
- GEMI Local Water Tool
- Internal company knowledge
- IPIECA Global Water Tool for Oil & Gas
- Life Cycle Assessment
- Maplecroft Global Water Security Risk Index
- Regional government databases
- UNEP Vital Water Graphics
- Water Footprint Network
- WBCSD Global Water Tool
- WRI water stress definition
- WRI Aqueduct

Risk assessment

- WWF-DEG Water Risk Filter
- PwC ESCHER tool
- Other, please specify

W2.4 Which of the following contextual issues are always factored into your organization's water risk assessments?

Issues	Choose option	Please explain
Current water availability and quality parameters at a local level	• Relevant, included • Relevant, included for some facilities/suppliers • Relevant, not yet included • Not relevant, included • Not relevant, explanation provided • Not evaluated	[open text: 500 characters max]
Current water regulatory frameworks and tariffs at a local level		
Current stakeholder conflicts concerning water resources at a local level		
Current implications of water on your key commodities/raw materials		
Current status of ecosystems and habitats at a local level Estimates of future changes in water availability at a local level		
Estimates of future potential regulatory changes at a local level		
Estimates of future potential stakeholder conflicts at a local level		
Estimates of future implications of water on your key commodities/raw materials Estimates of future potential changes in the status of ecosystems and habitats at a local level		
Scenario analysis of availability of sufficient quantity and quality of water relevant for your operations at a local level		
Scenario analysis of regulatory and or tariff changes at a local level		
Scenario analysis of stakeholder conflicts concerning water resources at a local level		
Scenario analysis of implications of water on your key commodities/raw materials		
Scenario analysis of potential changes in the status of ecosystems and habitats at a local level		
Other		

Risk assessment

W2.4a Which of the following stakeholders are always factored into your organization's water risk assessments?

Stakeholder	Choose option	Please explain
Customers	• Relevant, included • Relevant, included for some facilities/suppliers • Relevant, not yet included • Not relevant, included • Not relevant, explanation provided • Not evaluated	[open text: 500 characters max]
Employees		
Investors		
Local communities		
NGOs		
Other water users at a local level		
Regulators at a local level		
Statutory special interest groups at a local level		
Suppliers		
Water utilities/suppliers at a local level		
Other		

W2.5 Do you require your key suppliers to report on their water use, risks and management?

- Yes
- No

If Yes:

W2.5a Please provide the proportion of key suppliers you require to report on their water use, risks and management and the proportion of your procurement spend this represents

Proportion of key suppliers %	Total procurement spend %	Rationale for this coverage
• Less than 1% • 1-25 • 26-50 • 51-75 • 76-100	• Less than 1% • 1-25 • 26-50 • 51-75 • 76-100	[open text: 500 characters max]

Risk assessment

If No:

W2.5b Please choose the option that best explains why you do not require your key suppliers to report on their water use, risks and management

Primary reason	Please explain
• Judged to be unimportant • No instruction from management • Other, please specify	[open text: 500 characters max]

Implications

W3. Water risks

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?

- Yes, direct operations and supply chain
- Yes, direct operations only
- Yes, supply chain only
- No
- Don't know

W3.2 Please provide details as to how your organization defines substantive change in your business, operations, revenue or expenditure from water risk [open text with 2,400 characters max]

If Yes, direct operations and supply chain; if Yes, direct operations only

W3.2a Please complete the table below providing information as to the number of facilities in your direct operations exposed to water risks that could generate a substantive change in your business, operations, revenue or expenditure. Please also provide either the proportion of cost of goods sold, global revenue or global production capacity that could be affected across your entire organization at the river basin level

Country	River basin	Number of facilities within the river basin exposed to water risk	Reporting metric	Proportion of chosen metric that could be affected within the river basin
[Country drop down list]	• List of basins • Not known • Other, please specify	[numeric response]	• % cost of goods sold • % global revenue • % global production capacity • % other, please specify	• Less than 1% • 1-5 • 6-10 • 11-20 • 21-30 • 31-40 • 41-50 • 51-60 • 61-70 • 71-80 • 81-90 • 91-100

Implications

If Yes, direct operations and supply chain; if Yes, direct operations only

W3.2b Please list the inherent water risks that could generate a substantive change in your business, operations, revenue or expenditure, the potential impact to your direct operations and the strategies to mitigate them

Country	River basin	Risk driver	Potential impact	Description of impact	Timeframe	Likelihood	Magnitude of potential financial impact	Response strategy	Costs of strategy	Details of strategy and costs
[Country drop down list]	[list of basins] Not known Other, please specify	Physical: • Climate change • Declining water quality • Dependency on hydropower • Drought • Ecosystem vulnerability • Flooding • Inadequate infrastructure • Increased water scarcity • Increased water stress • Pollution of water supply • Projected water scarcity • Projected water stress • Seasonal supply variability/inter annual variability Regulatory: • Changed product standards • Higher water prices • Increased difficulty in obtaining operations permit • Lack of transparency of water rights • Limited or no river basin/catchment management • Mandatory water efficiency, conservation, recycling or process standards • Poor coordination between regulatory bodies • Poor enforcement of water regulation • Regulation of discharge quality/volumes leading to higher compliance costs • Regulatory uncertainty • Statutory water withdrawal limits/changes to water allocation • Unclear and/or unstable regulations on water allocation and wastewater discharge. Reputational: • Changes in consumer behavior • Community opposition • Cultural and religious values • Inadequate access to water, sanitation and hygiene • Litigation • Negative media coverage Other, please specify	• Brand damage • Closure of operations • Constraint to future growth • Decrease in shareholder value • Delays in permitting • Higher operating costs • Fines/ penalties • Litigation • Loss of license to operate • Property damage • Supply chain disruption • Transport disruption • Other, please specify	[open text: 500 characters max]	• Current - up to 1 year • 1- 3 years • 4- 6 years • >6 years • Unknown	• Highly probable • Probable • Unlikely • Unknown	• Low • Low-medium • Medium • Medium-high • High • Unknown	• Alignment of public policy positions with water stewardship goals • Comply with local legal requirements or company own internal standards, whichever is more stringent • Engagement with customers • Engagement with public policy makers • Engagement with suppliers • Establish site-specific targets • Greater due diligence • Increased capital expenditure • Increased insurance cover • Increased investment in new technology • Infrastructure investment • Infrastructure maintenance • Implement minimum performance standards • Implement regulatory requirements • New products, markets • Strengthen links with local community • Supplier diversification • Water management incentives • Other, please specify	• Low • Low-medium • Medium • Medium-high • High • Unknown • Other, please specify	[open text: 2000 characters max]

Implications

If Yes, direct operations and supply chain; if Yes, supply chain only

W3.2c Please list the inherent water risks that could generate a substantive change in your business, operations, revenue or expenditure, the potential impact to your supply chain and the strategies to mitigate them

Country	River basin	Risk driver	Potential impact	Description of impact	Timeframe	Likelihood	Magnitude of potential financial impact	Response strategy	Costs of response strategy	Details of strategy and costs
[Country drop down list]	[list of basins] Not known Other, please specify	Physical: • Climate change • Declining water quality • Dependency on hydropower • Drought • Ecosystem vulnerability • Flooding • Inadequate infrastructure • Increased water scarcity • Increased water stress • Pollution of water supply • Projected water scarcity • Projected water stress • Seasonal supply variability/inter annual variability Regulatory: • Changed product standards • Higher water prices • Increased difficulty in obtaining operations permit • Lack of transparency of water rights • Limited or no river basin/catchment management • Mandatory water efficiency, conservation, recycling or process standards • Poor coordination between regulatory bodies • Poor enforcement of water regulation • Regulation of discharge quality/volumes leading to higher compliance costs • Regulatory uncertainty • Statutory water withdrawal limits/changes to water allocation • Unclear and/or unstable regulations on water allocation and wastewater discharge Reputational: • Changes in consumer behavior • Community opposition • Cultural and religious values • Inadequate access to water, sanitation and hygiene • Litigation • Negative media coverage Other, please specify	• Brand damage • Closure of operations • Constraint to future growth • Decrease in shareholder value • Delays in permitting • Higher operating costs • Higher commodity prices resulting in reduced profit • Fines/ penalties • Litigation • Loss of license to operate • Property damage • Supply chain disruption • Transport disruption • Other, please specify	[open text: 500 characters max]	• Current - up to 1 year • 1-3 years • 4 -6 years • >6 years • Unknown	• Highly probable • Probable • Unlikely • Unknown	• Low • Low-medium • Medium • Medium-high • High • Unknown	• Alignment of public policy positions with water stewardship goals • Comply with local legal requirements or company own internal standards, whichever is more stringent • Engagement with community • Engagement with customers • Engagement with public policy makers • Engagement with suppliers • Greater due diligence • Increased capital expenditure • Increased insurance cover • Increased investment in new technology • Infrastructure investment • Infrastructure maintenance • New products, markets • Supplier diversification • Tighter supplier performance standards • Water management incentives • Other, please specify	• Low • Low-medium • Medium • Medium-high • High • Unknown • Other, please specify	[open text: 2000 characters max]

Implications

If No; if Yes, supply chain only

W3.2d Please choose the option that best explains why you do not consider your organization to be exposed to water risks in your direct operations that could generate a substantive change in your business, operations, revenue or expenditure

Primary reason	Please explain
• Risks exist, but no substantive impact anticipated • Other, please specify	[open text: 500 characters max]

If No; if Yes, direct operations only

W3.2e Please choose the option that best explains why you do not consider your organization to be exposed to water risks in your supply chain that could generate a substantive change in your business, operations, revenue or expenditure

Primary reason	Please explain
• Risks exist, but no substantive impact anticipated • Other, please specify	[open text: 500 characters max]

If Don't know

W3.2f Please choose the option that best explains why you do not know if your organization is exposed to water risks that could generate a substantive change in your business operations, revenue or expenditure and discuss any future plans you have to assess this

Primary reason	Future plans
• Environmental risk assessments are incomplete at this time • No instruction from management • Other, please specify	[open text: 500 characters max]

Implications

W4. Water opportunities

W4.1 Does water present strategic, operational or market opportunities that substantively benefit/have the potential to benefit your organization?

- Yes
- No
- Don't know

If Yes:

W4.1a Please describe the opportunities water presents to your organization and your strategies to realize them

Country or region	Opportunity	Strategy to realize opportunity	Estimated timeframe	Please explain
• Company-wide • Country drop down list • Other, please specify	• Cost savings • Increased brand value • Improved water efficiency • Regulatory changes • Sales of new products/services • Staff retention • Other, please specify	[open text: 500 characters max]	• Current - up to 1 year • 1-3 years • 4-6 years • >6 years • Unknown	[open text: 500 characters max]

If No:

W4.1b Please choose the option that best explains why water does not present your organization with any opportunities that have the potential to provide substantive benefit

Primary reason	Please explain
• Opportunities exist, but nothing substantive • Other, please specify	[open text: 500 characters max]

If Don't know:

W4.1c Please choose the option that best explains why you do not know if water presents your organization with any opportunities that have the potential to provide substantive benefit

Primary reason	Please explain
• Incomplete analysis • Judged to be unimportant • No instruction from management • Other, please specify	[open text: 500 characters max]

Accounting

W5. Water accounting

W5.1 Please report the total withdrawal, discharge, consumption and recycled water volumes across your operations for the reporting period

Water use	Quantity (megaliters)
Total volume of water withdrawn	
Total volume of water discharged	
Total volume of water consumed	
Total volume of recycled water used	

W5.2 For those facilities exposed to water risks that could generate a substantive change in your business, operations, revenue or expenditure, the number of which was reported in W3.2a, please detail which of the following water aspects are regularly measured and monitored and an explanation as to why or why not

Water aspect	% of facilities	Please explain
Water withdrawals – total volumes	• Less than 1% • 1-25 • 26-50 • 51-75 • 76-100	[open text: 500 characters max]
Water withdrawals – volume by sources		
Water discharges – total volumes		
Water discharges – volume by destination		
Water discharges – volume by treatment method		
Water discharge quality data – quality by standard effluent parameters		
Water consumption – total volume		
Water recycling / reuse – total volume		

W5.3 Water withdrawals: for the reporting period, please complete the table below with water accounting data for all facilities included in your answer to W3.2a

Facility reference number	Country	River basin	Facility name	Total water withdrawals (megaliters / year) at this facility	How does the total water withdrawals at this facility compare to the last reporting period?	Please explain the change if substantial
[drop down reference number]	[Country drop down list]	[list of river basin] Not known Other, please specify	[open text: 500 characters max]	[numeric]	• Much Lower • Lower • About the same • Higher • Much Higher • This is our first year of estimation	[open text: 500 characters max]

W5.3a Water withdrawals: for the reporting period, please provide withdrawal data, in megaliters per year, for the water sources used for all facilities reported in W5.3

Facility reference number	Surface water	Groundwater (renewable)	Groundwater (non-renewable)	Municipal water	Recycled water	Produced/ process water	Waste water	Brackish/ salt water
[drop down reference number]	[numeric]	[numeric]	[numeric]	[numeric]	[numeric]	[numeric]	[numeric]	[numeric]

W5.4 Water discharge: for the reporting period, please provide the water accounting data for all facilities reported in W5.3

Facility reference number	Total water discharged (megaliters/year) at this facility	How does the total water discharged at this facility compare to the last reporting period?	Please explain the change if substantive
[drop down reference number]	[numeric]	• Much Lower • Lower • About the same • Higher • Much Higher • This is our first year of estimation	[open text: 500 characters max]

W5.4a Water discharge: for the reporting period, please provide water discharge data, in megaliters per year, by destination for all facilities reported in W5.3

Facility reference number	Surface water	Municipal Treatment Plant	Saltwater	Injection for production / disposal	Aquifer recharge	Storage / waste lagoon
[drop down reference number]	[numeric]	[numeric]	[numeric]	[numeric]	[numeric]	[numeric]

W5.5 Water consumption: for the reporting period, please provide water consumption data for all facilities reported in W5.3

Facility reference number	Consumption (megaliters/year)	How does this compare to the last reporting period?	Please explain the change if substantive
[drop down reference number]	[numeric]	• Much Lower • Lower • About the same • Higher • Much Higher • This is our first year of estimation	[open text: 500 characters max]

W5.6 For the reporting period, please provide any available water intensity values for your organization's products or services across its operation

Country	River basin	Product name	Product unit	Water unit	Water intensity (Water unit/ Product unit)	Water use type	Comment
[Country drop down list]	[drop down list of river basin] Not known Other, please specify	[open text: 500 characters max]]	• Liters • Mega-liters • Kilogram • Ton • Other, please specify	• Liters • Mega-liters	[numeric]	• Withdrawals • Water use in operations • Other please specify	[open text: 1000 characters max]

W5.7 For all facilities reported in W3.2a what proportion of their accounting data has been externally verified?

Water aspect	% verification	What standard was used?
Water withdrawals – total volumes	• Not verified • 1-25 • 26-50 • 51-75 • 76-100	[open text: 500 characters max]
Water withdrawals – volume by sources		
Water discharges – total volumes		
Water discharges – volume by destination		
Water discharges – volume by treatment method		
Water discharge quality data – quality by standard effluent parameters		
Water consumption – total volume		
Water recycling / reuse – total volume		

Response

W6. Governance & Strategy

W6.1 Who has the highest level of direct responsibility for water within your organization and how frequently are they briefed?

Highest level of direct responsibility for water issues	Frequency of briefings on water issues	Comment
• Individual/Sub-set of the Board or other committee appointed by the Board • Senior Manager/Officer • Other Manager/Officer • No individual or committee with overall responsibility for water • Other, please specify	• Scheduled - quarterly • Scheduled - annual • Sporadic - as important matters arise • Never (does not happen) • Other, please specify	[open text 500 characters max]

W6.2 Is water management integrated into your business strategy?

- Yes
- No

If Yes:

W6.2a Please choose the option(s) below that best explain how water has positively influenced your business strategy

Influence of water on business strategy	Please explain
• Alignment of public policy positions with water stewardship goals • Establishment of sustainability goals • Exploration of water valuation practices • Greater due diligence • Introduction of water management KPIs • Investment in staff / training • Water resource considerations are factored into location planning for new operations • Water resource considerations are factored into new product development • Water resource considerations are factored into new market exploration • Publicly demonstrated our commitment to water • Water is factored into procurement directives • Greater supplier diversification • Greater supplier engagement • Tighter operational performance standards • Tighter supplier performance standards • Water management incentives established • No measurable influence • Other, please specify	[open text: 500 characters max]

Response

W6.2b Please choose the option(s) below that best explains how water has negatively influenced your business strategy

Influence of water on business strategy	Please explain
• Closure of operations • Divestment from regions exposed to water risks • Increased capital expenditure • Increased insurance cover • No measurable influence • Other, please specify	[open text: 500 characters max]

If No,

W6.2c Please choose the option that best explains why your organization does not integrate water management into its business strategy and discuss any future plans to do so

Primary reason	Please explain
• Water does not pose a substantive risk to the business strategy • Judged to be unimportant • No instruction from management • Other, please specify	[open text: 500 characters max]

W6.3 Does your organization have a water policy that sets out clear goals and guidelines for action?

- Yes, a publicly available company-wide water policy with performance standards for direct operations including supplier, procurement and contracting best practice and acknowledges the human right to water and sanitation
- Yes, a publicly available company-wide water policy with performance standards for direct operations including supplier, procurement and contracting best practice
- Yes, a publicly available company-wide water policy
- Yes, a company wide water policy
- Yes, a water policy for select facilities only
- No
- Other, please specify

W6.4 How does your organization's water-related capital expenditure (CAPEX) and operating expenditure (OPEX) during the most recent reporting period compare to the previous reporting period?

Water-related spending: % of *total CAPEX* during this reporting period compared to last reporting period	Water-related spending: % of *total OPEX* during this reporting period compared to last reporting period	Motivation for these changes
[numeric response]	[numeric response]	[open text: 500 characters max]

Response

W7. Compliance

W7.1 Was your organization subject to any penalties and/or fines for breaches of abstraction licenses, discharge consents or other water and wastewater related regulations in the reporting period?

- Yes, significant
- Yes, not significant
- No
- Don't know

If Yes,

W7.1a Please describe the penalties and/or fines for breaches of abstraction licenses, discharge consents or other water and wastewater related regulations and your plans for resolving them

Facility name	Incident description	Financial penalty or fine	Currency	Incident resolution
[open text: 500 characters max]	[open text: 500 characters max]	Numerical field	[Dropdown]	[open text: 500 characters max]

W7.1b
Please indicate the total of all penalties and/or fines for breaches of abstraction licenses, discharge consents or other water and wastewater related regulations as a percentage of total operating expenditure (OPEX) compared to last year

- Much lower
- Lower
- No change
- Higher
- Much higher

Response

W8. Targets and initiatives

W8.1 Do you have any company wide targets (quantitative) or goals (qualitative) related to water?

- Yes, target and goals
- Yes, targets only
- Yes, goals only
- No

If Yes targets and goals; if Yes targets only:

W8.1a Please complete the following table with information on company wide quantitative targets (ongoing or reached completion during the reporting period) and an indication of progress made

Category of target	Motivation	Description of target	Quantitative unit of measurement	Base-line year	Target year	Proportion of target achieved, % value
• Absolute reduction of water withdrawals • Reduction in consumptive volumes • Reduction of water intensity • Water pollution prevention • Other, please specify	• Brand value protection • Cost savings • Increased revenue • Recommended sector best practice • Risk mitigation • Sales of new products / services • Shared value • Water stewardship • Other, please specify	[open text: 500 characters max]	• % increase in rainwater harvesting per facility • % increase in rainwater harvesting per product • % increase in recycling / reuse per facility • % increase in recycling / reuse per product • % increase of wastewater reclamation per facility • % increase of wastewater reclamation per product • % reduction in concentration of contaminants per discharge volume • % reduction of water sourced from groundwater • % reduction of water sourced from municipal supply • % reduction of water sourced from surface water • % reduction per business unit • % reduction per dollar revenue • % reduction per employee • % reduction per product • % reduction per unit of production • Other, please specify	[Numeric]	[Numeric]	[Numeric]

Response

If Yes targets and goals; If Yes goals only:

W8.1b Please describe any company wide qualitative goals (ongoing or reached completion during the reporting period) and your progress in achieving these

Goal	Motivation	Description of goal	Progress
• Increase access to Safe Water, Sanitation, and Hygiene (WASH) • Strengthen links with local community • Educate customers to help them minimize product impacts • Engagement with public policy makers to advance sustainable water policies and management • Engagement with suppliers to help them improve water stewardship • Sustainable agriculture • Watershed remediation and habitat restoration, ecosystem preservation • Other, please specify	• Brand value protection • Cost savings • Increased revenue • Recommended sector best practice • Risk mitigation • Sales of new products / services • Shared value • Water stewardship • Other, please specify	[open text: 500 characters max]	[open text: 500 characters max]

If No:

W8.1c Please explain why you do not have any water-related targets or goals and discuss any plans to develop these in the future [open text: 500 characters max]

Sign off

W9.1 Please provide the following information for the person that has signed off (approved) your CDP water response

Name	Job title	Corresponding job category
[open text: 200 characters max]	[open text: 200 characters max]	Select from: Board chairman Board/Executive board Director on board Chief Executive Officer (CEO) Chief Financial Officer (CFO) Chief Operating Officer (COO) Business unit manager Energy manager Environment/Sustainability manager Facilities manager Head of risk Head of strategy Process operation manager Public affairs manager Risk manager Other, please specify

Important information

The Carbon Disclosure Project (CDP) has been making information requests relating to carbon and climate change on behalf of investors since 2002 and this is CDP's fifth information request relating to water. To find out more about CDP and the previous responses from other major companies, please refer to our website at www.cdp.net.

Why is this request from a group of shareholders to a group of companies rather than from an individual shareholder to an individual company?

1. To facilitate ease of reporting for companies by providing one standardized request that requires one response to be delivered to numerous investors
2. To receive data in a common format from the largest companies in the world

Which companies will be written to?

Companies participating in CDP's programs are selected using economic (market) and environmental criteria. Please refer to our website at https://www.cdp.net/en-US/Programmes/Pages/samples.aspx to learn more about the companies targeted by each program and the selection criteria used.

What are the financial implications of responding?

CDP has charitable status and seeks to use its limited funds effectively. Consequently, responses must be prepared and submitted at the expense of responding companies. CDP also reserves the right, where it deems it appropriate in view of its charitable aims and objectives, to charge for access to or use of data and/or reports it publishes or commissions.

What is the basis of participation and what will happen to the data received?

Companies responding to CDP's 2014 water information request make no claim of ownership in the data they submit and agree that CDP has an irrevocable license to use and copy the responses and their contents without restriction and to authorize others to do the same. Companies responding to CDP's 2014 water information request agree that CDP is free to make use of the data including as described below and with respect to public responses otherwise without restriction whatsoever in furtherance of its charitable mission. Companies also agree that CDP will own the databases in which that data is stored, as well as the contents of those databases.

When responding to CDP you will be given a choice as to whether your response is made public or nonpublic. We strongly encourage companies to make their responses public which means that the response will be made publicly available from the CDP website as outlined below. Non-public responses will not be made publicly available and will only be used as outlined below.

For public responses

Companies agree that a public response to CDP's 2014 water information request will be used by CDP in furtherance of its charitable mission and that the response may be:

1. Made available as soon as it is received by CDP to its signatories, partners, appointed report writers, selected rating agencies and any other parties that CDP deem appropriate
2. Made publicly available at www.cdp.net after the release of the 2014 CDP Global Water Report and stored and preserved on CDP's servers indefinitely thereafter
3. Distributed through selected partners
4. Compiled in CDP databases and made available in original, modified or adapted form (for a fee or otherwise) for use by commercial and non-commercial organizations
5. Amalgamated with information about the responding company from other public sources including rating agencies and financial information distributors
6. Used as a best practice example in CDP literature and research
7. Used individually or as part of aggregate results in CDP's reports and in any other research conducted or commissioned by CDP
8. Used in any other way that accords with CDP's charitable mission

Important information

For non-public responses

Companies agree that a non-public response to CDP's 2014 water information request may be:

1. Made available as soon as it is received by CDP to its signatories, partners and appointed report writers but not to any other parties
2. Used in production of aggregate or anonymous statistics in any CDP report

Scoring of responses

CDP and other organizations write and publish reports that include an overview of CDP responses. In 2014, CDP will test a water scoring methodology on a confidential basis with Global 500 respondents whereby the company's score will only be made available to the responding company, to CDP for research purposes, and to CDP's scoring partner. Throughout 2014 CDP will work with a wide range of stakeholders to test and refine the methodology. The methodology will be fully implemented across all respondents in the 2015 disclosure cycle.

What if a company wishes to change or update a response?

Submissions and revisions must be made by companies by 30 June 2014 to be included in the annual CDP reports. After this date, responses can only be amended by CDP staff and this may incur an administration fee. CDP cannot guarantee that changes made after 30 June 2014 will be reflected in the reports produced.

How can a company confirm its participation?

On receipt of these documents, please e-mail respond@cdp.net to confirm your participation in CDP 2014.

What is the legal status of CDP?

CDP Worldwide (CDP) is a UK Registered Charity no. 1122330 and a company limited by guarantee registered in England no. 05013650. In the US, Carbon Disclosure Project (North America) Inc has United States IRS 501(c)(3) charitable status.

CDP is an independent not-for-profit organization holding the largest collection globally of self reported climate change, water and forest-risk data.

Thousands of organizations from across the world's major economies measure and disclose their environmental information through CDP. CDP puts this information at the heart of financial and policy decision-making and its goal is to collect and distribute high quality information that motivates investors, corporations and governments to take action to prevent dangerous climate change and protect our natural resources.

APPENDIX 2: CDP-AWS LINKAGES

AWS Criteria	CDP Water Questionnaire
Commit	
1.2 Develop a water stewardship policy	W6.3 Does your organization have a water policy that sets out clear goals and guidelines for action

AWS Criteria	CDP Water Questionnaire
Gather & Understand	
2.1 Define the physical scope	W2.2 Please state how frequently you undertake water risk assessments, what geographical scale and how far into the future you consider
2.2 Identify stakeholders, their water-related challenges and the site's sphere of influence	W2.4 Which of the following contextual issues are always factored into your organization's water risk assessments?
	W2.4a Which of the following stakeholders are always factored into your organization's water risk assessments?
2.3 Gather water-related data for the catchment	W2.4 Which of the following contextual issues are always factored into your organization's water risk assessments?
2.4 Gather water-related data for the site	W5: Accounting - 5.3 withdrawals (2.4.2 Standard), 5.4 discharge (2.4.2 Standard), 5.5 consumption (2.4.2 Standard), 5.6 water intensity (2.4.2 Standard) 2.4.3 - link to W5.2 table option about water discharge quality data
2.5 Improve the site's understanding of its indirect water use	W1.1 Please rate the importance (current and future) of water quality and water quantity to the success of your organization
	W2.5 Do you require your key suppliers to report on their water use, risks and management?
	W2.5a Please provide the proportion of key suppliers you require to report on their water use, risks and management and the proportion of your procurement spend this represents
2.6 Understand shared water-related challenges in the catchment	W3.2b & W3.2c (Risk driver column, IF shared) W3.2b Please list the inherent water risks that could generate a substantive change in your business, operations, revenue or expenditure, the potential impact to your direct operations and the strategies to mitigate them
	W3.2c Please list the inherent water risks that could generate a substantive change in your business, operations, revenue or

AWS Criteria	CDP Water Questionnaire
Gather & Understand	
	expenditure, the potential impact to your supply chain and the strategies to mitigate them
2.7 Understand and prioritize the site's water risks and opportunities	W1.3a (Impact column) Please describe the detrimental impacts experienced by your organization related to water in the reporting period
	W1.3a Please describe the detrimental impacts experienced by your organization related to water in the reporting period
	W3.2b & W3.2c (Potential impact, Description of impact, Timeframe and Likelihood columns) Please list the inherent water risks that could generate a substantive change in your business, operations, revenue or expenditure, the potential impact to your direct operations & supply chain and the strategies to mitigate them
	W4.1 Does water present strategic, operational or market opportunities that substantively benefit/have the potential to benefit your organization?
	W4.1a Please describe the opportunities water presents to your organization and your strategies to realize them
2.10 Review a formal study on future water resources scenarios	W1.2 Have you evaluated how water quality and quantity affects/could affect the success of your organization's growth strategy?
2.11 Conduct a detailed, indirect water use evaluation	W2.5 Do you require your key suppliers to report on their water use, risks and management?
	W2.5a Please provide the proportion of key suppliers you require to report on their water use, risks and management and the proportion of your procurement spend this represents
	W3.2c Please list the inherent water risks that could generate a substantive change in your business, operations, revenue or expenditure, the potential impact to your supply chain and strategies to mitigate them

AWS Criteria	CDP Water Questionnaire
Plan	
3.1 Develop a system that promotes and evaluates water-related legal compliance	W6.1 Who has the highest level of direct responsibility for water within your organization, and how frequently are they briefed?
3.2 Create a site water stewardship strategy and plan	W1.3a (Response strategy and Description of response strategy columns) Please describe the detrimental impacts experienced by your organization related to water in the

AWS Criteria	CDP Water Questionnaire
Plan	
	reporting period
	W8.1a Please complete the following table with information on company-wide quantitative targets (ongoing or reached completion during the reporting period) and an indication of progress made
	W8.1b Please describe any company-wide qualitative goals (ongoing or reached completion during the reporting period) and your progress in achieving these

AWS Criteria	CDP Water Questionnaire
Implement	
4.1 Comply with waterrelated legal and	W7. Compliance (will need to qualify)
4.2 Maintain or improve site water balance	W8.1a. Please complete the following table with information on company-wide quantitative targets (ongoing or reached completion during the reporting period) and an indication of progress made - Dropdown option: "Absolute reduction of water withdrawals", "Reduction in consumptive volumes".
4.3 Maintain or improve site water quality	W8.1a. Please complete the following table with information on company-wide quantitative targets (ongoing or reached completion during the reporting period) and an indication of progress made - Dropdown option: "Quantitative unit of measurement - % reduction in concentration of contaminants per discharge volume".
4.6 Maintain or improve indirect water use within the catchment	W8.1a. Please complete the following table with information on company-wide quantitative targets (ongoing or reached completion during the reporting period) and an indication of progress made - Dropdown option: "Engagement with suppliers to help them improve water stewardship".
4.7 Provide access to safe drinking water, adequate sanitation and hygiene awareness (WASH) for workers on-site	W8.1a. Please complete the following table with information on company-wide quantitative targets (ongoing or reached completion during the reporting period) and an indication of progress made - Dropdown option: "Increase access to Safe Water, Sanitation and Hygiene (WASH) ".
4.18 Provide access to safe drinking water, adequate sanitation and hygiene awareness off-site	W8.1a. Please complete the following table with information on company-wide quantitative targets (ongoing or reached completion during the reporting period) and an indication of progress made - Dropdown option: "Increase access to Safe Water, Sanitation and Hygiene (WASH)"

AWS Criteria	CDP Water Questionnaire
Evaluate	
5.5 Conduct executive or governance body-level review of water stewardship efforts	W9.1 Please provide the following information for the person that has signed off (approved) your CDP water response

AWS Criteria	CDP Water Questionnaire
Communicate & Disclose	
6.1 Disclose water-related internal governance	W6.1 Who has the highest level of direct responsibility for water within your organization, and how frequently are they briefed?
6.3 Disclose efforts to address shared water challenges	W3.2b & W3.2c (Risk driver and Response strategy columns) Please list the inherent water risks that could generate a substantive change in your business, operations, revenue or expenditure, the potential impact to your direct operations & supply chain and the strategies to mitigate them
6.4 Drive transparency in water-related compliance	W7. Compliance (will need to qualify
6.6 Disclose water risks to owners (in alignment with recognized disclosure frameworks)	W3. Water risks

APPENDIX 3: CORRELATION OF VARIABLES IN REGRESSION MODELS

Correlations between CWS- all companies- and predictor variables

Correlations

		CWS score (max 32)	PHYSRsk	REGRsk	REPRsk	Number of facilities within river basin exposed to water risks	Annual (2014) revenues (USD)	HQ in Dev'g vs Dev'd country	S1-ConFinHC vs IndusMatITTelc	S3-UtilEnergy vs IndusMatITTelc
Pearson Correlation	CWS score (max 32)	1.000	.509	.423	.270	.403	.160	.150	.169	.042
	PHYSRsk	.509	1.000	.469	.311	.459	.059	.189	-.025	.100
	REGRsk	.423	.469	1.000	.284	.416	.000	.060	-.012	.271
	REPRsk	.270	.311	.284	1.000	.302	-.003	.150	.036	.013
	Number of facilities within river basin exposed to water risks	.403	.459	.416	.302	1.000	.108	.092	.007	.183
	Annual (2014) revenues (USD)	.160	.059	.000	-.003	.108	1.000	-.204	.059	.108
	HQ in Dev'g vs Dev'd country	.150	.189	.060	.150	.092	-.204	1.000	-.084	-.085
	S1-ConFinHC vs IndusMatITTelc	.169	-.020	-.013	.036	.007	.059	-.084	1.000	-.287
	S3-UtilEnergy vs IndusMatITTelc	.042	.100	.271	.013	.183	.108	.085	.237	1.000
Sig. (1-tailed)	CWS score (max 32)		.000	.000	.000	.000	.004	.005	.002	.232
	PHYSRsk	.000		.000	.000	.000	.150	.001	.329	.043
	REGRsk	.000	.000		.000	.000	.150	.150	.417	.000
	REPRsk	.000	.000	.000	.	.000	.479	.005	.260	.411
	Number of facilities within river basin exposed to water risks	.000	.000	.000	.000	.	.031	.057	.453	.001
	Annual (2014) revenues (USD)	.004	.150	.150	.479	.031		.000	.155	.031
	HQ in Dev'g vs Dev'd country	.005	.001	.150	.005	.057	.000	.	.253	.071
	S1-ConFinHC vs IndusMatITTelc	.002	.329	.417	.260	.453	.155	.053	.	.000
	S3-UtilEnergy vs IndusMatITTelc	.232	.043	.000	.411	.001	.031	.071	.000	

Correlations between CWS-companies that pursued less than 6 steps- and predictor variables

Correlations

		CWS Score <6 Steps	PHYSRisk	REGRisk	REPRisk	Number of facilities within river basin exposed to water risks	Annual (2014) revenues (USD)	B1-ConFinHC vs IndusMatTel	B3-UtilEnergy vs IndusMatTTel	HQ in Dev'g vs Dev'd country
Pearson Correlation	CWS Score <6 Steps	1.000	.547	.500	.161	.443	.262	.111	.122	.111
	PHYSRisk	.547	1.000	.624	.333	.444	.155	.053	.165	.262
	REGRisk	.500	.621	1.000	.316	.402	.097	.020	.203	.071
	REPRisk	.161	.333	.316	1.000	.277	.097	-.051	-.058	.135
	Number of facilities within river basin exposed to water risks	.440	.444	.402	.277	1.000	.002	-.054	.135	.250
	Annual (2014) revenues (USD)	.262	.155	.097	.097	.032	1.000	.062	.119	-.164
	B1-ConFinHC vs IndusMatTTel	.111	-.053	.020	-.051	-.054	.062	1.000	-.280	.004
	B3-UtilEnergy vs IndusMatTTel	.122	.165	.203	-.086	.133	.119	-.280	1.000	-.115
	HQ in Dev'g vs Dev'd country	.111	.262	.071	.135	.250	-.164	.004	-.115	1.000
Sig. (1-tailed)	CWS Score <6 Steps		.000	.000	.034	.000	.001	.106	.057	.105
	PHYSRisk	.000	.	.000	.000	.000	.040	.276	.031	.001
	REGRisk	.000	.000	.	.000	.000	.138	.410	.010	.211
	REPRisk	.034	.000	.000	.	.001	.138	.284	.155	.064
	Number of facilities within river basin exposed to water risks	.000	.000	.000	.001	.	.178	.272	.013	.002
	Annual (2014) revenues (USD)	.001	.040	.138	.138	.173		.241	.059	.031
	B1-ConFinHC vs IndusMatTTel	.106	.276	.410	.284	.272	.241		.001	.480
	B3-UtilEnergy vs IndusMatTTel	.064	.031	.010	.166	.010	.009	.001	.	.097
	HQ in Dev'g vs Dev'd country	.105	.001	.211	.064	.002	.031	.480	.097	

Correlations between CWS- companies that pursued all 6 steps- and predictor variables

Correlations

		CWS Score =6 Steps	PHYSRsk	REGRsk	REPRsk	Number of facilities within river basin exposed to water risks	Annual (2014) revenues (USD)	B1-ConFinHC vs IndusMatTTel	B3-UtilEnergy vs IndusMatTTel	HQ in Dev'g vs Dev'd country
Pearson Correlation	CWS Score =6 Steps	1.000	.547	.500	.161	.443	.262	.111	.122	.111
	PHYSRsk	.547	1.000	.624	.333	.444	.156	.053	.165	.262
	REGRsk	.500	.624	1.000	.316	.402	.097	.020	.203	.071
	REPRsk	.161	.333	.316	1.000	.277	.097	-.051	-.086	.105
	Number of facilities within river basin exposed to water risks	.440	.444	.402	.277	1.000	.002	-.054	.135	.250
	Annual (2014) revenues (USD)	.262	.156	.097	.097	.002	1.000	.062	.119	-.164
	B1-ConFinHC vs IndusMatTTel	.111	-.053	.020	-.051	-.054	.062	1.000	-.280	.004
	B3-UtilEnergy vs IndusMatTTel	.122	.165	.203	-.086	.135	.119	-.280	1.000	-.115
	HQ in Dev'g vs Dev'd country	.111	.262	.071	.105	.250	-.164	.004	-.115	1.000
Sig. (1-tailed)	CWS Score =6 Steps		.000	.000	.034	.000	.001	.106	.084	.106
	PHYSRsk	.000	.	.000	.000	.000	.040	.276	.031	.001
	REGRsk	.000	.000	.	.000	.000	.138	.410	.010	.211
	REPRsk	.034	.000	.000	.	.001	.138	.284	.166	.064
	Number of facilities within river basin exposed to water risks	.000	.000	.000	.001	.	.178	.272	.013	.002
	Annual (2014) revenues (USD)	.001	.040	.138	.138	.178		.241	.009	.031
	B1-ConFinHC vs IndusMatTTel	.106	.276	.410	.284	.272	.241		.001	.480
	B3-UtilEnergy vs IndusMatTTel	.084	.031	.010	.166	.013	.009	.001	.	.097
	HQ in Dev'g vs Dev'd country	.106	.001	.211	.064	.002	.031	.480	.097	

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