CREATING SHARED VALUE THROUGH CORPORATE SOCIAL INVESTMENT: MANAGING WATER-RELATED RISK AND OPPORTUNITY THROUGH COCA-COLA'S REPLENISH AFRICA INITIATIVE

by

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Abstract

Nearly 300 million people throughout the African continent lack access to clean drinking water, and far more are without improved sanitation facilities. Companies such as The Coca-Cola Company, which rely on access to freshwater resources and surrounding communities for their core business operations and supply chains, face growing material risks as well as opportunities from the global water crisis (which includes sanitation challenges as well). Investments in water stewardship are becoming an increasingly common strategy for corporate or other private investors to both manage downside risk and build upside potential, particularly in emerging economies throughout the African region. Indeed, organizations that are able to forge relationships with markets and societies in Africa today are likely to be well positioned to enjoy the high rates of growth projected for the region. This report highlights 5 thematic area where business benefits from water stewardship investments can be realized, including: corporate competitiveness, operational efficiency, human capital, social capital, and risk exposure. Through the development of original spatial analyses, the report underscores selected trends and presents a series of recommendations for what type of water stewardship activities should be targeted to specific countries. Through a systems-based mapping of over 50 distinct dimensions of both societal and business value creation and their interconnections, the report also discusses several high-level leverage points for value creation. These leverage points are capable of effecting deep systems-level change, and are presented as recommended programmatic themes. Finally, The Coca-Cola Africa Foundation's Replenish Africa Initiative (RAIN) is presented and discussed as an example of a water stewardship investment that provides numerous benefits to societies, to larger economies, and to natural ecosystems.

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We are also truly appreciative of the team of passionate professionals at the Global Water Challenge (GWC) and Global Environment & Technology Foundation (GETF, the secretariat for GWC) for opening their doors to our team. Every single member of the GETF team was a clear example of someone who lived his or her values of generosity, patience, and commitment. In particular, we would like to thank Monica Ellis and Maurie Carr, without whom this project would not have been possible. We would also like to offer our sincere thanks for the opportunity to travel to the Republic of South Africa, made possible through the kind support of GWC; and to Kyle Sucher, for being a patient traveling partner and gracious guide.

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Last, and most certainly not least, we wish to thank the many individuals throughout The Coca-Cola Company and The Coca-Cola Africa Foundation, as well as the numerous experts and stakeholders who contributed their experiences, their insight, their time, and themselves.

The GWC and GETF team included:

Monica Ellis CEO	**Maurie Carr** Vice President, Partnerships and Development	**Kyle Sucher** Program Director, Southern Africa & Executive Officer
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We would also like to acknowledge the various contributions of each member of the report team. Each member of the team contributed in many different ways to the project, and indeed, each was vital.

Dan Mitler authored the business case chapter, prepared the executive summary, co-researched and developed the value creation systems model, researched and designed the Social Capabilities Index, co-authored and served as 'loop analyst' for the value creation model section, contributed to the case study, and researched and developed the IDPM Framework. His extensive research efforts helped provide a solid foundation for each stage of the project. His innovative problem solving approach helped keep the project moving forward, and his oversight on a wide variety of administrative and managerial responsibilities was instrumental to the success of the team. His professional approach to stakeholder interviews and conversations was likewise an asset to the team.

Devan Rostorfer was the primary author for the introduction, a co-researcher and co-author for the value creation model section, a contributor to the case study, and the primary author of the section that ties the spatial assessment results to the value creation model. She was a wellspring of dedicated and enthusiastic energy throughout the project and contributed in many ways. In addition to assisting with the management of various administrative tasks and responsibilities, she brought a strong background in water systems to the team and she also has a strong understanding of Coca-Cola's water, stewardship, and replenishment goals. For the value creation model, she co-created the systems model and contributed substantially towards the identification, preparation, and explanation of loops and graphics. Her presence during presentations and site visits brought appreciable positive impacts.

Keely Ledbetter researched and designed the State of Freshwater Resources Index and analyzed spatial trends across Africa and within South Africa. She authored the spatial assessments section and was co-author for the case study section. Her research helped infuse the project with important and useful information and resources. Her analytical problem solving skills helped overcome obstacles impeding project advancement, and her critical reality checks and management of project scope were invaluable to the team's success. Her attention to detail and unparalleled data management skills were invaluable throughout the course of the project.

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Introduction

According to UNESCO, "*Water is a critical natural resource upon which all social and economic activities and ecosystem functions depend.*"[1] However, just this year, the World Economic Forum listed the global water crisis as the number one societal risk, in terms of impact, for 2015. The World Economic Forum defines the water crisis as, "a significant decline in the available quality and quantity of freshwater, resulting in harmful effects on human health and/or economic activity."[2] The very fact that the World Economic Forum (which is best known for its annual meeting of 2,500 global business, political, and thought leaders) gives such importance to the water crisis is demonstrative not only of the magnitude of the challenge, but also of the fast-growing interest in addressing water-related issues. This ultimately leads to the framing question for this report:

What role can private sector actors play in addressing the water crisis?
Can investments in water stewardship generate shared value?

Using The Coca-Cola Africa Foundation's *Replenish Africa Initiative* (RAIN) as an illustrative example of an active water stewardship program, the University of Michigan team assessed the intersection of water-related risk, corporate social investment and shared value creation in Africa in order to contextualize the shared value creation opportunities associated with corporate investments in water stewardship. This report has several objectives, which are as follows: (1) to develop and present the business case for corporate water stewardship investments; (2) to identify and map social, environmental, and economic risks and opportunities on the African continent, with a focus on identifying areas with high water risk and high economic opportunity, in order to suggest appropriate water-related investments to drive shared value; (3) to explore the concept of shared value creation through the development of a value creation model representing the most current perspectives on shared economic, social and environmental value associated with water-related investments; (4) to investigate specific pathways to value from these investments by using the value creation model as a guide; and (5) to present the RAIN Water for Schools program in South Africa, along with connected results from the spatial assessments and value creation model, allowing the value-creation potential associated with the program to be explored. A short description of each section is included on the following page.

Overview

Business Case for Water Stewardship Investments in Africa

Is there a business case for investing in water stewardship in Africa? This chapter reviews relevant economic trends and projections to demonstrate the market growth potential throughout Africa in the coming years and decades. After a brief overview of water stewardship interventions, the available literature is surveyed to provide an in-depth analysis of macroeconomic and ecological benefits and costs. Finally, the chapter provides a comprehensive discussion of the potential benefits that can be realized by businesses in the categories of: enhanced competitiveness, operational efficiency improvements, human capital growth, social capital growth, and reduced risk exposure. It concludes that there is a definite case to be made for investing in water stewardship throughout Africa, particularly by business and related interests. The currently available evidence points clearly to the benefits from such investments outweighing the costs.

Spatial Assessments

Spatial assessments are conducted to identify trends in social, environmental, and economic risks, and opportunities on the African continent using three composite indicators. The composite indicators include an original *State of Freshwater Resources Index*, an original *Social Capabilities Index*, and an adopted *Global Competitiveness Index*. In addition to three composite indicators, the assessments also examine important standalone datasets to help understand social, economic, and environmental risks and opportunities. The results from the spatial assessments are coupled with insights from the value creation model to determine which water stewardship investments have the potential to create shared value in specific geographies.

Value Creation Model

A value creation model is developed using *complex systems theory* to illustrate pathways to value through corporate water stewardship. By taking a novel systems-based approach, the *Water Stewardship Causal Loop Diagram (CLD)* is developed to analyze how value can be created from water-related investment. This analysis provides an original and holistic way of understanding the relationship between societal value, and business value.

Case Study

Finally, a case study is developed to apply results from the spatial assessments and the *Water Stewardship CLD* to Coca-Cola's Replenish Africa Initiative (RAIN) with a specific focus on one of RAIN's many programs--the RAIN Water for Schools program.

Defining water security for industry and development agencies

In order to further contextualize the global water crisis, the competing definitions of water security for both industry and development agencies (including the United Nations, which recognizes clean water as a basic human right) will be explored. Furthermore, human risks related to water, sanitation and hygiene will be discussed before introducing water-related risks that effect industry. Additional business risks and opportunities associated with freshwater will be further explored in the *Business Case for Water Stewardship* section of this report.

Finally, opportunities associated with managing water-related risk will be explored before introducing the Coca-Cola System's approach to managing water-related risks. In this sub-section, the Coca-Cola System's relationship with water will be analyzed before introducing its sustainability commitments and the Replenish Africa Initiative, which is the flagship community water program that is currently being implemented by The Coca-Cola Africa Foundation.

The Team

Dan Mitler

M.S., Natural Resources and Environment; Certificate: Industrial Ecology
Focus: Environmental Planning and Policy

Dan Mitler completed a Master of Science in the University of Michigan's School of Natural Resources and Environment. He founded and served as principal consultant for a corporate sustainability consultancy, where he advised multinational and regional companies on strategic sustainability issues, facilitated workshops with executives and staff, and prepared GHG, energy, and waste reviews. He has also worked with companies such as Steelcase, Inc. and the Whirlpool Corporation to manage sustainability data analytics, prepare Carbon Disclosure Project (CDP) annual reporting documents, calculate global Scope 1, 2, and 3 emissions, and to conduct a competitive lifecycle assessment on a best-in-class appliance. He has also published an original case study through the Ross School of Business, and served as lead or contributing author in two University of Michigan reports on shale gas and hydraulic fracturing. He received his Bachelor of Arts in the applied social sciences from Kalamazoo College, and has both worked and studied internationally, including six months at the International Sustainable Development Studies Institute in Northern Thailand as well as time in Africa, Central America, and Europe.

Devan Rostorfer

M.S., Natural Resources and Environment; Certificate: Industrial Ecology
Focus: Environmental Planning and Policy/Sustainable Systems/Conservation Ecology

Devan Rostorfer completed a Master of Science in the University of Michigan's School of Natural Resources and Environment. She has experience working for The Nature Conservancy to develop regional water quality strategy and she also has experience conducting stormwater assessments to manage water quantity and quality. In 2015, her base-of-the pyramid, social enterprise concept earned a spot in the Hult Prize International Regional finals in San Francisco. She also published an original case study on Chevron's business operations in Chad through the Ross School of Business and the William Davidson Institute. She received her Bachelor of Science in pre-medical biology from Chaminade University of Honolulu and a certificate in entrepreneurship from the Hogan Entrepreneur Program. Devan has volunteered and studied internationally in China, India, American Samoa, Australia, and most recently, South Africa. Her primary career interests resonate at the intersection of integrated watershed management, corporate water stewardship, and sustainable development. In June 2015, Devan started working at the Southeast Michigan Council of Governments as an Environmental Planner to protect water quality and manage water quantity across seven counties in southeast Michigan.

Keely Ledbetter
M.S., Natural Resources and Environment;
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Keely Ledbetter completed a Master of Science in the University of Michigan's School of Natural Resources and Environment. She received her bachelor's degree in Natural Resources, with a minor in Applied Statistics, from Northland College in Ashland, Wisconsin. She is interested in coupled human-natural systems, particularly due to changes in climate patterns and land use and the interactions between the two. She has valuable spatial analysis experience from her work in the Environmental Spatial Analysis Lab, where she analyzed demographic and environmental data for Michigan counties, census tracts, and block groups, and her work with Quantum Spatial, Inc., where she consulted on geospatial analysis projects for such clients as the U.S. National Oceanic and Atmospheric Administration and the U.S. Forest Service. Her coursework focuses on spatial analysis, remote sensing, modeling, data illustration and management, and nontraditional sources of information.

Terry Nelidov (Advisor)
Managing Director, University of Michigan Erb Institute for Sustainable Enterprise

Terry Nelidov came to the University of Michigan from BSR, where he worked with member companies on social risk and human development in Latin America, Asia, and the US. Terry began his sustainability career as a US Peace Corps Volunteer in Paraguay in the early 1990s. Later he served as Founding Director of INCAE Business School's Business Leadership for Sustainable Development Network in Latin America, as General Manager for AmeriCasas (small land-development company in El Salvador), and then Country Representative for Catholic Relief Services in Peru. Terry holds a BS in Industrial Engineering from Stanford University and an MBA from IESE Business School in Spain. His languages include native English, as well as Spanish, Portuguese and Guarani (Paraguay).

Rebecca D Hardin Ph.D. (Advisor)
Associate Professor, University of Michigan School of Natural Resources and Environment

Rebecca Hardin is an Anthropologist and an Africanist. Her areas of interest and scientific study include human/wildlife interactions, and social and environmental change related to tourism, logging, and mining in Africa. Recent projects focus on the increasingly intertwined practices of health, environmental management, and corporate governance in Africa, including sites in Central African Republic, Gabon, South Africa and Kenya. The transnational links between African contexts and U.S. social movements around environmental rights increasingly feature in her teaching and research. In 2013-14 she advised a student team studying environmental justice cases within the U.S., and connecting them to the international *Environmental Justice Atlas*. Her recent book, Transforming Ethnographic Knowledge, explores the discipline of anthropology as a set of skills and tools for social change in sectors as different as business, biological conservation, conflict resolution, and biomedical care. Rebecca's postdoctoral fellowships were with Yale University, the Institut de la Reserche pour el Developpement (IRD) in France, and Harvard University. She has taught at McGill University before coming to UM, and as a visiting professor at Universite Paris I (Sorbonne) and the graduate program in Ethnobiology at the Museum National d'Histoire Naturelle in Paris.

Water security

Historically, the World Economic Forum defined *water security* by the quantity of water accessible (relative to demand).[3] However, increases in pollution and poor sanitation conditions have led to a more current definition of freshwater security, which refers not only to the quantity of water available but also to its *quality*. According to the World Bank and the International Union for Conservation of Nature (IUCN), freshwater security is currently defined as, "the reliable availability of an acceptable quantity and quality of water for health, livelihoods and production, coupled with an acceptable level of water-related risks."[4] However, while most agree that water is a critical natural resource that is defined by both water quantity and water quality, there are no universal definitions of 'secure' quantity and quality. Without a universal standard, actors in different sectors may adopt definitions that are tailored to their specific interests, which may not align with the interests of other important stakeholders. In particular, industry and international development agencies (or governance bodies, as in the case of the U.N.) have already adopted definitions that are relatively narrow in comparison to the most current IUCN definition.

Water quantity

According to the World Resources Institute (WRI), industry defines *secure water quantity* as the "quantity of water required to sustain the company's direct operations, supply chains and logistics."[5] Furthermore, secure quantity also considers the quantity of water needed to avoid disruption of electrical power because many electricity sources require water for cooling or for generation.[6]

On the opposite end of the spectrum, the United Nation's Millennium Development Goals (MDGs), which included a goal to halve the proportion of the population without sustainable access to safe drinking water by 2015,[7] define secure water quantity by the number of people with sustainable access to an improved source of water.[8] In September 2015, new Sustainable Development Goals will be established by the U.N. to replace the Millennium Development Goals. Within the Sustainable Development Goals, the goal is to achieve universal access to safe and affordable drinking water and sanitation for all by 2030,[9] therefore an increased demand for freshwater will likely influence the overall water quantity of water available to industry as well.

Water quality

Similarly, *secure water quality* has competing definitions. According to WRI, industry defines secure water quality as the level of water quality that does not impact a company's direct operations, supply chains, and/or logistics, as well as the level of water quality that ensures the company avoids "reputational issues that can damage a company's image or result in the loss of the company's license to operate in a community."[10] Alternatively, the Millennium Development Goals define water quality as the level that enables "safe drinking water and basic sanitation"[11] to prevent and control waterborne disease.[12] Thus, while there are no universally accepted definitions of what constitutes a secure quantity and quality of water, stakeholders in both industry and in international agencies will often base their definitions off of the needs of their constituencies. While the water and sanitation interests of industry and agencies representing civil society may not always be identical, it is important to understand their differences in order to ensure effective communication and cooperation across sectors. These crosscutting partnerships can be one way to create shared value, and they are explored further in the *Business Case* chapter.

Human risks

According to the World Health Organization (WHO), nearly 1 billion people lack access to an improved drinking water resource and 2.5 billion people lack access to improved sanitation.[13] Drinking water resources are considered improved when they are adequately protected from external contamination, and individuals have reliable access to 20 liters of water less than 1 kilometer from their place of use.[14] Similarly, sanitation facilities are considered improved when the infrastructure hygienically separates human waste from human contact.[15]

As reported in a joint publication produced by UNICEF and the World Health Organization, increased investments in drinking water programming have enabled the successful achievement of the Millennium Development Goal (MDG) of halving the proportion of the global population without sustainable access to safe drinking water by 2015.[16] This MDG was met five years ahead of schedule in 2010, as 2.3 billion people gained access to improved drinking water resources between 1990 and 2012.[17]

While significant progress has been made towards improving drinking water access, the same report indicates that the goal to halve the proportion of the population globally without access to basic sanitation by 2015 will not be met. Additionally, challenges associated with sanitation and water-borne illnesses have been amplified by urbanization as most of the people that are added to the world's towns and cities each year "move to informal settlements (i.e., slums) with no sanitation facilities."[18] According to the World Health Organization, "1.1 billion people still practice open defecation." Furthermore, "more than 3.4 million people die each year from water, sanitation, and hygiene-related causes and nearly all deaths (99 percent) occur in the developing world."[19]

Table 1. Examples of improved and unimproved drinking water and sanitation infrastructure.

Improved sources of drinking-water	**Improved sanitation[20]**
Piped water into dwelling	Flush toilet
Piped water to yard/ploy	Piped sewer system
Public tap or standpipe	Septic tank
Tube well or borehole	Flush/pour flush to pit latrine
Protected dug well	Ventilated improved pit latrine
Protected spring	Pit latrine with slab
Rainwater	Composting toilet
Unimproved sources of drinking-water	**Unimproved sanitation**
Unprotected spring	Flush/pour flush to elsewhere
Unprotected dug well	Pit latrine without slab

Cart with small tank/drum	Bucket
Tanker-truck	Hanging toilet or hanging latrine
Surface water	No facilities or bush or field
Bottled water	

In addition to substantial challenges with poor sanitation and degraded water quality, diminished water quantity and impending water scarcity reinforce water-related human risk. According to the 2012 U.N. Millennium Development Goal Report:

> "Global water use has been growing at more than twice the rate of population in the last century. By 2025, two-thirds of the world's population will be experiencing water stressed conditions and 1.8 billion people will be living in countries or regions with absolute water scarcity."[21]

Furthermore, challenges within water-stressed regions and populations are likely to be reinforced as "water withdrawals are expected to increase by 50 percent in developing countries."[22] Most of the global water withdrawals can be attributed to agriculture and industrial operations.

Water-related risks in industry

According to the Pacific Institute, an organization that conducts research on corporate water stewardship, every company has a corporate water footprint that can be defined as, "the total volume of freshwater that is used to produce goods and services produced by the business."[23] Thus, the scarcity of clean, freshwater inputs presents a variety of risks to companies across varying business sectors. Water-related risks can specifically manifest in three forms: physical water risk, regulatory water risk, or reputational water risks. [24]

Physical risk

Physical water risk occurs when "water scarcity directly impacts business activities, raw material supply, intermediate supply chain, and product use."[25] Physical water risk can manifest in various ways, depending on the business. For instance, physical water risk can manifest as disruptions in manufacturing, operations, material processing, energy production, or reduced water for cooling, washing and cleaning.[26] While physical risk is often escalated when there are water scarcity issues, pollution and poor water quality can also reinforce physical water risk. In addition to causing physical water risk, water pollution and poor water quality can also impose excess costs on business by requiring them to invest in treatment technology. According to the Pacific Institute, "water quality risks are often overlooked but many have significant financial implications."[27] Furthermore, growing awareness around the ecological impacts of water withdrawal and discharge increases both reputational and regulatory risks.[28]

Regulatory risk

Regulatory water risk occurs when physical and reputational pressures affecting water availability and wastewater discharge result in more stringent water policies.[29] Regulatory water risk can affect business as greater water usage can result in more stringent water permitting and allocation. Additionally, regulatory risks can take the form of changes to withdrawal allotments and increased restrictions on pollutant discharge to the environment.[30] Finally, regulatory water risk stemming from water scarcity can have an effect on water prices. According to the Pacific Institute, "price increases may adversely affect profit margins for water-intensive industries or sectors that rely on water-intensive raw material inputs, such as the food and beverage industries."[31] Thus, issues with water quantity or quality can cause policy makers to react with measures that can ultimately hurt the bottom lines of commercial water consumers.

Reputational risk

Another way in which water-related issues could negatively impact businesses comes from risks to their reputation. [32] Reputational risks are often manifested when reduced water quantity or quality provoke tension between businesses and the local communities in which they operate.[33] Community opposition to industrial water use and conflicts oriented in inequitable distribution of water resources can emerge quickly and affect business operations and value chains profoundly."[34] Community opposition can also emerge as people learn of their right to water.[35] Local conflicts can damage brand image or even result in the loss of a company's social or regulatory license to operate in that area. Thus, decline in water quantity and quality can increase consequences as physical water constraints make companies more susceptible to reputational risks.[36]

Current freshwater management practices and inequitable allocation of water resources across sectors further reinforce the aforementioned water-related risks. With withdrawal of freshwater resources surpassing the replenishment rate of resources, physical water risks and the corresponding water crises are perpetuating.[37] According to the *World Water Assessment Program* produced by the *UN World Water Development Report*, "The global groundwater abstraction rate has at least tripled over the past 50 years [and] this has fundamentally changed the role of groundwater in human society."[38] In addition to high withdrawal rates, disproportionate allocation and unsustainable water management between industry and communities have led to community-based challenges and human rights debates. [39]

In order to manage water-related risk, the private sector is taking an active role in managing physical, reputational, and regulatory risks associated with their corporate water footprint, while advancing the conservation and sustainable management of water resources for communities, nature and business. If businesses do not take an active role in managing water-related risk, opportunities to create business value through cost savings, new markets, obtaining a social license to operate, and increased brand value could be missed.[40] Additional business risks and opportunities associated with freshwater scarcity will be further explored in the *Business Case for Water Stewardship* section of this report.

Managing water-related opportunity

Effectively managing water-related *opportunities* has the potential to drive positive business value.[41] According to the CEO Water Mandate, which is a unique public-private initiative designed to assist companies in the development, implementation and disclosure of water sustainability policies and practices,[42] water-related opportunities can be aggregated into three categories: operations, brand value, and new markets.[43]

Operations

According to the CEO Water Mandate's *Corporate Water Disclosure Guidelines*, "companies can take advantage of water-related opportunity by reducing the costs associated with procuring, pumping, heating, circulating, or treating water. Many companies enable water-related cost savings simply reducing their water and energy needs."[44] They can accomplish this by installing water-efficient appliances, redesigning processes to use less water, or investing in other water-related upgrades. Companies can also discover cost savings by using alternative methods for treating or disposing of water discharge associated with pretreatment and wastewater treatment processes.[45]

Brand value

Companies that can create a positive water reputation by associating themselves with decreased water consumption and conflict may have the opportunity to increase the brand value of the business.[46] Leveraging brand value through water sustainability can help a company gain competitive advantage by increasing its market share or positioning itself more strongly in new markets.

New markets

As the CEO Water Mandate's Corporate Water Disclosure Guidelines aptly stated,

> "Markets are emerging around the world for products or services that provide solutions to water challenges. These opportunities are not limited to companies in the water technology sector, as companies in other sectors might have the opportunity to capture new markets by redesigning products to become more water efficient."[47]

Companies have clear economic incentives to closely assess their relationship to water inputs and outputs while also developing proactive interventions to address water risk in their operations and value chains. Increasingly, businesses are investing in water-efficient technologies, working with suppliers to encourage more responsible water use, introducing cleaner and more efficient products, and seeking to advance sustainable water programming as a strategy to mitigate water-related risks and impacts. In the following section, The Coca-Cola Company is introduced in order to understand how the Company is proactively investing in water to manage water-related risk.

The Coca-Cola System

The Coca-Cola Company has actively invested in water stewardship for over a decade to address their intimate relationship with water-related risks around the world. The Atlanta-based Coca-Cola Company was founded in 1886 and manufactures, retails, and conducts marketing for its beverage concentrates and syrups. At the end of the 2014 fiscal year, Coca-Cola reported revenues of nearly US$46 billion and gross profits of just over US$28 billion.[48]

Coca-Cola's business model relies on *The Coca-Cola System,* which is an intricate worldwide partnership network consisting of The Company, manufacturers, and bottlers. Within the System, The Company sources ingredients and manufactures product concentrates and syrups, which are then sold to bottling partners. The 275 bottling partners worldwide are responsible for manufacturing, packaging, merchandising, and distributing products.[49] The Coca-Cola Foundation is a separate, independent, 501 (C) (3) entity, which awards grants based on priority areas: *women* (economic empowerment, and entrepreneurship); *water* (access to clean water, water conservation, and recycling); and *well-being* (active healthy living, education, and youth development).[50] In addition to The Coca-Cola Foundation, in 2001 The Coca-Cola Company established The Coca-Cola Africa Foundation (TCCAF) in response to the mounting African HIV pandemic. Since then, it has expanded its focus to include issues connected with water, health, education, and entrepreneurship in Africa.[51]

Overall, the Coca-Cola System relies on the global freshwater supply to maintain its value chain. Indeed, The Coca-Cola Company has reported water as a material risk for over a decade and mentions water multiple times as a material risk to its core business in its 2014 annual report, where they note:

> "Water is a main ingredient in substantially all of our products. While historically we have not experienced significant water supply difficulties, water is a limited natural resource in many parts of the world, and our Company recognizes water availability, quality and sustainability, for both our operations and also the communities where we operate, as one of the key challenges facing our business."[52]

Most of the physical water risks linked to the food and beverage industry are associated with the water needed in the raw material production phase at the bottler level. According to the Pacific Institute, since potable water is a non-substitutable ingredient for the industry, water scarcity (or the opposite: flooding) or degraded water quality can result in business disruption.[53] Figure 62 and Figure 63 in Appendix A, illustrate the water footprint in the beverage industry and corresponding water-related risks.[54]

Managing water-related risks through corporate social investment

Coca-Cola has made significant strides towards balancing its industrial water needs with the needs of communities and nature. Following incidents related to physical, reputational, and regulatory water risk in India (that were linked to increasing material risks and securing a social license to operate),[55] The Company has proactively incorporated numerous social and environmental commitments into their business operations through a series of sustainability commitments. These commitments are captured under their “Me, We, World” framework, and serve as operational targets towards 2020.[56] Under the “Me, We, World” framework, Coca-Cola’s commitments to water stewardship are captured within the “World” category, which focuses on environmental protection. Within this framework, Coca-Cola has pledged to “safely return to nature and to communities an amount of water equal to what [they] use in [their] finished beverages and their production.”[57] Specifically, The Company has pledged to replenish 100% of the water used in their finished products by 2020, while improving water efficiency by 25% from a 2010 baseline.[58] In addition to this commitment, The Company added the goal to “assess the vulnerabilities of the quality and quantity of water sources for each of [its] system’s bottling plants and begin implementing locally relevant source water protection programs by the end of 2012.”[59] Source vulnerability assessments function to inventory social, environmental, and political risks associated with water sources near bottling plants:[60] an important corporate risk management activity. At the end of 2012 (their goal deadline), 91% (788 of 863) of all bottling plants had conducted source vulnerability assessments and developed source water protection plans. However, by the end of 2014, only 70% (587 of 863) of the bottling plants had started implementing source water protection plans to address environmental and social challenges at the watershed level.[61] Information collected and included in Coca-Cola's source water protection plans can be viewed in Table 24 in Appendix A.

In addition to implementing source water protection plans, Coca-Cola works collaboratively with well-known development agencies and NGOs including the U.S. Agency for International Development (USAID) and the Millennium Challenge Corporation to facilitate environmental and community development globally. According to Brian Richter, the Director of Global Freshwater Strategies at The Nature Conservancy (another partner), “Coca-Cola is at the forefront in the effort to catalyze a movement toward sustainable use of water resources by testing and demonstrating solutions that can be leveraged by others.”[62] Additionally, Carter Roberts, the President and CEO of the World Wildlife Fund and a Coca-Cola NGO partner, has likewise talked highly about their partnership:

> “Our partnership with Coca-Cola has set the global standard for sustainable commitments, with a specific focus on water….Water is not just essential to Coca-Cola’s business, but to all our lives. Now is the time to build on our successes and mobilize individuals around the world to join us in conserving this most precious of resources.”[63]

The Replenish Africa Initiative (RAIN)

One of the community water programs that is currently funded and implemented from within The Coca-Cola System is the Replenish Africa Initiative (RAIN). RAIN is a flagship community initiative that was started by The Coca-Cola Africa Foundation in 2009.[64]

The Replenish Africa Initiative (RAIN) is a leading multi-stakeholder water stewardship partnership that will improve access to sustainable clean water for 6 million people in Africa by the end of 2020. As The Coca-Cola Africa Foundation's (TCCAF) flagship program, RAIN is building sustainable communities, catalyzing investment in clean water access, improving water and sanitation access for school children, and empowering women and youth through clean water access and entrepreneurship.[65]

TCCAF's recent $35 million commitment to RAIN at the World Water Forum in Daegu, South Korea builds on their original investment of $30 million to launch the program in 2009.[66] This expansion, along with $50 million in co-finance and the support of more than 140 partners,[67] will enable RAIN to improve water access for 6 million people, economically empower up to 250,000 women and youth, and return 18.5 billion liters of water to nature and communities by the end of 2020.[68] To date, RAIN has reached more than 1.5 million people with sustainable clean water access.

RAIN programs can be organized into three categories:

- **Water, Sanitation and Hygiene (WASH) –** Improve access to water and sanitation and promote improved hygiene behaviors for positive impacts on health and development (Approximately 90 percent of RAIN projects have WASH components).
- **Watershed Protection –** Establish or enhance sustainable water management practices and improve environmental stewardship and community health.
- **Productive Use of Water –** Promote efficient and sustainable use of water for economic development.[69]

RAIN management & implementation

The Coca-Cola Africa Foundation's Replenish Africa Initiative (RAIN) is managed by the Global Environment & Technology Foundation (GETF). The Global Environment & Technology Foundation serves as the project management organization, providing strategic support to The Coca-Cola Africa Foundation throughout program design, implementation and close out. The Coca-Cola System is embedded throughout project design and implementation and consistently communicates with GETF to ensure water programs are strategically aligned with the Foundation priorities.

Global Environment & Technology Foundation (GETF)[70]

Established in 1988, GETF is a 501(c)(3) nonprofit organization based in Arlington, Virginia that operates with the mission to promote sustainable development through partnerships and targeted action. GETF seeks to "shape a brighter future for communities and the environment by developing innovative strategic plans, creating high-impact partnerships, introducing new technologies and managing programs that have a lasting and positive impact on the world."[71] GETF focuses on three core issues as the basis of its efforts: water and sanitation (WASH), clean energy and climate change, and sustainability. Within GETF's WASH initiatives, they provide strategic and management support to The Coca-Cola Company's Replenish Africa Initiative. Partnerships developed and managed by GETF include both RAIN and the "Water and Development Alliance" (WADA), which is the ongoing partnership between The Coca-Cola Company and the U.S. Agency for International Development. GETF also manages Global Water Challenge and the U.S. Water Partnership.

Global Water Challenge (GWC) [72]

Founded in 2006, Global Water Challenge (GWC) is a 501(c)(3), nonprofit coalition of leading organizations committed to addressing water and sanitation issues. Drawing upon the experience, expertise and assets of its members, GWC is able to create partnerships that achieve far greater results than any one organization could by itself. Since its inception, GWC has been a powerful catalyst for fostering collective action in the water sector across three core functions:

> **Learning:** GWC is committed to improving the long-term impact of investments in the water sector by working with its members and other partners to identify and share important lessons and best practices.
>
> **Connecting:** GWC is a platform for collaboration that unites corporations, implementing nonprofits, research institutes, and governmental agencies in partnerships that leverage their unique resources and expertise. In addition, GWC connects citizens with policymakers to increase the priority placed on water and sanitation globally.
>
> **Investing:** GWC has invested in and collaborated with members on innovative programs and campaigns globally.

Building off the successes of its first three years, GWC formed a strategic alliance with GETF in mid-2010. GETF's experience in creating public-private partnerships helps GWC achieve its mission of accelerating the flow of clean water and sanitation to those most in need.[73]

U.S. Water Partnership (USWP)[74]

Launched by then-Secretary of State Hillary Clinton in 2012, the U.S. Water Partnership (USWP) is a coalition of over 100 public and private partners including federal agencies, leading corporations, universities, foundations, associations and NGOs that have actively been working together to solve global water challenges. It operates with a mission to unite and mobilize the best of U.S. expertise and resources to address water challenges where needs are greatest. The USWP operates under a vision of working together for a water secure world. The objectives of the USWP are to ensure sustainable water management that benefits the environment and all people, with particular attention to gender considerations, through:

- Improving the quantity, quality and accessibility of water, sanitation and hygiene to promote better health
- Advancing integrated water resources management to conserve and restore watersheds, to curb pollution, to adapt to climate change and to reduce risk from floods and droughts
- Increasing efficiency and productivity of water use to boost agricultural, energy and industrial output and conserve water
- Improving governance for economic, environmental and social sustainability through stronger public and private institutions, policies and process

To learn more about the activities of the U.S. Water Partnership, Global Water Challenge, and their members, please visit:

- http://www.uswaterpartnership.org
- http://www.globalwaterchallenge.org

The Business Case for Water Stewardship in Africa

Why Africa?

By most accounts, the African continent is poised for relatively strong growth over the coming decades. With stability across the continent slowly but consistently increasing, a downward trend in poverty, and an upward trend in business friendliness, African economies present a significant opportunity for those who are prepared.

Since 2005, 45 out of the 46 sub-Saharan economies tracked by The World Bank's Doing Business research have shown improvements in their business regulatory environments.[75] In a possibly connected trend, GDP across the continent has been increasing, having more than quadrupled since 2000 (Figure 1 below).[76] This is particularly noteworthy considering the global economic issues that began around the 2007-2008 period.

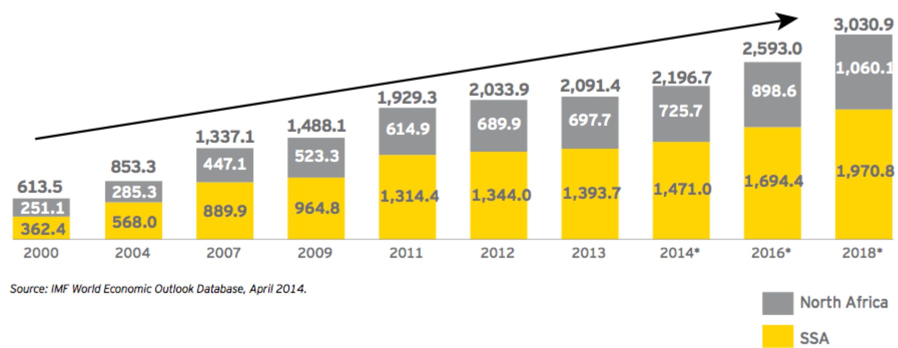

Figure 1: Pan-African GDP (current prices, US$b), 2000-2018

Looking further into the future, both business analysts and the African Development Bank forecast continuing growth in both GDP and GDP per capita through the first half of this century (Figure 64 and Figure 65 in Appendix B). With this type of growth, analysts at Ernst & Young project that by 2030, sub-Saharan Africa will reach the level of per capita income that emerging Asia has today.[77] The economic future of African countries currently looks promising, both for residents of those countries and for companies interested in doing business there.

Water stewardship interventions

Water stewardship can take many forms (see Figure 66 in Appendix B for examples). Considering water for human use as a resource spanning multiple lifecycle stages is a helpful way to frame stewardship activities so as to understand the range of potential stewardship interventions. As illustrated in Figure 2 below, all water begins as part of the natural environment, where it is collected and used, or treated and distributed for use by intermediate or end consumers further downstream. These water users eventually generate wastewater, which can be collected and either disposed of or recycled and treated for further use.

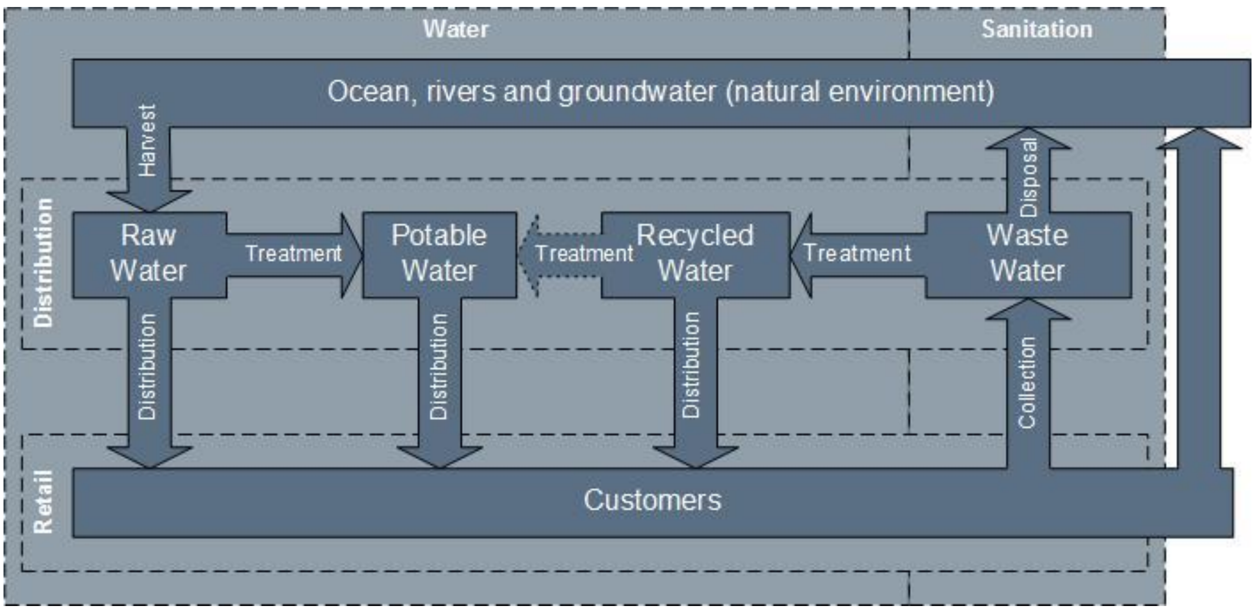

Figure 2: The lifecycle of water for human use[78]

Improvement opportunities, also called interventions, can be found at every step in the process. Several example interventions are presented in Figure 66.

Why water: macroeconomic benefits

Water stewardship activities, particularly around access to clean drinking water and sanitation facilities, creates a variety of benefits to both public (e.g., governments) and private (e.g., individual, commercial, etc.) actors. Beginning in the early 2000's, several global-scale studies were undertaken by researchers with the World Health Organization to attempt to identify and quantify both the costs and the benefits associated with improvements to water and sanitation.

The costs are relatively straightforward, and involve both the initial and ongoing costs for construction, operation, maintenance, and replacement. The benefits, however, are somewhat more diffuse, and may accrue to a variety of different actors and stakeholders. Researchers concluded that the main drivers of societal economic benefits include:

1. Health sector benefits from avoided illness
2. Patient expenses avoided due to avoided illness
3. Value of deaths avoided
4. Value of time savings due to access to water and sanitation
5. Value of productive days gained to those with avoided illness
6. Value of days of school attendance gained to those with avoided illness
7. Value of child days gained of those with avoided illness[79]

Not all of these create the same level of value, however. In Africa, for instance, time savings generate the most benefits, across both water and sanitation interventions (Figure 67 and Figure 68 in Appendix B). The time savings realized may be used for education or economic activities, or otherwise for leisure, social, or community-oriented activities. Each of these would likely yield different benefits. As noted by one study, without time savings, the benefit-cost ratio for water improvements in sub-Saharan Africa would have been only slightly greater than one. While disease reduction can certainly result from point-of-use interventions (such as chlorination), **low-cost investments to bring water supplies closer to the household are likely to generate higher economic returns because of the substantial savings in access time.[80]**

Of the various studies done to evaluate the benefits and costs of water and sanitation interventions, all concluded that the benefits consistently outweigh the costs (Table 2).[a] However, the *level* of benefits created relative to the costs was found to be particularly dependent upon the assumptions used, such as how expensive the interventions were and the magnitude of the benefits generated. Nonetheless, even when using more pessimistic assumptions (i.e., higher costs and lower benefits), the benefits created still outweighed the costs.[81]

Table 2: Estimates of benefit to cost ratio for water and sanitation interventions in sub-Saharan Africa

	Study 1[82]	Study 2[83]	Study 3[84]
MDG target for water	11.50	2.8	-
MDG target for sanitation	-	6.6	-
MDG target for combined W&S	12.54	5.7	-
Universal water	-	3.9	2.5
Universal sanitation	-	6.5	2.8
Universal W&S	11.71	5.7	2.7

[a] The one exception is a study conducted by Whittington and Hanemann (2006), but their study looked at one very particular intervention and used a method for estimating benefits that was different from most of the other studies, placing a heavy emphasis on willingness to pay and 'coping' costs.

Why water: ecosystem services

Another area of potentially substantial benefits from water stewardship is ecosystem services. Ecosystem services are, "the many life-sustaining benefits we receive from nature – clean air and water, fertile soil for crop production, pollination, and flood control."[85] While societies depend on these ecosystem goods and services, they have not been historically seen as economic commodities, and have not typically been valued.

Beginning primarily with the widespread publication of an article in 1997 on the monetary valuation of ecosystem services, there has been a steady growth in the number of articles and reports evaluating the monetary value of natural resources, ecosystem services, and biodiversity.[86] While the science of ecosystem service valuation is still developing, it is clear that watersheds provide a number of ecosystem services, such as:

- Water supplies for consumptive use (drinking, domestic use, agricultural and industrial uses)
- Water for non-consumptive use (for generating power and for transport/navigation)
- Water filtration/purification
- Flow regulation
- Flood control
- Erosion and sedimentation control
- Nutrient cycling
- Timber and other forest products
- Recreation/tourism
- Habitat for biodiversity preservation
- Providing sources of food and medicine
- Aesthetic enjoyment
- Climate stabilization
- Cultural, religious, inspiration values[87] [88]

The most recent estimate on the monetary value of some of these services is organized by biome (e.g., coastal wetlands, inland wetlands, tropical forest, grasslands, etc.) (Table 25). While there is no separate valuation category in the literature specifically for watershed ecosystems, one may gain a sense of the value of their various services through looking at related biomes and individual related services. For instance, the estimated value of ecosystem services provided by fresh water biomes (such as rivers and lakes) is $4,267 per hectare per year, the value of services provided by inland wetlands is $25,682 per hectare per year, and the value of coastal wetlands is $193,845 per hectare per year.[89] Given the substantial value of ecosystem goods and services, it seems likely to the authors that the benefit to cost ratio for investments in watershed conservation would be likewise positive.

Why water: business value

The global water supply and sanitation crisis can substantially impact businesses of all kinds directly and indirectly. Acting through worldwide business supply chains, through local operations, or through international consumer populations, the crisis has the potential to either amplify downside risk or build upside business potential, depending on how it is addressed. Figure 3 highlights the five thematic drivers of business risk and opportunity from the water crisis and water stewardship. Every business is unique and exists as part of a varied and complex ecosystem, and therefore the business impacts from the crisis or responses to it can vary substantially between different firms. Nonetheless, each impact can ultimately be categorized as a positive or negative impact to competitiveness, operational efficiency, human or social capital, or to risk, all of which will be explored in the following section.

Broadly speaking, increasing pressures on both the supply side and the demand side, a few of which are illustrated in Figure 69, will continue to create major challenges around water security. As growing numbers of regulators, investors, financial institutions, consumers, and businesses take action around the crisis, the business case for action will continue to become even more pronounced.

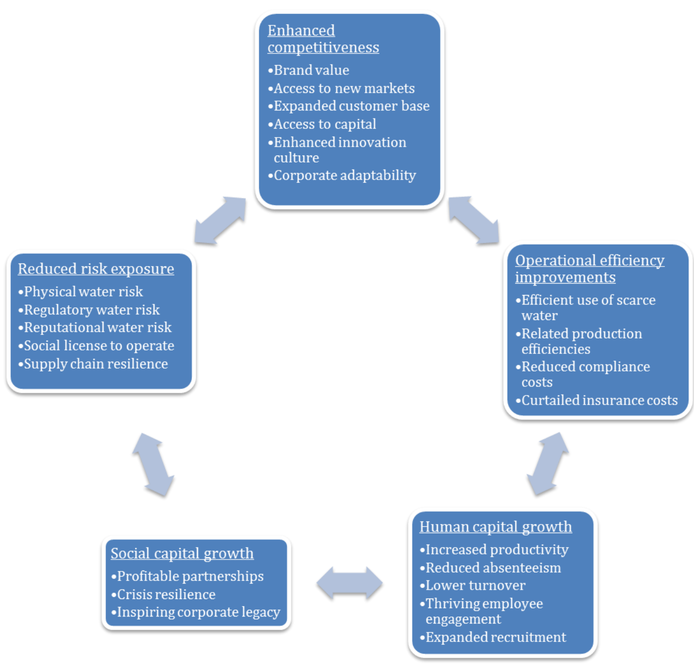

Figure 3: Primary business opportunities and risks presented by water stewardship and the water and sanitation crisis

Enhanced Competitiveness.

Brand value

A company's brand is widely considered to be one of its most important assets, as it can essentially communicate to consumers what qualities, features, and associations are connected with a product or company. A brand can heavily impact the way a potential customer sees a product, and can allow companies to charge a price premium. Crises related to water withdrawals from India and California, for instance, led to significant negative brand impacts to two major food and beverage companies in recent years. Conversely, corporate investments in water stewardship can enhance brand and reputation value, potentially offering a competitive advantage over competitors.

Access to new markets

In the short-term, water stewardship investments can enable businesses to maintain or increase access to important markets, including supplier and source markets, merger and acquisition targets, and innovative new product markets. By promoting economic development in the longer-term, water stewardship investments can secure access to emerging and high growth consumer markets as well. For example, chemical giant BASF has estimated that the water conservation, recycling, reuse, and treatment products markets offer the company US$1 billion in sales through 2020.[90]

Expanded customer base

Water stewardship investments can lead to a stronger customer base for both today and tomorrow. Near-term benefits would primarily come from increases in customer loyalty and increases in sales volume that can accompany a well-executed communication strategy highlighting water stewardship efforts. Long-term benefits could include a sustainable growth trajectory as well as larger markets to participate in, as beneficiaries from water and sanitation projects gain purchasing power.

Access to capital

In just one example of the growing trend among investors and asset managers towards incorporating elements of 'responsible investing' or 'impact investing,' the U.N.'s Principles of Responsible Investment (PRI) initiative has garnered over 1,300 signatories with US$45 trillion in assets.[91] These signatories have voluntarily committed to incorporating environmental, social, and governance

(ESG) issues into their investment practices. Furthermore, the Equator Principles, with their 80 current signatories, provide guidelines to financial institutions for how to incorporate and address environmental and social risks in their projects.[92] As water-related risks and opportunities can cut across environmental, social, and governance considerations for many companies and supply chains, water stewardship is likely to become increasingly necessary in order to maintain current and secure new capital.

Enhanced innovation culture

Investments and partnerships based around water stewardship programs can lead to the creation of new technologies or new business models to address unmet demand or enter untapped markets. For instance, the World Bank's Water and Sanitation Program recently estimated that the total market for improved on-site sanitation services in only four countries (Bangladesh, Indonesia, Peru, and Tanzania) is worth over $2.5 billion.[93] For companies or individuals willing and able to innovate in this arena, there is significant potential.

Corporate adaptability

The global water and sanitation crisis will put new pressures on supply chains and businesses as critical inputs become less available and more expensive. Different regions will face unique challenges connected with insufficient infrastructure, fundamental ecosystem shifts, public health crises, and demographic changes. All of these have the potential to disrupt business as usual and expose businesses across sectors to a wide range of risks. Investments in water stewardship can effectively mitigate many of these risks. Addressing the global water and sanitation crisis directly can promote corporate adaptability by enabling a strategic understanding of a firm's related risks and by positioning it for success in a rapidly changing world.

Operational efficiency improvements.

Efficient use of scarce water

The most direct and straightforward cost related to water is the material cost of water itself. While the costs involved in extracting, treating, and transporting water to the point-of-use vary from place to place, water always comes at a cost, and there are typically costs associated with its disposal as well. In most locations, the price of water is a function of factors such as the quantity and quality of available water, the presence of infrastructure (e.g., collection, treatment, distribution, and disposal infrastructure), and resource governance or management structures. Accordingly, water stewardship investments that improve the quality or increase the quantity of available water or that promote more efficient use of water resources are likely to lead to lower costs connected with water consumption. One example of this comes from Diageo Plc, a UK beverage company that reduced its water consumption by nearly 1 million cubic meters through efficiency improvements, leading to cost savings of around US$3.2 million in 2014 alone.[94]

Related production efficiencies

There can be other major costs related to water too, particularly costs for energy and other material inputs. The availability and cost of agricultural goods and cotton, for instance are highly dependent on the state of water resources. The production of energy from many sources likewise depends on water; therefore changes in the availability or quality of water are likely to be reflected in energy costs, either for better or for worse. Sasol, for example, a South African energy company, relies on water for washing, extraction, and cooling during the coal production process. While their water supply is relatively secure for now, they anticipate that within ten years, demand for water will outstrip supply, exposing them to major physical water risk, and opening the door to energy price increases for their customers. To mitigate this risk, Sasol has invested in water conservation projects, water recycling, wastewater treatment, and alternative supply technologies such as desalination.[95]

Reduced compliance costs

In addition to the risks posed from certain water resource management or governance structures, water policies and regulations can lead to steep costs for compliance. For instance, in areas where water quality is an issue, policies may be enacted to limit discharge, which could lead to substantial costs for treatment equipment or fines for violation. Water stewardship investments that improve the area's water quality could limit the chances of such policies being imposed. Likewise, investments that increase water efficiency and recycling would reduce the amount of wastewater discharged as well as reducing the quantity of water supply needed.

Curtailed insurance costs

Insurance and reinsurance markets are already accounting for certain types of water-related risks, particularly those stemming from climate change and its projected impacts.[96] [97] As the various types of risks presented from water and sanitation challenges increase, insurance markets are likely to give greater weight to related considerations. The implications of this are that companies that are engaged in water stewardship activities are likely to enjoy lower premiums through reduced risk exposure.

Human capital growth.

There are a range of costs connected with a company's workforce, including absenteeism, turnover, recruiting, and productivity. The global water and sanitation crisis creates substantial private costs in the form of higher absenteeism at school and at work and reductions in worker productivity. This can be a major barrier to workforce development. Water stewardship investments have the potential to significantly reduce these costs and improve performance. As noted in the macroeconomic analysis, many of the benefits from improved drinking water supply and sanitation infrastructure manifest in better health and more time for productive use, such as school and work. Practically speaking, this means a potential workforce that misses less work, turns over less frequently, has higher educational attainment, and is more productive at work.

Further, recent surveys have highlighted a growing trend: top talent is increasingly interested in meaningful work with companies that align with their personal values.[98] In addition to the other benefits to be found from investments in water stewardship, building a reputation around those investments and activities can lead to enhanced access to top talent and more engaged employees. Taking it one step further, as highlighted in a recent Harvard Business Review article, studies have found that engaged employees are 50% more productive and 33% more profitable, as well as being responsible for 56% higher customer loyalty scores.[99]

Social capital growth.

Profitable partnerships

Public-private partnerships have been widely embraced as an effective model for action in the water stewardship space. These and other partnerships foster trust-based relationships that can lead to new and innovative opportunities. For example, Nestlé has a long-standing partnership with the International Federation of Red Cross and Red Crescent Societies (IFRC), and has helped rehabilitate water and sanitation infrastructure in Côte d'Ivoire, benefiting local communities as well as the company's brand.

Crisis resilience

Water-related crises do happen, and their consequences can be costly. Starbucks' Ethos brand water recently relocated after news reports began to surface that the water was being sourced from drought-stricken California.[100] Nestlé is facing similar public pressure in California, and Coca-Cola's bottling operations in India are likewise no strangers to this sort of crisis. Water stewardship investments can not only mitigate the risk of such a crisis arising in the first place, but should one occur, the partnerships and engaged network of stakeholders that can often accompany a successful water stewardship strategy can be leveraged to provide critical support.

Inspiring corporate legacy

Over the long-term, businesses have the opportunity to create a lasting legacy – to shape how they will be viewed and what they will be known for. One need not think hard to come up with examples of companies that have created a lasting legacy: companies that have pioneered new technologies or processes or companies that destabilized global economies, for instance. The opportunity for creating a lasting legacy around a resource as vital as water is a significant one. Through investing in water stewardship, businesses can begin to lay the foundation for an enduring legacy both in communities and around the world.

Reduced risk exposure.

Physical water risk

"Water is a fundamental business input…too much, too little, too polluted, and companies may be unable to maintain consistent production"[101] or operations. Physical water risk refers specifically to the risks presented by a mismatch between industrial water supply and demand or from water quality issues. This risk can manifest in many ways and lead to negative impacts as outlined in the box below.

Scarcity can halt industrial production simply because there is not enough water for production, irrigation, material processing, cooling, washing, or cleaning. Flooding can disrupt the flow of operations because workers have to tend to the effects of the flood rather than work. Contaminated water supply may require additional investment and operational costs for pre-treatment. Availability and affordability of clean water may affect the interest or ability of customers to purchase or use certain water-intensive products and services.

Water scarcity can also affect businesses indirectly by affecting energy and food production. For instance, in 2001, energy production in São Paulo, Brazil was highly constrained as a result of both severe drought and government energy tariff policies. In order to prevent blackouts, the government imposed quotas aimed at reducing energy consumption by 10-35 percent. Many industries based in Brazil's southeast were plagued by reductions in operational capacity, production delays, or increased production costs.

Source: CEO Water Mandate

Furthermore, global forces that individual businesses may have only limited influence over, such as climate change, have the potential to significantly increase physical water risk for regions across the planet. Nonetheless, while physical water risks may be substantial, depending on individual circumstances, water stewardship programs can help mitigate and reduce physical water risk by proactively contributing to programs geared around local water quantity and quality. For further discussion of the range of strategic responses to water risk, please see the University of Michigan and LimnoTech report *Mitigating Corporate Water Risk*.[102]

Regulatory water risk

Regulatory water risks emerge from water policies or regulations that are ineffective, inconsistent, or otherwise unstable. Water resources around the world are managed and governed in markedly different ways. Some governance structures are effectively able to manage competing demands for finite water supplies, often using bottom-up or top-down approaches, while others lack the capacity to properly manage water resources or enforce water regulations. Businesses can be exposed to risks stemming from these governance mechanisms (or the lack thereof) through corrupt or nonexistent enforcement that allows for widespread pollution; through the mismanagement of water supplies that compounds water scarcity; or through other adverse regulatory consequences. Water stewardship programs can reduce regulatory water risk by strengthening institutional capacity or promoting multi-stakeholder management processes, helping to secure both water supply and a seat at the table for resource governance decisions.

Reputational water risk

As advances in technology and connectivity that allow for greater transparency throughout entire supply chains combine with growing public concern for human and environmental well-being, corporate practices are facing rising scrutiny. Companies that over-exploit water resources, whether in actuality or in the eyes of the public, are very vulnerable to damage to brand and reputation, to share price, and to their ability to conduct business. Water stewardship investments can not only reduce reputational risks from water, but can lead to positive benefits in the same areas: benefits to brand and reputation, benefits from investors, and benefits to the ability to conduct business both in the region and elsewhere.

Social license to operate

Securing the formal and informal approval of stakeholders for a business and its local operations, or a 'social license to operate,' is a particularly important task for businesses today. Increasing scrutiny can and has led to major incidents around the world, in some cases ultimately leading to expensive re-locations and lasting damages to brand and reputation. What it takes to secure a social license to operate will vary substantially, depending on contextual factors such as stakeholders and geography.

Losing a social license to operate can be at best expensive, and at worst lead to suspension or termination of operations in a given location. The extractives industry, in particular, is replete with case studies on companies and individual sites that suffered costly consequences from local activists and government, and even regional or international media coverage. The risks are by no means limited to the extractives industry, however, as many supply chains rely upon inputs and suppliers that depend on maintaining a social license.

Activities and programs that can help secure a social license to operate, such as investments in water stewardship, frequently lead to benefits beyond only maintaining the social license. These benefits are outlined throughout the rest of this business case, but can include reduction of other types of risks, enhanced opportunities for growth, and a competitive advantage against competitors.

Supply chain resilience

Water is a vital part of many, if not most, supply chains. Some firms depend on water to produce key inputs (such as in food and beverage, apparel, and other consumer staples), other firms depend on it for its role in generating energy, and still other firms for many of its diverse uses. Each link in a supply chain that depends on water is vulnerable to physical, regulatory, and reputational water risks. Investing in water stewardship and promoting it within supply chains can lead to cascading benefits for businesses within those supply chains, to the communities in which they operate, and to the larger watershed ecosystems that society and business depend upon.

Summary

In all, there are wide ranges of potential benefits that can be realized through water stewardship. In particular, the combination of macroeconomic benefits, ecosystem service benefits, and direct benefits to businesses present a compelling case for investing in water stewardship. The currently available evidence points clearly to the benefits from such investments outweighing the costs, especially over longer time horizons. Even in the near-term though, the potential benefits can be substantial.

Spatial Assessments

According to the United Nations World Water Development Report**, "African economies are growing faster than they have in the past 40 years.**[103] Additionally the 2014 African Economic Outlook report focusing on global value chains and Africa's industrialization indicated that, in the 2000s, six of the world's 10 fastest growing countries (based on GDP) were in sub-Saharan Africa and Economic growth in sub-Saharan Africa was 5% in 2013, close to 5% in 2014 and is expected to reach 5-6% in 2015.[104] In addition to tremendous economic growth, population growth in Africa is also increasing. With the fastest growing middle class in the world, by 2030, Africa will comprise of 17% of the world's population, as 434 million new people are projected to live in Africa.[105] According to the World Bank, in the next 20 years, as Africa's urban population doubles, there will be in an increased service delivery gap for water supply and sanitation. [106] Furthermore by 2020, an additional 75 to 250 million people in Africa will be exposed to increased water stress.[107] The United Nations estimates suggest about 5% of the African continent's wealth is lost from lack of access to water and sanitation. If everyone had access to these services, it would add a conservative estimate of $33 billion USD a year to the continent's economies.[108]

Considering the rapid economic growth on the Africa continent, and impending water stress, the following spatial assessments, composite indices, and corresponding analyses functions to determine how water-related investments can function to create shared value throughout Africa. Spatial assessments are specifically conducted to identify social, environmental, and economic risks, and opportunities throughout Africa continent using three composite indicators. The composite indicators include an original *State of Freshwater Resources Index*, an original *Social Capabilities Index*, and an adopted *Global Competitiveness Index*. In addition to three composite indicators, the assessments also examine important standalone datasets to help understand social, economic, and environmental risks and opportunities.

Within the conclusion of the Value Creation Model Section of this report, results from the spatial assessments and inferences from the Water Stewardship CLD, will be utilized to understand the intersection of the spatial assessments and value creation potential in Africa. This original analysis will ultimately enable areas with high water risk and high economic opportunity to be identified in order to suggest appropriate water-related investments that have the potential to drive shared value, for specific geographies in Africa. In the remainder of this section, the data, indices, and methodology used to execute the spatial assessments is described before contextualizing the environmental, social, and economic landscape in Africa.

Index Methodology

Initial Literature Review

A literature review explored factors that contribute to risks, opportunities, and value creation within the realms of environment, society, and business.

All spatial analyses in this report were performed using ArcGIS software.[109] Maps throughout this report were created using ArcGIS® software by Esri. ArcGIS®

Composite Index Review

Since so many variables were found to be integral to complex risk and opportunity dynamics, it was necessary to find a way to summarize the key risk, opportunity, and value drivers, in order to allow for easier understanding without compromising any components.

This decision towards data summarization was corroborated by established experts regarding composite indicators, such as the Organisation for Economic Co-operation and Development (OECD) and The Fund for Peace (responsible for the *Fragile States Index*).[110] [111] In fact, an examination of the OECD's *Handbook on Constructing Composite Indicators: Methodology and User Guide*, uncovered the argument referenced from Saltelli: "It often seems easier for the general public to interpret composite indicators much more easily than to identify common trends across many separate indicators."[112] Other well-respected sources lauded the use of composite indicators for summarizing trends across multiple indicators, and the report team decided to develop three composite indicators to simplify the complexity of social, environmental, and economic risk and opportunity.

Once composite indices were selected as the most appropriate tool for interpreting the information about Africa, a second and more targeted literature review examined existing indices within the three realms (society, environment, economy) and identified their strengths and limitations. A diversity of resources were scoured, but the project team relied primarily on the OECD's *Handbook on Constructing Composite Indicators: Methodology and User Guide*[113] because of the source's emphasis on providing impartial general recommendations and conducting peer reviews of their published materials.[114] The purpose of the Handbook is "to provide a guide to the construction and use of composite indicators, for policy-makers, academics, the media and other interested parties."[115] Headquartered in Paris, France, the OECD "is a unique forum where the governments of […] democracies work together to address the economic, social and environmental challenges of globalization,"[116] and their mission is "to promote policies that will improve the economic and social well-being of people around the world."[117] They "work with business, through the Business and Industry Advisory Committee to the OECD, and with labour, through the Trade Union Advisory Committee";[118] they also "have other contacts […] with other civil society organisations."[119]

Although the report team researched many individual indicators and indices, and quite a few were relevant, only a limited number of them captured the key interrelationships within the focus realms of environmental, social, and economic risk and opportunity at a broad scale.

Towards this end, the team collected relevant data regarding African countries, focusing on those data sets with continent-wide coverage. For each of the three categories (environment, society, economy), a composite indicator was either adopted from the existing literature (as in the case of the World Economic Forum's Global Competitiveness Index) or created based on the index objectives. The environmental category is represented by an original *State of Freshwater Resources Index* (SOFI), which contains five components that illustrate key visible and invisible aspects of physical water scarcity, water resources and uses. The category for society is represented by an original *Social Capabilities Index* (SCI), which contains seven components to illustrate societal 'development' or 'health' using the concepts of social capacity and social capabilities. The economy category is represented using the *Global Competitiveness Index*, which was adopted from the World Economic Forum and contains 12 "pillars" that include static and dynamic components that are recognized as being the fundamental building blocks for long-term economic growth and stability, as well as illustrating the level of productivity in a country.[120]

The Indices

The Composite Indicators

According to the European Commission's Composite Indicators Research Group, indices or composite indicators are mathematical aggregations of a set of indicators "that have no common meaningful unit of measurement" and can be used "to summarize complex or multi-dimensional issues." [121] They can provide a glimpse into the big picture of any issue or topic by uniting elements that would otherwise be not directly comparable.

The environmental category is represented by the original *State of Freshwater Resources Index*, created by the University of Michigan team. This index was created because current indices did not incorporate enough detail to adequately represent water risk issues, were not useful for comparisons at the country-level, or required information that was not yet available for the majority of Africa.

The society category is represented by the original *Social Capabilities Index*, also created by the University of Michigan team. The team created this composite index because the most current indices do not paint a complete picture of the dynamics that lead to societal flourishing, instead focusing on individual components of the larger societal system.

The economy category is represented by the *Global Competitiveness Index* adopted from the World Economic Forum.[122] [123] An original composite indicator was not created for the business category because the most important aspects of business value, risk, and opportunity were included within the *Global Competitiveness Index*. The World Economic Forum, a multilateral international organization, had already covered the key interactions within this existing framework. The creation of a second index would have been pointless and redundant.

Methodological Strengths

Composite indicators can be useful for accounting for stakeholder needs through the weights given to the different components. However, the report team chose not to specifically tailor our composite indices (and their weighting schemes) to a specific/individual scenario or project. This allowed the composite indices to be more applicable across water development projects, but less accurate for specific implementations. The decision to keep the composite indices broadly applicable was also influenced by the limited access that the report team had to stakeholder opinions, which is widely recognized as an important element for building credibility and improving scientific robustness in an index.

Methodological Limitations

If thorough statistical testing is not performed and sensitivity is not analyzed when developing a composite index, then the results could be misleading or misinterpreted, leading to "misleading, non-robust policy messages."[124] In addition, even if such statistical analyses are performed, the attraction of the "big picture" idea that composite indicators have may lead to people drawing overly-simplistic conclusions of their own accord.

Another weakness of composite indicators in general is that their creation and development process involves judgment at several key points: "the selection of sub-indicators, choice of model, weighting indicators and treatment of missing values," to name a few.[125] Multiple sources have given advice to keep the judgment aspects of the development as transparent as possible.[126] [127]

Due to limited time, resources, and access to stakeholder perspectives, the report team strategically omitted some of the steps recommended by the OECD handbook during the development of the *State of Freshwater Resources Index* (SOFI) and the *Social Capabilities Index* (SCI) and during the weighting and analyses of all three composite indices used in this report: SOFI, SCI, and the *Global Competitiveness Index* (the GCI, however, was created by the WEF using a more comprehensive approach that included a multi-stakeholder process and expert-based weightings. Because of such omissions, these spatial analyses may include subjective influences or other biases, and results should be taken with a grain of salt. This can be amended in the future for application to specific programs.

For any analysis to be statistically significant, the composite index needs to be proven to be extremely robust.

State of Freshwater Resources Index (SOFI)

Until now, this report has focused around global freshwater supplies primarily in the contexts of industrial demand and basic human needs. However, there is another fundamental dimension to freshwater security that powers the supply dynamics: ecological functioning, especially in the context of the hydrologic cycle. As noted in a report by the Sustainability Consortium, "Freshwater scarcity is commonly described as a function of available water resources and human population."[128] While this description is pleasingly simple, it leaves out components that are vital to fully capturing the complexity of the hydrologic cycle. Developed by the University of Michigan team, the *State of Freshwater Resources Index* (SOFI) describes the state of a country's freshwater resources by accounting for water pollution, surface and groundwater supplies, internal water consumption, and reliance on external water resources. While currently available indices were helpful for understanding important discrete aspects of freshwater security, no single index adequately represented the complex interplay between surface water, groundwater, dependence on water imports, population size, and water consumption. The SOFI index attempts to present a unifying perspective on a watershed's ecological state at any point in time, by analyzing essential water quantity and quality factors on both the supply- and the demand-side. Ultimately, a high score on the SOFI index suggests that the watershed is healthy, with a stable balance between water supplies and their consumption, and that societies living within that watershed are not living beyond their freshwater means: a situation that if left unchanged could lead eventually to the collapse of the watershed ecosystem and its supported societies.

The idea for this index is to represent aspects of physical water scarcity and water consumption, both visible and hidden. Since this report examines water stewardship programming, this index started with a visible aspect: basic human water needs. However, since that only reflects one of numerous elements within an inclusive conceptualization of water security, more needed to be included. Other factors were examined to incorporate types of freshwater consumption: internal and external. Accounting for climate change adaptation was another desired aspect to SOFI. Among other indicators, groundwater storage is an important resource for reducing the vulnerability of populations and wildlife to variations in climate. Fortunately, advancing research in the fields of geology and hydrology allowed the SOFI to account for that previously hidden resource. This aspect alone drastically improved the ability of the SOFI to evaluate physical water scarcity. Aside from these factors, the body of literature surveyed contains many ideas for evaluating physical water scarcity and the strengths and weaknesses of various composite models.

The SOFI is not intended to be the only tool in major decision-making processes, but rather as a means to better understand key interplays within the realm of water scarcity. This composite index is meant to summarize the available data most important to freshwater resources and their use.

Components overview.

SOFI is comprised of five indicators: the Falkenmark Indicator, the import dependence ratio, the use-to-resource ratio, groundwater quantity per capita, and water pollution level. Unless otherwise stated, the data used for these indicators was acquired directly or indirectly through the World Bank's *World Development Indicators*.[129]

For each of the components, a score was calculated from the raw indicator value and an assigned weight. The weights are constant within each indicator but can differ between different indicators. The weight values are between 0 and 1 depending on the quality and coverage of the data and the importance of the indicator. Weighted scores were standardized over all African countries for which data was available for each SOFI indicator. These weighted scores were then averaged, accounting for missing scores, and re-standardized to achieve the final weighted, standardized SOFI scores, which range from 0 to 1.

Falkenmark Indicator.

Developed in 1989, the Falkenmark indicator is a widely used measure of water stress, and is defined as the fraction of total annual runoff available for human use.[130] It is one of several indicators based on human water requirements. In this indicator, thresholds of 1,700 cubic meters and 1,000 cubic meters per capita per year are used to differentiate between water stressed and water scarce areas, respectively.[131]

The indicator only requires data at the country scale, where data is most readily available across the world, which is likely one factor for its popularity. It is possible to examine things on a deeper level. J.P. Morgan's Watching Water report utilized a version of the Falkenmark indicator called the "water barrier index" which went beyond country-level availability to examine water stress at regional levels within countries.[132] Due to the lack of such granular data for most of Africa, SOFI was unable to go to such detail. Although the original Falkenmark indicator is extremely simple, its usage in political and corporate decision-making, along with the data for it being available for almost all countries in Africa, led to its usage in the SOFI.

Inclusion in SOFI.

Data for this indicator originated from the Food and Agriculture Organization (FAO)'s AQUASTAT data and from The World Bank. The specific data gathered from the FAO was "renewable internal freshwater resources," which refers to internal renewable freshwater resources, such as internal river flows and groundwater from rainfall, in a country. The World Bank supplied a calculation of renewable internal freshwater resources *per capita* by dividing the FAO information by World Bank population estimates. The most recent data year 2013 was used for this indicator.

The Falkenmark Indicator is the keystone of the SOFI and displays the key aspect of this report: water availability for people. So, this component of SOFI received a weight of 1. While the simplicity of this indicator is attractive, it is also a large weakness. Utilizing data at the country level overlooks regional differences within countries. In addition, the indicator does not account for water quality, although such information is currently very limited for many African countries.

Use-to-resources ratio.

The use-to-resources ratio, also known as the *Water Resources Vulnerability Index*, measures the ratio of total annual freshwater withdrawals to annual renewable freshwater resources.[133] Domestic, agriculture, and industrial water use are all included in the withdrawals total. A country is considered water scarce if total annual withdrawal is between 20-40% of the annual renewable freshwater supply, and severely water scarce if total withdrawals exceed 40% of annual renewable freshwater supply.[134] The Use-to-Resources Ratio has been used in previous freshwater availability assessments, including one that involved geospatial tools and climate inputs,[135] and various corporate evaluations of risk.[136]

Use-to-resources ratio values of less than 1.00 indicate that a country's annual combined internal agricultural, industry, and domestic water withdrawal is *less than* its annual amount of renewable freshwater resources, and so there is an average annual surplus of some size. A value of 1.00 indicates that a country's annual combined internal agricultural, industry, and domestic water withdrawal *equals* the annual amount of renewable freshwater resources, and so, at the country level, there is no annual change in nonrenewable (or previously existing) freshwater resource levels. Any value over 1.00 indicates that a country's annual combined internal agricultural, industry, and domestic water withdrawal is *greater than* the annual amount of renewable freshwater resources.

Inclusion in SOFI.

Data for this indicator originated in the FAO's AQUASTAT data. The World Bank provided the data for the variable "annual freshwater withdrawals, total (% of internal resources)," defined as follows:

> Annual freshwater withdrawals refer to total water withdrawals, not counting evaporation losses from storage basins. Withdrawals also include water from desalination plants in countries where they are a significant source. Withdrawals can exceed 100 percent of total renewable resources where extraction from nonrenewable aquifers or desalination plants is considerable or where there is significant water reuse. Withdrawals for agriculture and industry are total withdrawals for irrigation and livestock production and for direct industrial use (including withdrawals for cooling thermoelectric plants). Withdrawals for domestic uses include drinking water, municipal use or supply, and use for public services, commercial establishments, and homes. Data are for the most recent year available for 1987-2002.[137]

The Use-to-Resources Ratio gives a direct look at a country's water use compared to its renewable water resources, so this SOFI component received a weight of 1.

Import dependence ratio.

UNESCO defines the "water import dependency" of a country as "the ratio of the external water footprint [...] to the total water footprint."[138] The import dependence ratio measures how dependent a country is on water resources in other countries. This indicator relies on the idea of virtual-water flows, which are "calculated by multiplying, per trade commodity, the volume of trade by respective average water footprint per ton of product in the exporting nation".[139] A nation's virtual water import dependency is defined as the ratio of the external water consumption to the total water footprint of national consumption.

Inclusion in SOFI.

The data used to calculate this SOFI component included external and total numbers for total water footprint of national consumption (m^3/year/capita) by country, provided by Mekonnen & Hoekstra in National Water Footprint Accounts: The Green, Blue and Grey Water Footprint of Production and Consumption.[140] To calculate the import dependence ratio, the external virtual water footprint of a nation was divided by that nation's total virtual water footprint. The import dependence ratio does not show direct impact on a country's freshwater resources but does add a necessary component for understanding a country's total water use, so this SOFI component received a weight of 0.9.

Groundwater quantity per capita.

With the exception of some areas in eastern Africa, surface freshwater resources on the African continent are predicted to continue declining in the future due to climate change. Because of this, programs such as RAIN to improve access to clean water throughout Africa will increasingly depend on groundwater resources. The continent contains vast groundwater supplies, with best estimates around 0.66 million km^3, with an uncertainty range between 0.36 and 1.75 million km^3.[141] To put that estimate in more understandable terms, Africa is estimated to contain approximately 660,000 trillion liters, or 660,000,000,000,000,000 liters.

These estimates of groundwater resources do not take into account important factors such as the quality of groundwater, since there are currently insufficient data to make any meaningful regional assessments for the continent. Groundwater may contain many different types of contaminants, ranging from minerals to radioactive elements to pathogens. Fluoride concentrations, for example, in excess of drinking water guidelines, have been found in the East African rift valley's volcanic rocks.[142] Increases in such information, through well testing and spatial interpolation using geological data, would improve this component of SOFI.

In addition to the quality of the water, its accessibility is likewise an important consideration. Indeed, researchers have noted that "the accessibility of groundwater resources is as important as overall groundwater storage in determining how far groundwater can support nations and communities to adapt to climate change and population growth"[143] The current version of SOFI does *not* account for accessibility to groundwater resources. Metrics such as depth to the aquifer, ease of drilling, technology needed for drilling and well creation (which varies with how deep the well needs to be), and borehole yield can reflect accessibility;[144] and although some of that data were available, uncertainty in how to incorporate such information into the SOFI in a meaningful way led to their exclusion.

Inclusion in SOFI.

The groundwater estimates for this SOFI component came from MacDonald et al.'s paper entitled *Quantitative maps of groundwater resources in Africa*.[145] The importance of groundwater resources resulted in this SOFI component receiving a weight of 1.

Water pollution level.

Due to increases in populations, food production, and energy consumption, the mobilization of bioavailable nutrients such as nitrogen and phosphorus is becoming an increasingly serious issue.[146] . Human activities have altered global nitrogen and phosphorus cycles, "resulting in eutrophication of lakes, rivers and coastal zones worldwide".[147] Eutrophication drastically impacts water quality by reducing the biodiversity of organisms within the water body or area and impacting the ability of aquatic ecosystems to provide valuable ecosystem services for the human population.

The most common anthropogenic sources of nitrogen and phosphorus nutrients that end up in freshwater systems come from agriculture, sewage, urban runoff, industrial wastewater, and fossil fuel combustion, though specific sources differ among river basins. The "grey water footprint" indicates the degree of freshwater pollution of a water body and is defined as "the volume of freshwater required to assimilate the load of pollutants based on existing ambient water quality standards."[148] [149] [150] In other words, it is the calculation of how much additional freshwater would be needed to dilute polluted water to an acceptable level.

Liu et al. calculated grey water footprints based on nitrogen and phosphorus in rivers around the world using the Global *NEWS* (Global Nutrient Export from WaterSheds) model.[151] Natural concentrations of each nutrient in various forms (dissolved inorganic, dissolved organic, particulate, and total suspended solids) were calculated by the authors and found to be in agreement with previously published studies that created estimates based on available empirical studies. The natural concentration estimates were used during the grey water footprint estimates to determine the difference between the nutrient's ambient water quality standard and its natural concentration in the receiving water body. This difference determines the appropriated assimilation capacity and calculates the grey water footprint when the additional (non-natural) nutrient load is included in the equation.

Inclusion in SOFI.

The data for the water pollution level component of the SOFI comes from Liu et al., as described above. The paper examined the overall grey water footprint, or water pollution level, for phosphorus and nitrogen in 1970 and 2000, and this indicator uses the 2000 data.[152] The data was first processed spatially, and then country water pollution level histograms were examined for outliers. The histograms for both nitrogen pollution level and phosphorus pollution level were both right-skewed, so the standardized scores might slightly misrepresent countries by making their pollution level seem lower than it should in comparison to the rest of the continent.

The potential for misrepresentation with the pollution level and the lack of data on pollutants other than nitrogen and phosphorus resulted in this SOFI component receiving a weight of 0.7.

Factors not included.

SOFI only utilized a portion of available indices and indicators. These were not included in SOFI due to a variety of reasons, such as: lack of Africa-specific data, inadequate documentation showing how to calculate the indicator score, and lack of support for the indicator. For example, the *Social Water Stress Index*, a weighted measure of the Falkenmark indicator, accounts for the ability of populations to adapt to water stress; however, this methodology was not well documented and could not be easily applied to Africa due to data constraints.

Another such index that did not make the final cut for the SOFI was the *Watershed Sustainability Index*.[153] This index incorporated components that the team viewed as extremely important for capturing the environmental dynamics of water programming and development; however, the index was rather complex in its data needs—the aspects (hydrology, environment, life, and policy) each had pressure, state and response parameters. In addition, the index was intended for use at the watershed or basin level for a maximum area of 2,500 km^2; larger basins could have been broken down into smaller sections to fit this size requirement, but the task would have been daunting considering the number of individual basins Africa has and the sheer size of each of them. Because of the complex data requirements, the incompatible resolution of analysis, and the fact that this index had not previously been applied to all of Africa, the *Watershed Sustainability Index* was not adopted in place of SOFI or utilized in its calculation.

Improving individual components measuring water quality for surface water and groundwater could enhance this index. Due to the lack of data at the time of this analysis, the only water quality information available was nitrogen and phosphorus levels for surface freshwater basins. The inclusion of other organic compounds and heavy metals such as fluoride and arsenic would be a drastic improvement to the index. Such additions would improve the information available for decision-making in water development programs.

Findings.

Central Africa has the best SOFI scores, which is not surprising since that is the region with the Congo River Basin. The next best regions of Africa with good SOFI scores include Western Africa and Eastern Africa. Southern Africa has mostly good SOFI scores with some moderate scores. Northern Africa has moderate to very poor states of freshwater resources.

Social Capabilities Composite Index

The *Social Capabilities Index* (SCI) was created because while the current indices within the social realm were each helpful individually, they did not necessarily paint a complete picture of the interplay between society and water and social development programming. Many components of this index were included to provide needed contextual social data to frame the much-used economic production and consumption explanations and solutions to development problems. Although each component index attempts to represent societal health, they approach it from different directions, and that diversity is what this composite index, the *Social Capabilities Index*, seeks to capture in order to create a more complete picture of the social components of development.

The starting points for this index were the concepts of “adaptive capacity” and “adaptive capabilities.” Adaptive capacity is typically used in the context of climate change, but essentially refers to the ability of a social-ecological system to adapt when exposed to various stressors. The ability to adapt is very useful, since without it, a slight change in circumstances could cause the collapse of an ecosystem, social system, or both. There is a huge body of literature pertaining to factors that contribute to adaptive capacity, such as material assets, knowledge, information, equity, social networks, physical and psychological well-being, and much more. Most of the factors that make up adaptive capacity have also been described in the literature about social capital, or about objectives of international development projects, or for what makes a society strong, health, resilient, etc.

The social capability approach was pioneered by economist-philosopher and Nobel Laureate Amartya Sen and later developed further by other scholars and philosophers, such as Martha Nussbaum.[154] It is a theoretical framework that involves "two core normative claims":

> first, the claim that the freedom to achieve well-being is of primary moral importance, and second, that freedom to achieve well-being is to be understood in terms of people's capabilities, that is, their real opportunities to do and be what they have reason to value.[155]

The capability approach allows for the comparison of human well-being that is different from other such accounts, "which focus exclusively on subjective categories (such as happiness) or on the material means to well-being (such as resources like income or wealth)."[156]

Since there are many contributing components—and it is more accurately a systems attribute or characteristic—it seemed that measuring only three aspects of a very complex social system (as the Human Development Index (HDI) does with education, income and life expectancy)[157] would yield a result that would not necessarily be indicative of the state of the entire system. In light of this, the team considered a wide array of factors that have all been recognized as important elements of enabling social capabilities. Among these factors are infrastructure, education, income, health, and governance, for example.

The SCI was created using six elements: the *African Infrastructure Development Index*, the *Human Development Index (HDI)*, the *Gender Inequality Index*, the *Ibrahim Index of African Governance*, the *Social Progress Index*, and the *Happy Planet Index*.

For each of the components, a score was calculated based on the normalized indicator value and an assigned weight. The weights are constant within each indicator but differed between different indicators. Weight values are between 0 and 1 and were assigned by the report team depending on the quality and coverage of the data and importance of the indicator (as decided by the report team using information from the previous literature reviews.) Weighted scores were normalized over all African countries for which data was available for each SCI indicator. These weighted scores were then averaged, accounting for missing scores, and standardized again to achieve the final weighted, standardized SCI scores, which range from 0 to 1, with 1 representing a high score and 0 representing a low score. Ultimately, a high score means that society is able to provide a reasonable quality of life in a stable manner, along with a foundation of freedom and opportunity for individuals, communities, and societies to thrive.

The SCI incorporated many different indicators and data sets. While this increased the amount of factors that were being explained, it also increased the potential for overlap and duplication. This caused some factors to be over-represented and carry more weight than was intended in the composite index. In future versions of the SCI, to reduce duplication error, it would be a good idea to separate larger composite indicators into subcategories and only utilize part of the composite indicator.

African Infrastructure Development Index (AIDI).

Infrastructure is widely recognized as a critical component of both economic and social development – facilitating trade and commerce,[158] [159] transportation,[160] WASH services, [161] and much more.[162] Over the past decade, "the information and communications technology sector had been a major economic driver in Africa, [and] it enhanced regional trade and integration."[163] At the Second Committee of the Sixty-eighth UN General Assembly, Tekeda Alemu, the Permanent Representative of Ethiopia to the United Nations, "noted the digital divide between countries which have high broadband capacity and Internet and those who did not."[164]

The African Development Bank's *African Infrastructure Development Index* (AIDI) is based on four primary components: transport, electricity, information and communication technologies, and water and sanitation.[165] These four components then disaggregated into a total of 9 indicators "that have a direct or indirect impact on productivity and economic growth" (Table 26).[166]

At the time of this report, the AIDI did not include infrastructure development indicators such as the presence of seaports or airports, although there was mention of including such data once it became available in order to improve the index's robustness and scope.[167]

Inclusion in the SCI.

The data used for this indicator cover the period of 2000-2010.[168] The observations were based on data collected under the Africa Infrastructure Knowledge Program, which is hosted by the African Development Bank, as well as on other data sources. The AIDI has a minimal lack of data, as only Burkina Faso and South Sudan are without scores.

Infrastructure plays a critical role in providing for basic needs as well as economic advancement. The AIDI only covers the category of infrastructure, but it covers that single topic with significant depth (9 indicators), and so this component of the SCI was given a weight of 0.7.

Human Development Index.

Although it only examines three things, the *Human Development Index* (HDI) is widely recognized as a prime indicator for assessing the state of human development.[169] [170] It is the geometric mean of normalized proxy indices for each of three dimensions: health, education, and standard of living.[171]

In this index, life expectancy at birth is used to assess the health dimension.[172] The education dimension is assessed using mean of years of schooling for adults aged 25 years and expected years of schooling for children of school entering age, both of which are estimated by the UNESCO Institute for Statistics and combined into an education index using arithmetic mean.[173] Gross national income per capita is used to assess the standard of living dimension.[174]

One weaknesses of the global HDI include that it does not account for inequalities, poverty, human security, and empowerment, among other things. These issues have been addressed in some of the regional and national human development reports, but they have not been brought into the global report.[175]

Inclusion in the SCI.

Data for life expectancy at birth is sourced from the UN Department of Economic and Social Affairs – the UN Population Division.[176] Mean years of schooling data is based on UNESCO Institute for Statistics education attainment data.[177] Data for expected years of schooling are provided by the UNESCO Institute for Statistic.[178] Finally, gross national income per capita data was sourced from the World Bank and the International Monetary Fund and also obtained from the UN Statistical Division's dataset with the SNA Main Aggregates.[179]

The HDI contained data for all African countries except for Somalia and South Sudan, and the final HDI scores were included in the SCI as one of the six inputs. It contains information from three categories – as opposed to AIDI which only looked at infrastructure[180] – although it does not explore as deeply (it does examine two separate measurements for education), which is why this component of the SCI was given a weight of 0.75.

Gender Inequality Index.

Gender inequality is a still major barrier to human development, despite great improvements since 1990. "All too often, women and girls are discriminated against in health, education, political representation, labour market, etc. – with negative repercussions for development of their capabilities and their freedom of choice."[181] Although it is somewhat factored into the *Human Development Index* and the *Social Progress Index*, such inequality is not a prominent component in those indices. In addition, gender inequality is an important issue and is of particular focus as well within the RAIN program; thus, the University of Michigan team included it as a discrete component of the SCI.

One of the weaknesses of this component is missing data. Of the countries examined, the *Gender Inequality Index* did not have data for the following countries: Angola, Burkina Faso, Cabo Verde, Comoros, Djibouti, Equatorial Guinea, Eritrea, Guinea, Guinea-Bissau, Madagascar, Nigeria, Sao Tome and Principe, Seychelles, Somalia, and South Sudan.

Inclusion in the SCI.

Data used to calculate the *Gender Inequality Index* is sourced from major publicly available international databases; some examples include the maternal mortality ratio, adolescent birth rates, education attainment, parliamentary representation, and labour market participation. The maternal mortality ratio information is sourced from the United Nations Maternal Mortality Estimation Group, WHO, UNICEF, UNFPA, and the World Bank.[182] Adolescent birth rates are sourced from the UN Department of Economic and Social Affair's World Population Prospects.[183] Educational attainment statistics are sourced from the UNESCO Institute for Statistics educational attainment tables and the Barro-Lee data sets.[184] Parliamentary representation data is sourced from the International Parliamentary Union.[185] Finally, labour market participation is sourced from the International Labour Organization's Key Indicators of the Labour Market 7th Edition.[186]

Even with the aforementioned weakness of missing data, this component of SCI is still extremely important in the development scene. It only examines gender inequality, but it incorporates many indicators within that examination. Because of these reasons, this component of SCI was given a weight of 0.75.

Ibrahim Index of African Governance.

The Mo Ibrahim Foundation defines governance as "the provision of the political, social and economic goods that a citizen has the right to expect from his or her state, and that a state has the responsibility to deliver to its citizens."[187] The *Ibrahim Index of African Governance* (IIAG) is a respected index that looks at how effective and efficient the various African states are in terms of governance.[188] Good governance is one of the most critical elements that can make or break a strong social-ecological system, thus this index was relevant and important.[189] [190]

Inclusion in the SCI.

Compiled from more than 100 variables from 34 independent African and global sources, "the IIAG is the most comprehensive collection of data on African governance."[191] The 34 data sources include those such as the Freedom of the Press Index from Freedom House; IDA Resource Allocation Index from the World Bank; the Global Competitiveness Report from the World Economic Forum; Social Institutions and Gender Index under Gender, Institutions and Development Database from the Organisation for Economic Co-operation and Development; WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation Database from the World Health Organization; World Development Indicators from the World Bank; and the Political Terror Scale from the Political Terror Scale.[192] The only major data missing from the IIAG were for the countries of South Sudan and Sudan.

The IIAG covers quite a number of categories and also delves deep within each one. Due to the importance of good governance for social development efforts, the minor lack of data, and the great breadth and depth of the index, this SCI component was given a weight of 1.

Social Progress Index.

Development and growth require achieving both economic and social progress, and the *Social Progress Index* aims to examine this dual need by utilizing "a rich framework for measuring the multiple dimensions of social progress, benchmarking success, and catalyzing greater human wellbeing."[193]

Inclusion in the SCI.

The *Social Progress Index* is broken down into three dimensions, labeled Basic Human Needs, Foundations of Wellbeing, and Opportunity.[194] Each of these dimensions contains four components. The Basic Human Needs dimension contains nutrition and basic medical care, water and sanitation, shelter, and personal safety. The Foundations of Wellbeing dimension includes access to basic knowledge, access to information and communications, health and wellness, and ecosystem sustainability. The Opportunity dimension contains personal rights, personal freedom and choice, tolerance and inclusion, and access to advanced education. One of the distinguishing features of the *Social Progress Index* is how it accounts for opportunity, which is referred to as "an aspect of human wellbeing that is often overlooked or separated in thinking about social progress for more foundational and material needs such as nutrition and healthcare."[195] Country scores ranged from 0 to 100 and reflect realistic performance rather than abstract measures.

The *Social Progress Index* covers a great number of different topics in great depth. It is well-crafted with a development processes that involves multiple stakeholders, and it was given a weight of 0.9 because of these reasons.

Data for the *Social Progress Index* was sourced from the FAO; World Health Organization; UN Inter-agency Group for Child Mortality Estimation; WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation; Gallup World Poll; World Economic Forum's Global Competitiveness Report; Sustainable Energy for All; Institute for Global Health Metrics and Evaluation; Institute for Economics and Peace Global Peace Index; UN Educational, Scientific, and Cultural Organization Institute for Statistics; International Telecommunications Union; Reporters Without Borders; World Resources Institute; Yale Center for Environmental Law & Policy and Columbia University Center for International Earth Science Information Network Environmental Performance Index; Freedom House; Cingranelli-Richards Human Rights Data Project; Heritage Foundation; Pew Research Center Government Restrictions Index; OECD Gender, Institutions and Development Database; United Nations Population Division; Transparency International; Fund for Peace Fragile States Index; Times Higher Education World University Rankings; QS World University Rankings; Academic Rankings of World Universities; United Nations Development Programme; and Barrow-Lee Educational Attainment Dataset.[196]

The *Social Progress Index* lacked data for quite a number of African countries, including Cabo Verde, Comoros, Democratic Republic of the Congo, Equatorial Guinea, Eritrea, Gabon, Gambia, Guinea-Bissau, Ivory Coast, Libya, Sao Tome and Principe, Seychelles, Sierra Leone, Somalia, South Sudan, and Zimbabwe.

Happy Planet Index.

The *Happy Planet Index* is another index, like the *Human Development Index*, that only looks at a few indicators but is unique in that it looks at how many long and happy lives each country produces per unit of environmental output.[197] It was the only index found by the University of Michigan team that included a quality of life measure as directly reported by residents of the country and related it to ecological footprint (land resource consumption).

The *Happy Planet Index* uses data on experienced well-being, life expectancy, and ecological footprint. Experienced well-being was assessed using a question called the 'Ladder of Life' from the Gallup World Poll. In this question, respondents were asked to "imagine a ladder, where 0 represents the worst possible life and 10 the best possible life, and report the step of the ladder they feel they currently stand on."[198] Life expectancy data was obtained from the 2011 UNDP Human Development Report. The World Wildlife Fund's Ecological Footprint was used as a measure of resource consumption for each country. The Ecological Footprint measures the amount of land (in global hectares) required to sustain a country's consumption patterns, per capita.

Questions from the Gallup World Poll about feelings of safety, tolerance, and happiness were examined in the *Social Progress Index*, as well; however, ecological footprint data was not examined alongside it, which is what makes the *Happy Planet Index* distinctive.

One limitation of the Happy Planet Index is that the latest report is from 2012.[199] In addition, there is also a lack of data for twelve countries, including: Cabo Verde, Equatorial Guinea, Eritrea, Gabon, Gambia, Guinea-Bissau, Lesotho, Sao Tome and Principe, Seychelles, Somalia, South Sudan, and Swaziland.

Inclusion in the SCI.

Although the *Happy Planet Index* is a good barometer of how well a nation is doing, it does not measure everything. In fact, it is very limited in what it measures, which means there is a lot of other information to include in the *Social Capabilities Index*. Although perhaps counterintuitively, the *Happy Planet Index's* limited inclusion of different factors is actually beneficial for the SCI. Because so many other indices have attempted to cover as much ground as possible, the overlapping areas could increase the composite SCI's overall error due to duplication. Thus, the simple approach of the *Happy Planet Index* is a very good fit in terms of variables since it offers a special aspect of social capabilities neglected by the other components while reducing the error risk from data duplication.

Happy Planet Index scores were incorporated into the SCI with a weight of 0.75. This weight is because although the Happy Planet has greatly reduced the incidences of double counting within this report, it is still greatly lacking in material types or sources. For example, only one question from the Gallop Poll was examined to calculate well-being for this index.

Findings.

The majority of Africa shows medium to low social capability. Countries with good to very good social capability were noted in Northern Africa and Southern Africa. The other regions of the continent contain countries with medium to very low social capability.

Global Competitiveness Index

The *Global Competitiveness Index* (GCI) is an existing index that was adopted from the World Economic Forum (WEF) by the University of Michigan team to reflect global trends and local or regional realities. WEF is an independent, multilateral organization "committed to improving the state of the world through public-private cooperation."[200] They are well known for their annual meeting in Davos, where they host some 2,500 global business, political, and thought leaders to discuss some of the world's most pressing challenges.

Within the GCI, "competitiveness" is defined essentially by the presence of the various factors that typically fuel competitive economic growth. More specifically:

> We define competitiveness as the set of institutions, policies, and factors that determine the level of productivity of a country. The level of productivity, in turn, sets the level of prosperity that can be reached by an economy. The productivity level also determines the rates of return obtained by investments in an economy, which in turn are the fundamental drivers of its growth rates. In other words, a more competitive economy is one that is likely to grow faster over time.[201]

Similar to the other two composite indices used, the open-ended idea that many factors are likely to be important for growth and competitiveness and that they are not mutually exclusive is captured "by including a weighted average of many different components, each measuring a different aspect of competitiveness."[202]

The scores for the GCI were originally weighted and standardized on a scale of 1 to 7 for countries throughout the world. In order to better understand the GCI within the context of Africa, the report team standardized those GCI scores on a scale of 0 to 1 and only included countries within African.

Not all countries are represented within the GCI. The WEF report explains that not all uses of the terms "country" or "nation" "refer to a territorial entity that is a state as understood by international law and practice," and "the terms cover well-defined, geographically self-contained economic areas that may not be states but for which statistical data are maintained on a separate and independent basis."[203] Currently, there is only one territory in Africa that is disputed: Western Sahara.

The main weakness unique to the GCI is data availability. The 2014-2015 report includes placeholders (but not data) for two countries: Benin and Liberia, while 14 other nations are completely absent.[b]

Components.

The aspects of competitiveness are captured in three sub-indices with a total of 12 pillars. The "basic requirements" sub-index is key for factor-driven economies and includes the pillars of (1) institutions, (2) infrastructure, (3) macroeconomic environment, and (4) health and primary education.[204] The "efficiency enhancers" sub-index is key for efficiency-driven economies and includes the pillars of (5) higher education and training, (6) goods market efficiency, (7) labor market efficiency, (8) financial market development, (9) technological readiness, and (10) market size.[205] Finally, the "innovation and sophistication factors" sub-index is key for innovation-driven economies and includes the pillars of (11) business sophistication and (12) innovation.[206]

To obtain a final competitiveness score, each of the three sub-indices were weighted based on the country's stage of development, which was determined based on

[b] . The following countries are not represented, placeholders or otherwise, in the dataset: Central African Republic, Comoros, Democratic Republic of the Congo, Republic of the Congo, Djibouti, Equatorial Guinea, Eritrea, Guinea-Bissau, Niger, Sao Tome and Principe, Somalia, Sudan, South Sudan, and Togo.

two criteria: the level of GDP per capita at market exchange rates (proxy for wages) and the share of exports of mineral goods in total exports. More information on the details of the GCI scoring process that produced the numbers used in this report's assessments can be found within The Global Competitiveness Report 2014-2015.[207]

Findings.

Ignoring areas without data, the African regions with the best global competitiveness are Southern Africa and Northern Africa. Eastern Africa contained countries with good to moderately low global competitiveness. Western Africa and Central Africa contained countries with moderate to very low global competitiveness.

Spatial Analyses

People are able to understand spatial patterns and relationships (understand the world, actually) through the use of spatial analysis – "mapping where things are, how they relate, what it all means, and what actions to take."[208] Spatial analysis allows users to place things on a map and put the world in context. It also allows for measuring attributes (such as size, shape, and distribution), determining how places are related, finding the best locations and paths, detecting and quantifying patterns, and making predictions.[209] Finding suitable locations and managing risk are also possible with spatial analytics.

The number of countries and territories in Africa does not lend itself to summarizing data in tabular format. In addition, regional differences and geographic trends are lost in such a format. Therefore, spatial assessments were undertaken to illustrate the data in a format that would allow such geographic trends to be seen visually and for inferences to be made.

While spatial analyses can be used in conjunction with statistical tests, spatial assessments alone do not give any indication of whether two countries are significantly different, statistically, and this can lead to misleading interpretations if not specified clearly. Statistical tests can be performed on spatial data – such as cluster analysis,[210] – but no such examinations were undertaken for these spatial assessments due to the resource constraints of the report team. It was also in large part because the report team did not want to falsely portray these spatial assessments, particularly the composite indicators as they exist at the time of this report, as being statistically robust and potentially lead to misinterpretation by readers. In the future with more work and data sources, this weakness could be amended and transformed into a strength.

In addition to the data collected for the composite indices themselves, various spatial layers were used for these spatial analyses. For all continent-level maps, the country shapes and backgrounds were derived from Esri's "World Countries" layer package updated in 2015.[211]

Most of the data used was sourced and accessible from a publically accessible database or data set, but some data, such as a published map of groundwater accessibility,[212] was not available for use and also could not be extracted from the map image. These data were left out of the spatial assessments but would be good to reference for general knowledge and understanding.

The three composite indices (SOFI, SCI, and GCI) were mapped individually and in several combinations with one another to illustrate different narratives regarding environmental, social, and economic risks and opportunities on the African continent. Other data were mapped individually to highlight those variables and provide further context to the issue at large. Those data include access to improved drinking water sources, access to improved sanitation facilities, freshwater withdrawals for agriculture, population,

Spatial Methods

All spatial analyses in this report were performed using ArcGIS software.[213] Maps throughout this report were created using ArcGIS® software by Esri. ArcGIS® and ArcMap™ are the intellectual property of Esri and are used herein under license. Copyright © Esri. All rights reserved. For more information about Esri® software, please visit www.esri.com. Details for the processing methodology of the spatial files can be found in Appendix C.

Additional Assessments

The Fragile States Index (FSI).

The *Fragile States Index (FSI)* – previously known as the *Failed States Index* – was created by The Fund for Peace and is published annually in the Foreign Policy magazine. This index rates how vulnerable or fragile 178 nations are to conflict or destabilization[214] by "highlighting not only the normal pressures that all states experience, but also [by] identifying when those pressures are pushing a state toward the brink of failure."[215]

"Millions of documents are analyzed every year, and by applying highly specialized search parameters, scores are apportioned for every country based on [12] key political, social, and economic indicators and over 100 sub-indicators that are the result of years of painstaking expert social science research."[216]
The 12 indicators used in this index include demographic pressures, refugees and IDPs, uneven economic development, group grievance, human flight and brain drain, poverty and economic decline, state legitimacy, public services, human rights and rule of law, security apparatus, factionalized elites, and external intervention (Table 27).[217]

The FSI was originally going to be incorporated into the report team's original *Social Capabilities Index* (SCI), but the FSI was removed to reduce double counting, since the *Social Progress Index* (part of the SCI) includes the FSI in its own scoring calculations. However, because national stability is essential for societal stability and because the FSI tells a unique narrative with such a broad diversity of indicators, the report team felt that it was important enough to add to the independent analyses.

"The 2014 Fragile States Index, the tenth edition of the annual Index, comprises data collected between January 1, 2013 and December 31, 2013 – thus, certain well-publicized events that have occurred since January 1, 2014 are not covered by the 2014 Index."[218]

Because national stability is essential for societal stability and the *Fragile States Index* is very expansive in breadth.

The *Fragile States Index* scores were selected from the 2013 rankings, as those were the most current information available at the time of this report's creation. The rankings are available on the Foreign Policy website.[219] This index is mostly complete for the African continent, although information is missing for Burkina Faso.

The following excerpt from *The Fragile States Index 2014* provides a more technical explanation of the methodology used to develop the FSI scores:

> The Fund for Peace's software performs content analysis on [millions of pieces of] collected information. Through sophisticated search parameters and algorithms, the CAST software separates the relevant data from the irrelevant. Guided by twelve primary social, economic and political indicators (each split into an average of 14 sub-indicators), the CAST software analyzes the collected information using specialized search terms that flag relevant items. Using various algorithms, this analysis is then converted into a score representing the significance of each of the various pressures for a given country.
>
> The content analysis is further triangulated with two other key aspects of the overall assessment process: quantitative analysis and qualitative inputs based on major events in the countries examined. The scores produced by The Fund for Peace's software are then compared with a comprehensive set of vital statistics – as well as human analysis – to ensure that the software has not misinterpreted the raw data. Though the basic data underpinning of the Fragile States Index is already freely and widely available electronically, the strength of the analysis is in the methodological rigor and the systematic integration of a wide range of data sources.[220]

FSI scores should be interpreted as the lower the score, the better. In other words, "a reduced score indicates an improvement, just as a higher score indicates greater instability."[221] In Figure 74, higher scores (lower stability and greater fragileness) are illustrated as red, and lower scores (greater stability and lower fragileness) are illustrated as green.

Strength-based combination.

The strength-based analysis was developed to examine how likely a water stewardship program would succeed within countries. This approach did not look at specific water stewardship methods but looked at countries in terms of potential water stewardship success, in general. Each country's overall strength was measured in terms of the state of freshwater resources, social capability, and global competitiveness. Stronger countries are better able to support water stewardship endeavors through the provision of operational infrastructure, effective water resource governance structures, security and stability, and a variety of other factors. Water stewardship is less risky when there is adequate water with which to supply communities, social capability for people to adapt to new ways of living and to help ensure the stewardship efforts are possible with the level of governance in the country, and good current or future opportunities for creating business value. This analysis was performed by mathematically averaging (sum divided by 3) each country's scores from the three main composite indicators (SOFI, SCI, and GCI) examined in this report. The data included in the three composite indicators can be found in Table 4. More information about each component can be found in the previous portions of this *Spatial Assessments* section of the report.

Since the likelihood for stewardship success is higher with these countries than for others (since there are likely stronger structures and greater resources available to support these projects), these can be labeled as the strongest countries for water stewardship (see Table 3). For those considering investing in water stewardship in Africa or otherwise considering locations for such projects, the countries identified here likely represent lower-risk options (lower-risk particularly from violent conflict, political instability, and other social risk drivers). It is outside the scope of this report to consider the potential for returns on investments in these locations, and potential returns are likely to be variable over time and according to location and other circumstances. Overall, these countries have the highest-level of conditions likely to drive successful water stewardship efforts. It can be inferred that these countries are economically competitive, socially capable, and that they contain sufficient freshwater resources (in terms of ecological quantity and quality) to at least meet current demands for it. While these countries may not have the most need for all types of water stewardship, many of them could still benefit from specific approaches.

Table 3. "Strength-based combination." The top 10 countries with the highest potential for water stewardship.

Rank	Country
1	Gabon
2	Botswana
3	Mauritius
4	South Africa
5	Tunisia

Rank	Country
6	Rwanda
7	Morocco
8	Namibia
9	Algeria
10	Zambia

Table 4. Components and data of the SOFI, SCI and GCI.

SOFI	SCI	GCI
Falkenmark Index (renewable freshwater resources per capita)	African Infrastructure Development Index	Basic requirements sub-index
Use-to-resource ratio	Human Development Index	Efficiency enhancers sub-index
Import dependence ratio	Gender Inequality Index	Innovation and sophistication factors sub-index
Groundwater amount per capita	Ibrahim Index of African Governance	
Water Pollution Level	Social Progress Index	
	Happy Planet Index	

The strength-based combination illustrates the probable overall success and successful establishment of new social water development programs (Figure 7). It is evident from the map that country scores within this combination are well distributed along the blue color spectrum without much clustering at any one section.

There are also geographic trends in the data, and these trends are examined using geographic regions specified by the United Nations.[222] Several countries in the northern Africa show potential for becoming strong bases for development programming: Morocco, Algeria, Tunisia, and Libya (although this last country's data is outdated from current strife events). The eastern region of Africa also has a few countries that could make good program bases: Ghana and Rwanda. In the central portion of Africa, Gabon would make a good program base. The southern area of Africa also shows several countries that have the makings of being good areas for establishing successful water programs: Namibia, Botswana, and South Africa.

In the strength-based combination (Figure 75), lighter colors indicate areas where new social water programs are likely to collapse while darker areas would provide areas where a strong base could be established for a program to work from successfully.

Access to improved water sources and improved sanitation facilities.

A population's access to improved water sources and sanitation facilities is an important consideration when determining a country's well-being, socially. Although this indicator is captured within the SCI's *Social Progress Index* component, the report team decided that this information was especially important to include as an individual examination, separate from the composite indicators previously discussed. This decision was due to the great emphasis that many international development programs are placing on these issues and also due to its relevance both to the Replenish Africa Initiative, and to this report.

Data was sourced from the WHO/UNICEF Joint Monitoring Programme (JMP) for Water Supply and Sanitation.[223] A total of 55 countries had JMP estimate profiles.[224] Most countries had 2012 estimates for all population-access type combinations, but seven countries did not. All 6 of the estimates for Comoros and Somalia were for 2010. Equatorial Guinea and Eritrea had 2005 estimates. Libya's estimates for access to improved water resources were for 2000, but estimates for access to improved sanitation facilities were for the latest available year 2012. Some 2012 estimates were available for Réunion, but it did not have estimates for total population access to improved water sources or to improved sanitation facilities. Exactly the opposite, Seychelles only had estimates for 2012 total population access to improved water sources and improved sanitation facilities; the country did not have estimates from any year for the rural and urban populations.

The countries in most need of, and deemed most impactful for, water stewardship specifically related to water and sanitation access are shown in Table 5. Potential water stewardship impact was determined by these countries being in the top 10 most populous countries and being in either the top 10 of the World Bank and IFC's

Ease of Doing Business Index or KPMG's Africa's Top 10 for Investment List.[225] Need was determined by these countries having less than or equal to 50% of the total population with access to improved sanitation facilities and having less than or equal to 75% of the total population with access to improved water sources.

Table 5. Top 5 countries with highest potential for water sanitation and water source stewardship.

Countries
Tanzania
Ethiopia
Nigeria
Kenya
Uganda

Watershed protection.

The countries in most need of this type of water stewardship in the area of watershed protection are shown in Table 6. Need was approximated by these countries having the highest annual total freshwater withdrawal (top 10 for Africa), having extremely little upstream protected land, being in the bottom 50% for average annual precipitation, and being in the bottom 50% of the SOFI index ranking.

Table 6. Top 3 countries with highest potential for watershed protection stewardship.

Countries
Algeria
Morocco
South Africa

Sustainable agriculture and water for productive use.

The countries in most need of this type of water stewardship are shown in Table 7. Need was determined by these countries ranking in the top 10 for total amount of agricultural land, having over 50% of country land area dedicated to agriculture, and having over 50% of total water withdrawals dedicated to agriculture.

Table 7. Top 3 countries with highest potential for sustainable agriculture and water for productive use stewardship.

Countries
South Africa
Nigeria
Mozambique

"Top 20" and "Bottom 10"

In regards to the three main composite indicator analyses, this report examines the 20 countries with the best scores ("Top 20") (Table 28) and the 10 countries with the worst scores ("Bottom 10") (Table 29).

A number of countries reappeared on several "Top 20" lists. Countries that occurred in all three "Top 20" lists include Gabon and Botswana. Nineteen countries ranked in two of the "Top 20" lists.

Most interestingly, there were some countries that appeared in "Top 20" lists and did *not* appear in the "Bottom 10" lists. Specifically looking at countries in 2 or more "Top 20" lists, those that did not appear in any of the "Bottom 10" lists include Botswana, Cameroon, Ethiopia, Gabon, Ghana, Kenya, Madagascar, Namibia, Rwanda, Senegal, Tunisia, and Zambia. Botswana ranked 13th in the SOFI, 11th in the SCI, and 4th in the GCI. Cameroon ranked 14th in the SOFI and 16th in the GCI. Ethiopia ranked 20th in the SOFI and 20th in the GCI. Gabon ranked first in the SOFI, 14th in the SCI, and 12th in the GCI. Ghana ranked 12th in the SCI and 14th in the GCI. Kenya ranked 17th in the SCI and 9th in the GCI. Madagascar ranked 10th in the SOFI and 20th in the SCI. Namibia ranked 10th in the SCI, 7th in the GCI. Rwanda ranked 15th in the SCI and 6th in the GCI. Tunisia ranked third in the SCI and 8th in the GCI.

A number of countries appeared in multiple "Bottom 10" lists. Eritrea was the only country that occurred in four lists. Chad and Djibouti each appeared in 3 lists. The following countries appeared in two "Bottom 10" lists: Cabo Verde, Egypt, Gambia, Guinea, Guinea-Bissau, Niger, Seychelles, Sierra Leone, Somalia, Sudan, and Togo.

Conclusions

Gabon and Botswana offer the highest chances of water stewardship success. These countries placed in the top 20 for freshwater resources, social capability, and global competitiveness.

Looking beyond those two countries, the next tier of countries for potential investment include Cameroon, Ethiopia, Kenya, Madagascar, Namibia, Rwanda, and Zambia. These countries are not in the top 20 for all assessments, but are for 2 of them.

If a country's state of water resources is an important target for a stewardship project, then the countries of Gabon, Botswana, Madagascar, Cameroon, and Ethiopia should be examined, since these countries ranked highly in the *State of Freshwater Resources Index* and one of the other two indices in the assessments.

The regions with the highest chance for water stewardship success are Southern Africa and Western Africa. More specifically, the countries Gabon, Botswana, and Mauritius were the top 3 countries that showed the most likely chance for water stewardship success.

Specific regions and countries in Africa may be constrained by water scarcity in the future. Aside from human use, some environmental factors that affect water scarcity include inter-annual variability, seasonal variability, and groundwater supply. Inter-annual variability leads to unreliable refilling of renewable water resources (due to inconsistent precipitation patterns) between years and is a serious problem in Northern Africa, Southern Africa, and Eastern Africa. Seasonal variability causes problems with agriculture and areas where people need to limit water use since they do not know how much precipitation will fall between different seasons within a single year, and high seasonal variability affects Western Africa, Eastern Africa, and Central Africa. Investment in meteorological and hydrological monitoring would help increase the understanding of these phenomena. Groundwater is one method that is used to cope during periods of drought due to inter-annual or seasonal variability. Regions with low groundwater supply per capita include Eastern Africa and Western Africa. Watershed conservation projects that help increase infiltration of water into and protect the quality of groundwater aquifers in such drought-affected regions could potentially be valuable in the future.

Value Creation Model

Defining "Value"

<u>Value</u>: *val·ue /ˈvalyo͞o/*

1. *noun*, The regard that something is held to deserve; the importance, worth or usefulness of something
2. The material or monetary worth of something[226]

While the concept of "value" and the idea of "creating value" might resonate with some level of intuitive understanding, attempting to articulate a concrete and specific definition is not as straightforward. The definitions of business value and social value may not often be subject to detailed analysis, yet the way in which they are defined can make a substantial difference in the activities that businesses and organizations pursue or the policies that policy-makers craft.

Business value.

Various perspectives exist regarding the proper way to define and measure "business value," ranging from very particular to very comprehensive. On one end of the spectrum, business value may be understood narrowly as the strict economic value of a firm, as measured by metrics such as economic value added, earnings-per-share, or discounted cash flow. Further along this spectrum, additional tangible and intangible elements may begin to factor in to the determination of business value, such as intellectual capital, human capital, brand value and reputation.

Another aspect of business value concerns *whom* value is being created *for*. Today, many within the business world believe that the goal of a business is to create or maximize profits for its shareholders, but it was not until the 1970's that free-market academics introduced this idea,[227] which was captured perhaps most famously by University of Chicago economics professor Milton Friedman. Writing in *The New York Times Magazine* in 1970, he articulated a normative view of the firm, which held that the only responsibility of the firm was to create value for its shareholders.[228] This rising paradigm, combined with shifting incentives[229] and cultural changes, led many business executives to pivot towards increasing near-term gains for shareholders.

For much of the twentieth century, however, businesses were commonly seen as having a wider responsibility in society.[230] [231] As recently as 1981, the Business Roundtable (a national organization of top business leaders)[232] issued a statement asserting:

> "Corporations have a responsibility, first of all, to make available to the public quality goods and services at fair prices, thereby earning a profit that attracts investment to continue and enhance the enterprise, provide jobs, and build the economy…Business and society have a symbiotic relationship: The long-term viability of the corporation depends upon its responsibility to the society of

> which it is a part. And the well-being of society depends upon profitable and responsible business enterprises."[233]

Today, there are a growing number of concepts and frameworks that continue to develop and refine this type of 'symbiotic' thinking. A few of the more well-known examples include stakeholder theory, popularized by R. Edward Freeman;[234] shared value creation as described by Porter and Kramer;[235] and enlightened value maximization, articulated by Michael Jensen.[236] In recent years, driven in part by growing consumer and investor demand for this type of "corporate responsibility,"[237] businesses of all sizes have become increasingly focused on their relationship to society. Some are investing more heavily in philanthropic projects such as The Coca-Cola Africa Foundation's RAIN program, while others are structuring their entire business model around creating social value – with a growing number making use of new legal forms, such as Benefit Corporations.[238]

Social value.

With this renewed interest in the relationship between business and society, the question inevitably arises as to what exactly "social value" refers to. A professor at George Mason University, Philip Auerswald, provides a compelling account of the modern development of the narrative around social value in the *Stanford Social Innovation Review*.

One side of this narrative, according to Auerswald, was articulated by Harvard University economist Robert Barro, in response to a speech given by Bill Gates.[239] Barro argued that the social value of a given company or product comes from the economic gains enabled or created from its use. In the case of Bill Gates, the social value would derive from the increase in productivity created when Microsoft Windows was used. By this definition, "every market transaction creates social value, the bigger the better."[240] Extending this line of reasoning, one might conclude that corporations such as Exxon Mobil Corp. or Enron Corp. are - or were - some of the greatest creators of social value.

On the other side of the spectrum, Auerswald placed ideas from business and economics experts such as James A. Phills, Jr., Kriss Deiglmeier, and Dale T. Miller, authors of an article on social innovation.[241] In the article, the authors describe social value as "the creation of benefits or reductions of costs for society – through efforts to address societal needs and problems – in ways that go beyond the private gains and general benefits of market activity."[242] This definition has at least one critical difference from Barro's: it accounts for impacts outside of market activity. Barro's perspective focuses solely on market transactions and ignores any externalities that are not captured in a market (either because the market does not exist, or because it is imperfect). In the case of Exxon Mobil Corp., for instance, Barro's transactional view of social value fails to account for the consumption of environmental, health, or other such goods that have imperfect or nonexistent markets.

Another aspect of social value not captured in the strictly transactional view relates to societal governance. Some experts, such as University of Michigan professor Aneel Karnani, argue that job creation from large, labor-intensive industries creates social value on a wide scale, and that it does so more effectively than more directed social programs, such as microfinance.[243] While the creation of employment opportunities is certainly significant, this argument again fails to account for the negative externalities to health, human rights, quality of life, the environment, and governance that frequently accompany such labor-intensive industries. In fact, some of these same large corporations that can open the door to job creation also contribute to the centralization of power and poor governance structures.[244] Since governance structures and institutions can have direct influence over individual and societal well-being (positively or negatively), these governance-related impacts are important considerations. Nonetheless, they do not factor in to the transactional view.

Another important element of social value comes from the work of Nobel Laureate Amartya Sen. One of his major contributions was to establish a new theoretical foundation for comparing human well-being that did not rely solely on the material means to well-being, such as income, or on strictly subjective measures, such as happiness. Instead, the capability approach, as it has come to be known, "purports that freedom to achieve well-being is a matter of what people are able to do and to be, and thus the kind of life they are effectively able to lead."[245] In the context of social value, this adds another important factor into its accounting. Indeed, capabilities[c] (or their lack, deprivation) can be measured, and while capabilities may not always directly translate into monetary metrics, they represent an important aspect of social value.

Integrating business and social value.

As investors and others seek out additional information concerning the value creation activities of corporations, a new form of corporate reporting has emerged in recent years. Known as *integrated reporting*, "it is built on the foundations of financial, management commentary, governance and remuneration, and sustainability reporting in a way that reflects their interdependence."[246] Its roots can be traced back to 2009, the year in which the *King III Code of Governance Principles* was released in South Africa, which recommended the publication of integrated reports by companies. The following year, the Johannesburg Stock Exchange included this (or an explanation of why one was not published) as a pre-requisite for listing. Later in 2010, the Prince of Wales' Accounting for Sustainability Project and the Global Reporting Initiative formed the International Integrated Reporting Committee (IIRC), with the aim of developing an International Integrated Reporting Framework.[247] The International Framework was released to the public in 2013.[248]

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[c] Defined as: "effective opportunities to undertake actions and activities that [the individual] ha[s] reason to value, and be the person that the [individual] ha[s] reason to want to be."[20]

In response to a 2011 discussion paper published by the IIRC, roughly three-fourths of respondents agreed that the ability of an organization to create and sustain value over the short, medium, and long-term was appropriate as a central theme for reporting. As a result, value creation was given a central role in the eventual Framework.[249] While earlier discussion focused in part on normative considerations around value, the IIRC's work does not address questions such as "whether and to what extent the role of the modern corporation is to maximize shareholder value or to create value for the whole of society..."[250] Furthermore, it acknowledges that while value *capture* and value *appropriation* are closely linked to value creation, the work of the IIRC focuses solely on value *creation*.

In order to elucidate the concept of value creation, the IIRC conducted a literature review and identified ten general themes concerning value creation. These themes are summarized in Table 30 (Appendix D).[251]

Based on these themes, the Framework asserts that value creation for an organization is inextricably linked to the value it creates for others (Figure 77, Appendix D). Value creation, in this conceptualization, is a function of a wide array of activities, interactions, and relationships. The full IIRC value creation model is illustrated in Figure 4. The Framework also describes the importance of accounting for externalities, since they may "ultimately increase or decrease value created for the organization."[252] Finally, the Framework notes that due to different time frames and different stakeholders finding value from different factors, long-term value is unlikely to be created through maximizing only one capital (defined below) at the expense of others.

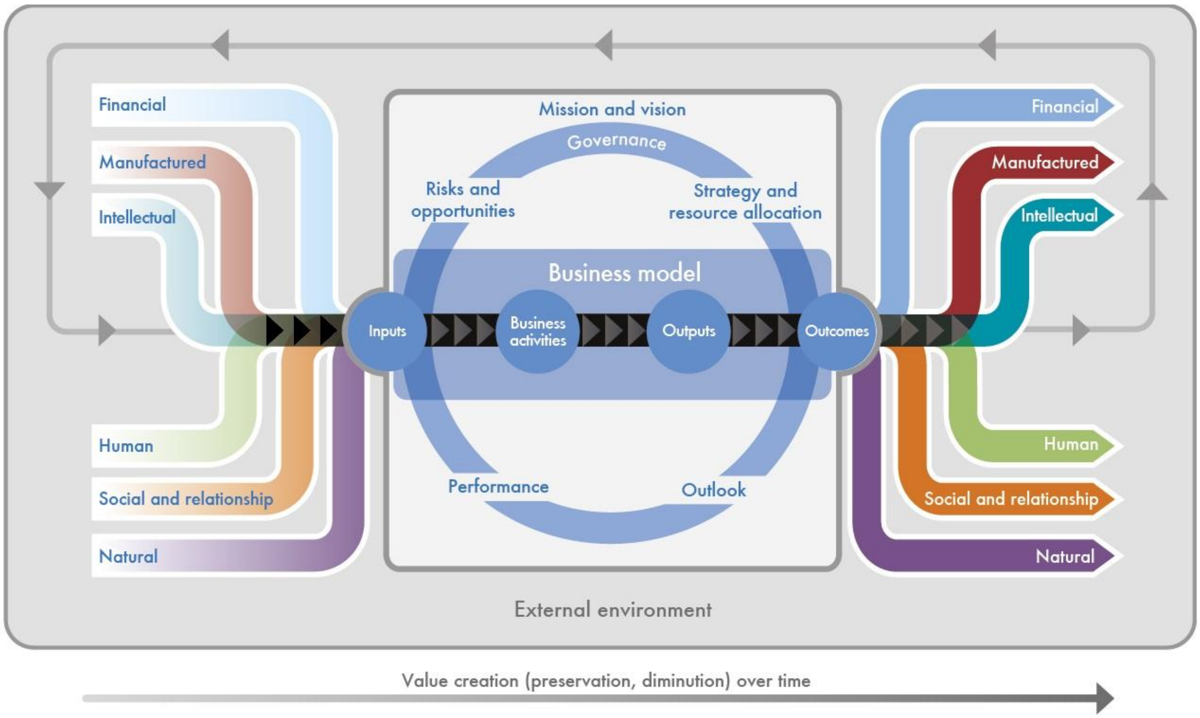

Figure 4. The value creation process, as defined by the IIRC[253]

As used in the Framework, the capitals refer to both inputs and outputs to/from the business. Specifically, they are "stocks of value that are increased, decreased or transformed through the activities and outputs of the organization [...] the overall stock of capitals is not fixed over time. There is a constant flow between and within the capitals as they are increased, decreased or transformed."[254] The Framework identifies six categories of capitals (Figure 4 above): financial, manufactured, intellectual, human, social and relationship, and natural.[255]

Ultimately, the Framework presents value creation as a constantly changing function of a non-linear system of dynamic processes, involving a multitude of actors with different values and objectives and a wide variety of resources. To gain a deeper understanding of what this means and what its implications might be, it is necessary to learn about complex systems.

Complex systems

Why complex systems?

The development and release of the IIRC's Integrated Reporting Framework and value creation model represented an important evolution in understanding and accounting for organizational impacts (both positive and negative, internal and external). In the case of The Coca-Cola Africa Foundation's RAIN program, the University of Michigan team was interested in digging deeper to gain insight into the various components of its 'value creation system.' Given the dynamic and multi-faceted nature of the value creation potential from water stewardship, the team selected a systems-based approach to modeling value creation.

What is a complex system?

> *"Hunger, poverty, environmental degradation, economic instability, unemployment, chronic disease, drug addiction, and war, for example, persist in spite of the analytical ability and technical brilliance that have been directed toward eradicating them. No one deliberately creates those problems, no one wants them to persist, but they persist nonetheless. That is <u>because they are intrinsically systems problems – undesirable behaviors characteristic of the system structures that produce them.</u>"*
> *- Donella Meadows, Ph.D, Professor, Dartmouth College*[256]

Theories of systems dynamics attempt to understand and analyze complex systems of all sizes and contexts, and are often applied to significant problems within individual firms and within society. Systems theory is generally recognized to have its roots with Professor Jay Forrester of the Massachusetts Institute of Technology.[257] In the mid- to late-1950s, Forrester worked with managers at General Electric to attempt to gain deeper insight into one of GE's corporate challenges. By using 'stock-flow-feedback' simulations, Forrester showed that the challenge GE faced was a result of internal firm structures rather than a product of exogenous factors. This approach was developed and refined in the intervening years, and in 1970, Forrester was invited by the Club of Rome to apply his systems dynamics approach to problem they referred to as the "predicament of mankind." He agreed and developed a model of the global socioeconomic system in order to better understand the relationship and potential causes and consequences of the demands placed on the planet's carrying capacity by the exponentially increasing human population ("the predicament of mankind").[258]

People tend to see the world and make decisions "using mental models that are static, narrow, and reductionist."[259] In contrast, the world is constantly evolving, deeply interconnected, and very dynamic. Understanding the world from linear, non-systemic perspectives tends to result in persistent reactions to symptoms of difficulty, with interventions aimed at low leverage points, triggering delayed and distant effects. Sometimes the problem may diminish in the short-term; however in the long-term, the problem will often intensify, and decision-makers will pull the same policy levers in an unrecognized vicious cycle.[260]

Systems thinking presents itself as a remedy to this situation. A system can range from simple to complex (Figure 78 in Appendix D) and is a set of elements (for instance people, cells, or molecules) that are interconnected and produce their own pattern of behavior over time. The system may be impacted, triggered, or driven by external forces, but its response to these forces is function of the particularities of the system itself.[261] Systems also have functions or purposes: perhaps to keep growing larger (as in the case of many national economies) or to maintain a certain ambient indoor temperature (as in the case of a thermostat).[262] This is often not expressed explicitly (and such explicit expressions can be misleading), but rather, it can be deduced from the behavior of the system. System purposes are not always human purposes and are not necessarily those intended by any individual actor within the system. In fact, the purposes of individual elements within the system may combine to create an overall system behavior that is unintended and undesired by everyone.[263]

Modeling complex systems

Complex systems typically have three important aspects, which are not characteristically intuitive: feedback structures, delays and time lags, and stocks and flows.[264] A given system may have many of each of these, so being able to understand the basic concept and behavior of each is crucial for understanding how and why systems behave the way they do. There are only two fundamental building blocks of any system: stocks and flows (Figure 5 below).[265] These stocks and flows can exhibit all types of behavior based on their connections and the decisions, rules, physical laws, or actions that drive or are driven by them.

Feedback loops are one such critical system structure. Studies have shown that people recognize few feedbacks and instead think in short, linear causal chains, with a tendency to assume that an effect has a single cause (Figure 79a in Appendix D). Furthermore, these same studies suggest that people frequently cease their investigation for explanations once the first sufficient cause is found, greatly hindering the prospects of identifying feedback loops or deeper system structures.[266]

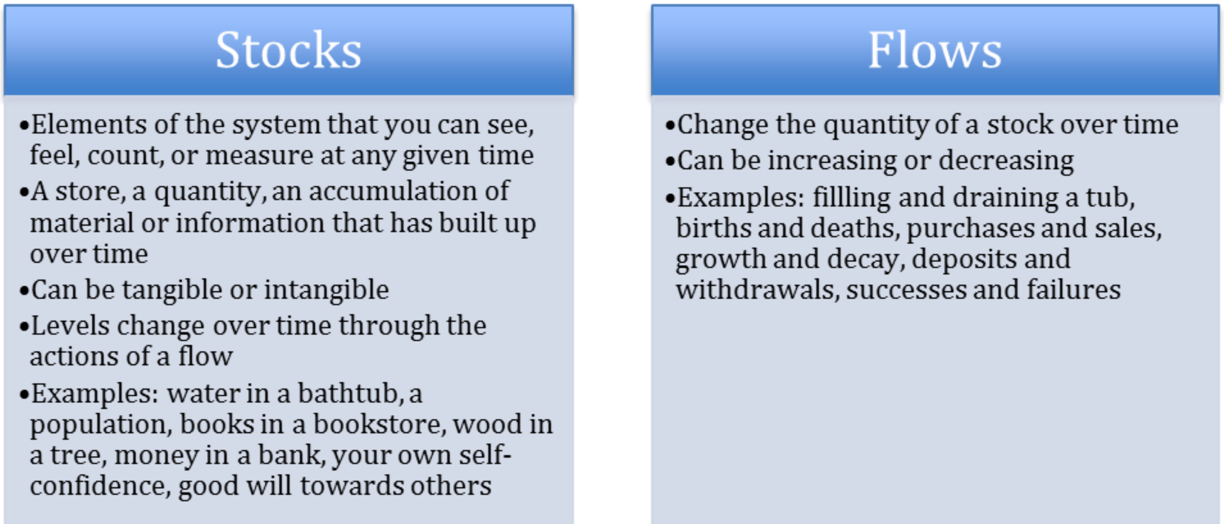

Figure 5. Definitions of stocks and flows[267]

Figure 6. Basic structure of a stock, with one inflow and one outflow

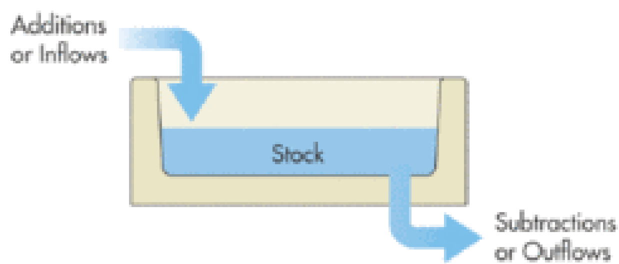

Figure 7. Visualizing a simple stock and flow[268]

Essentially, a feedback loop is created when changes in a stock influence the flow in or out of that same stock. "Feedback loops can cause stocks to maintain their level within a range or [otherwise] grow or decline. In any case, the flows into or out of the stock are adjusted because of changes in the size of the stock itself."[269] There are two types of feedback loops: positive (reinforcing) and negative (balancing).

A common example of a negative, or balancing, feedback loop is that of a thermostat set to 70°F during the winter. When the room temperature falls below 70°F, then the thermostat turns on and begins to increase the temperature. Once the room temperature is at 70°F, the thermostat shuts down, and the room begins to gradually cool off again as heat is lost to the exterior, and the cycle repeats.[270] This type of balancing loop is said to be *goal seeking* or *stability seeking*, since it is constructed to maintain a stock at or within a range of values. Another way to think of this is that the system opposes whatever pressure is put on it: if you push it too far one way, it will pull the other, and if you pull it too far, it will push back.[271]

On the other hand, a reinforcing, or positive feedback loop, amplifies change.[272] Regardless of whatever direction of pressure is imposed on it, it will enhance; so pushing it in one direction will lead to greater and greater change in that direction – a snowball or a vicious/virtuous cycle.[273] For example, as Earth's atmospheric temperature increases, evapotranspiration also increases, which in turn causes an increase in atmospheric water vapor concentration, and with the greenhouse effect, this causes a further rise in temperature, which leads to more evapotranspiration.[274]

Time delays are another common aspect of systems. A delay is just what it sounds like: it takes time for materials and information to move from one stock to another. Delays in systems mean that the results of actions and decisions are typically not immediate, and furthermore, even after a flow has been stopped, material or information from before it stopped may still continue to flow into a stock (in the same way that water may still continue to come out of a hose for a short while after the faucet was closed). Delays can be particularly troublesome when it comes to decision-making, as they not only can slow the accumulation of evidence, but they can also lead to substantially different short- and long-term impacts. For instance, cigarette smoking gives immediate gratification, yet lung cancer may take decades to develop.[275] Furthermore, delays can interfere with learning by creating instability and fluctuations. Since there are frequently delays between initiating an intervention and its effects on the system, decision-makers may continue to intervene to correct what they perceive as a problem even after enough corrective action has already been taken.[276] At best this would lead to waste, but at worst it could create an entirely new problem.

Challenges in systems management

Those who are responsible for managing any part of a complex system face numerous challenges, such as those described in the preceding paragraphs. An article in the September 2011 Harvard Business Review identified two major problems commonly faced by managers of complex systems: difficulty making sense of a situation and unintended consequences. In addition to multiple feedback loops and time delays that can interfere with the ability to fully understand a system's structure, managers are further limited by the fact that any individual's vantage point is inherently limited. As noted in the article, "it is very difficult, if not impossible, for an individual decision maker to see an entire complex system…It's hard to observe and comprehend a highly diverse array of relationships from any one location."[277] While this can be addressed to an extent by ensuring multiple information feedback channels and collaborating with other actors in the system, the magnitude and complexity of a system will always create a challenge for understanding.

Unintended consequences or "side effects" are simply the results of actions taken or decisions made that were unexpected as a result of a limited or bounded understanding of a system. For instance, a medicine may be administered to treat a specific condition in one part of the body, but unexpectedly cause a reaction in a completely different bodily system. In the same way that medicines can cause significant or dangerous 'side effects' for health, policy interventions can likewise cause unintended consequences with the potential to worsen the original problem. Figure 80 (Appendix D) shows one way in which a well-intentioned policy intervention may interact with other system elements to impact the problem/context in unexpected ways. "The boundary of the decision-makers' mental model is represented by the thin lines, showing the basic feedback loop through which we seek to bring the state of the system in line with our goals. Policy resistance arises when we fail to account for the so-called 'side effects' of our actions, the responses of other agents in the system (and the unanticipated consequences of these), the ways in which experience shapes our goals, and the time delays often present in these feedbacks."[278]

Understanding causal loop diagrams

Full systems models typically are based around stocks and flows, along with differential equations and algorithms to describe the various interconnections between system elements. Another way to model the basic relationships between different parts of the system is a *causal loop diagram (CLD)*.

A basic causal loop diagram contains two primary components: the individual elements or variables in the system and arrows indicating the causal relationships between these elements. Each arrow will have a polarity associated with it, either + (also written as "s") or – (also written as "o"). These signs indicate the following:

1. A causal link from element A to element B is positive (+) when either A adds to B or when a change in A leads to a change in B in the *same* direction.
2. A causal link from element A to element B is negative (-) when either A subtracts from B or when a change in A leads to a change in B in the *opposite* direction.[279]

To help illustrate this, Figure 8 below presents a simple causal loop diagram with annotations explaining how to read it (note that in the diagram, "gap" refers to the gap between the desired water level and the actual water level).[280]

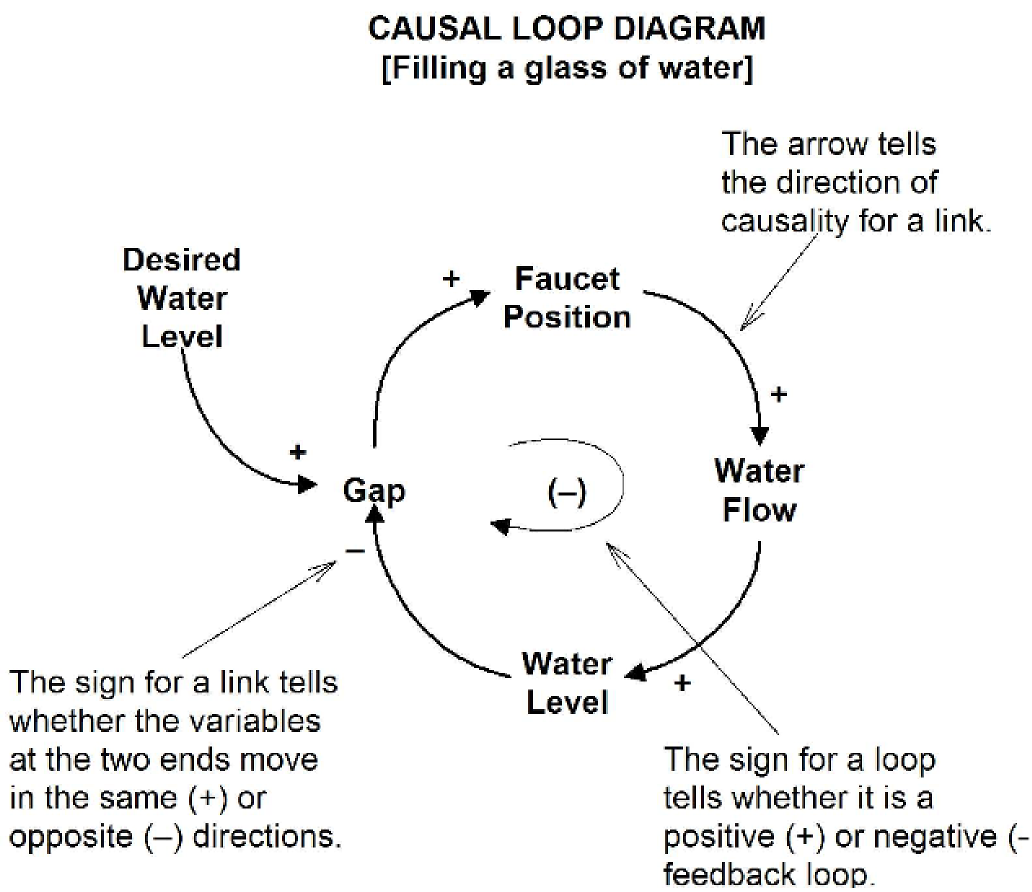

Figure 8. Example causal loop diagram of filling a glass of water, annotated

Leverage Points

One particularly valuable aspect of systems models is that they enable the identification of leverage points. Leverage points are "places within a complex system (a corporation, an economy, a living body, a city, an ecosystem) where a small shift in one thing can produce big changes in everything."[281] Although there is no universal formula for identifying leverage points, and even though complex systems have been described as "counterintuitive," Donella Meadows authored (through a collaborative and iterative process) a list of the top places to intervene in a system based on her many years of systems dynamics research, modeling, and analysis. They are as follows (in decreasing order of effectiveness):[282]

1. Transcending paradigms (becoming unattached to any one particular paradigm)
2. The mindset or paradigm out of which the system – its goals, structures, rules, delays, parameters – arises
3. The goals of the system
4. The power to add, change, evolve, or self-organize system structure
5. The rules of the system (such as incentives, punishments, constraints)
6. The structure of information flows (who does and does not have access to what kinds of information)
7. The gain around driving positive feedback loops
8. The strengths of negative feedback loops, relative to the impacts they are trying to correct against
9. The lengths of delays, relative to the rate of system change
10. The structure of material stocks and flows (such as transport networks, population age structures)
11. The sizes of buffers and other stabilizing stocks, relative to their flows
12. Constants, parameters, numbers (such as subsidies, taxes, standards)

Identifying and using leverage points can lead to meaningful systemic change. For a more detailed application of these leverage points to identify potential interventions based around water stewardship, please see the end of this chapter.

The Water Stewardship CLD: Part A

Advantages

There are many reasons why creating maps or models of complex systems can be beneficial. Creating such models provides an opportunity for various stakeholders to make explicit their mental paradigms and perspectives. This by itself can illuminate various dynamics or structural issues that may have been previously obscure. This modeling process can also provide a platform for rich dialogue between key stakeholders around challenges or solutions as well, and encourage the consideration of multiple perspectives.

One of the most significant strengths underlying systems mapping is that the models allow a thorough investigation of causality and behavior. Whereas conventional thinking and problem solving tends to be linear and proximal (as discussed in the *What is a Complex System* section earlier), systems thinking and modeling enables nonlinear structures and patterns to be examined. Systems modeling likewise can enable the identification of root causes and impactful leverage points, a feature that is important when attempting to solve complex and dynamic problems.

Additionally, systems mapping can be valuable when evaluating various possible actions, since it can highlight potentially unexpected consequences. Given the presence of time delays and feedback loops, the consequences of any action or change in a system can be hard to predict and may change over time. For instance, increasing access to a groundwater aquifer may bring valuable benefits to communities that lacked safe drinking water previously, but over time the aquifer may become depleted, which could cause a variety of harmful societal and ecological effects. Time delays may not always be as straightforward, but systems mapping can nonetheless account for them. Ultimately, systems mapping is a powerful tool for understanding and analyzing complex and dynamic systems, such as value creation across the realms of society, the environment, and business.

What the Water Stewardship CLD shows

The *Water Stewardship CLD* illustrates the various facets of value creation and how they can interact with each other. Spanning four ‘modules’ (natural capital, social and human capabilities, societal economic capital, and business value), the model highlights how value can be created within each module, and how elements from individual modules are connected to other modules. For instance, specific ecosystem functions and services are identified within the natural capital module. These elements are understood to contribute towards natural capital; in other words, they can create value in the context of natural capital. These elements are causally connected not only within the natural capital module, but also to variables in other modules, such as within the business value module. These connections show how creating value in the context of natural capital can also lead to the creation of value within a business. The systems model is filled with such connections. Since it is constructed as a comprehensive systems map, system structures such as feedback loops can be identified. Through an evaluation of these and other system structures, a nuanced understanding and analysis of the value creation process can be developed. This analysis can highlight patterns that may not have previously been apparent, such as unexpected consequences of actions or changes within the system. This type of analysis enables more robust problem solving, the identification of root causes, and it can promote action planning that maximizes shared value creation.

Limitations

The *Water Stewardship CLD* disaggregates many components within its main categories of natural capital, social and relationship capital, human capital, financial capital, and the business model (particularly risks and opportunities), and establishes causal interconnections between each. From this model, it is possible to begin to understand how certain activities or policies may impact other system elements, both proximal and distant.

Based on in-depth literature reviews, this model represents the largest and most comprehensive causal loop diagram of discrete impacts from water stewardship related programs and interventions available. Other similar models identified in the literature review were either significantly more aggregated, focused on only a small number of impacts (e.g., around social capital and natural capital impacts only), did not account for impacts on the firm level, or all of the above.[283] [284] [285] [286]

Despite these numerous innovations and strengths, the model has several limitations of varying degrees of significance. These include limited perspective, no inclusion of connection magnitudes, and no differentiation based on time or location. First, the modeling process was limited to the researchers in the University of Michigan team and the surveyed literature. These modelers were largely removed from both the business and social contexts in which the system is based, and consequently their perspectives (also known as “mental models”) may have lacked important system elements, relationships, and behaviors. Although several stakeholder interviews were held with individuals in both the business context and with local beneficiaries, these interviews were not structured around the model. While it is entirely possible to construct a model from this removed position, the accuracy of the final model is likely to increase markedly as additional stakeholder perspectives (in particular, perspectives from actors within the systems being modeled) are incorporated into the modeling process.

Furthermore, the model was conceptually bounded around value creation, meaning that potentially important and relevant elements may have not been included if they were not seen as being at least fairly closely related to value creation. Potentially omitted elements may (or may not) contribute to important system behavior.

Next, the model is strictly conceptual and does not quantify the magnitude or strength of relationships between elements. Practically speaking, this means that both weak and strong causal connections are treated equally in the model. There is no way in its current form to use the model to differentiate between a connection that doubles the value of the input and one that multiplies it by a factor of five (for example). Finally, there is no current mechanism to ultimately quantify the business or social value created.

The model also does not differentiate based on time. The model includes no delays between variables, since the vast majority of interconnections could conceivably be both long-term and short-term in nature. Consequently, it did not seem necessary to add additional symbols to the already busy diagram.

Another limitation is that the model is not specific to any geography or context. Rather than localize the value creation model around one specific project in one specific location, the model is intended to be generalizable to multiple project types in multiple locations. In order to do this, it is possible that important elements were not included, and that applying it to a specific context may yield interpretations that fail to include relevant factors.

Finally, the model is limited by its large size. The full model, with over 50 variables and their accompanying interconnecting arrows, is very busy, making it impractical to use in its full format. While it is possible to use the model in a modular format, doing so likely misses system structures that could be informative and helpful.

Future research and direction

While the *Water Stewardship CLD* represents a substantial step towards disaggregating the various elements within value creation along with their complex and dynamic relationships, numerous opportunities for future work exist. First, refining the causal loop diagram based on input from a more diverse group of relevant stakeholders could improve its accuracy and relevance and identify important system structures not brought out from the mental models of the original modelers. Second, additional primary or secondary research could be conducted to further elucidate the complex relationships between the elements included in the model. Third, the model as-is or in an aggregated format could be transformed into an operational stock-and-flow systems model that could quantitatively model the many different system elements and their relationships. Ultimately, such a model could be used to estimate value creation (for both business and society) and long-term and short-term impacts of various programs or policies, as well as potentially identifying new and powerful leverage points. Finally, the model could be field tested to determine its validity in various contexts.

Methodology

In order to construct the final *Water Stewardship CLD*, the team followed an approach that could be described as research-informed, consensus-driven, and iterative. The first step was to define what was to be modeled. After conversations between the modelers, advisors, and the client, model boundaries were loosely defined as the natural, human, and social drivers of business value. The research team wanted to capture the various ways in which investments in water stewardship – such as watershed protection and improving access to water and sanitation facilities - could create value. To accommodate the many types and locations of those programs, the model was kept as a generalizable and conceptual one, rather than specific to any particular context.

Once these rough parameters were established for the model, the team began with an initial research stage. Research included a literature review around several topics, including: various water and sanitation related interventions and their social/human/ecological impacts, value pathways from corporate sustainability or CSR efforts, operational definitions and elements of social sustainability and social capital, elements of social and human adaptive capacity, definitions of watershed/catchment sustainability, watershed management paradigms and case studies, and basic theories related to coupled social-ecological systems. The team also reviewed notes and other materials collected during stakeholder conversations with representatives of the Coca-Cola System in the United States and in Africa, with RAIN project managers, with RAIN implementing partners in South Africa, with representatives of other NGOs and multilateral organizations working on similar issues or utilizing similar approaches, and with primary school principals (representing beneficiaries of the RAIN projects).

Based on individual research results, each researcher independently designed a first draft of what, at the time, was simply referred to as a 'value creation model.' One model was a causal loop diagram constructed using the VenSim PLE software application and the other model was a Microsoft Word based flow chart visually illustrating the benefits identified from a 2012 report analyzing and quantifying benefits from The Coca-Cola Company's various water- and sanitation-related community projects.[287] After this individual drafting stage, the modelers discussed their models. Consensus was reached that the format of the final model would be a causal loop diagram, and that the flow chart illustrations would be used to guide later analysis of various 'pathways to value.' The modelers then discussed different elements within the initial causal loop diagram draft, making consensus-based revisions.

After further individual review, there was enough dissatisfaction with the rough model draft and its level of aggregation to warrant a second research stage. During this stage, further individual research and experimentation took place. Research centered around identifying related or similar published causal loop diagrams, reviewing the fundamentals of causal loop diagram construction, identifying causal connections between elements based on the literature, and identifying and removing connections that were correlation-based (as distinct from a causal relationship). Individual experimentation was based around different levels of aggregation, the use of different designs and variables, and exploring different ways of presenting the model's findings.

The rest of the development process followed a relatively consistent pattern of individual drafting and consensus-based decision-making. The modelers determined an appropriate level of aggregation: limiting each module to approximately ten variables. From there, the modelers developed individual drafts of the four different modules (natural, human and social, economic, and business), and collaboratively refined them by discussing points of disagreement or uncertainty until a rough consensus was achieved. This process was repeated several times, and eventually a final version of each module was confirmed. The iterative process then repeated again for identifying the causal interconnections between the modules. After discussing points of divergence, final consensus was reached, and a final causal loop diagram was formatted and confirmed.

The Water Stewardship CLD: Part B

The full *Water Stewardship Causal Loop Diagram (CLD)* consists of four distinct but very much interconnected modules including the [A] Natural Capital Module (Table 33), [B] Societal Economic Capital Module (Table 34), [C] Social and Human Capabilities Module (Table 35), and the [D] Firm Value Module (Table 36). Together, these modules illustrate the complex interconnectedness between natural, social, and economic systems. Opportunities to generate both social and business value ("shared value") can be illustrated by identifying significant causal relationships, strong feedback loops, and critical variables that serve as key leverage points to intervene in the system.

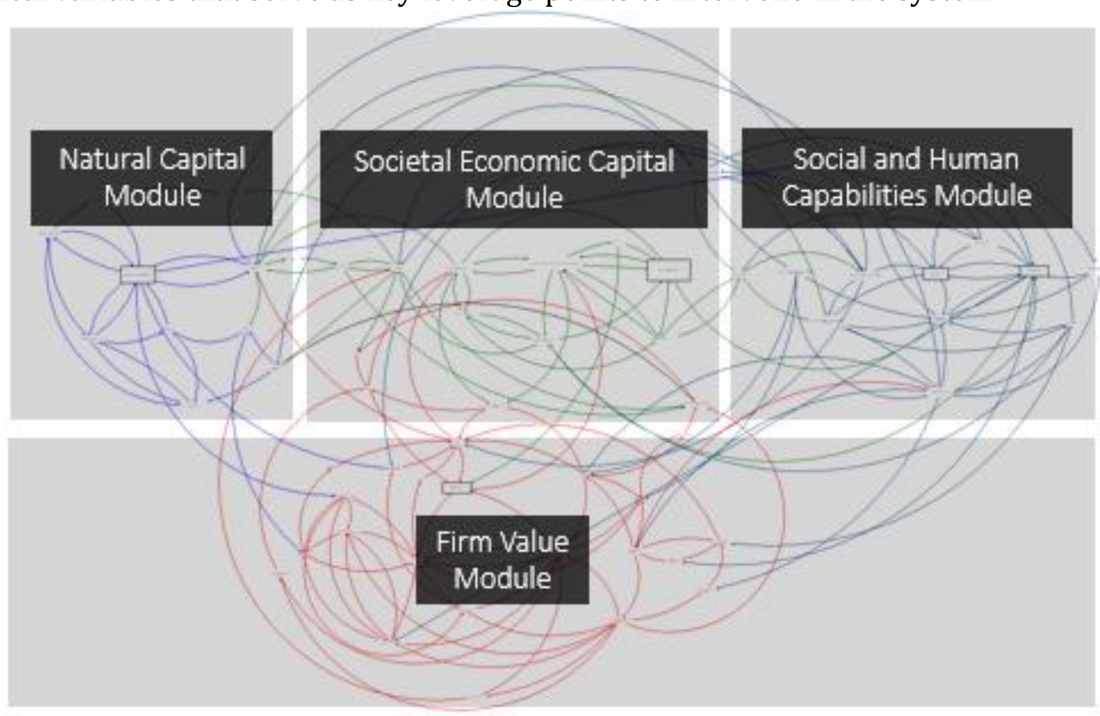

Figure 9. Four modules make up the full Water Stewardship CLD.

In the remainder of this section, each of the four modules will receive a high-level introduction before summarizing the primary *intra*-module causes and consequences associated with each variable. Module interconnectedness (i.e., important connections between the four modules) are also outlined, before using "cause trees" to illustrate the first and second order causes and consequences associated with natural capital, societal economic capital, social and human capabilities, and firm value in the full *Water Stewardship CLD.*

Finally, significant feedback loops are outlined within the full systems model, which will enable critical variables to be identified as leverage points for water-related interventions. Identifying key feedback loops will ultimately enable the tracing of pathways to value from water stewardship investments. The ultimate goal is to use this model to illustrate how water-related investments can dynamically influence the system and create shared value for the environment, economy, society, and business. Useful terminology related to complex systems and causal loop diagrams that will be helpful when navigating this section and applying the *Water Stewardship CLD* are included in Table 32 in Appendix D.

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Navigating this section

Intra-module causes and consequences.

In this section, the purpose of each individual module is outlined, and a concise explanation of each module is provided. Tables describing each of the variables in the modules are included in Appendix D to provide definitions of each variable in the *Water Stewardship CLD*. Furthermore, the first order, causal connections associated with each variable are outlined with their corresponding polarity or behavior to showcase how each respective variable is causally influenced by first-order causes, and how the variable causally influences first-order consequences. Tables containing this detail are included in Appendix D. Finally, cause-trees are included to illustrate both first and second order connections associated with the stocks in each module. A short discussion of causes and consequences outlined by the cause-trees is also included.

Module interconnectedness.

In this section, module interconnectedness and primary relationships between modules are explained before utilizing cause-trees to analyze first and second order causes and consequences associated with interconnected variables.

Intervening in a system to drive positive value.

In this section, the *Water Stewardship CLD* is used to identify feedback loops, which ultimately enable the identification of leverage points and interventions that can be utilized to drive value creation in the system. Specific water stewardship investments that are analyzed in this section include: watershed protection, water sanitation and hygiene (WASH), and water for productive use.

Intra-module causes and consequences.

[A] Natural Capital Module.

Explanation of module.

The purpose of the Natural Capital Module is to demonstrate a simple water quantity and quality based natural capital system that can dynamically influence and be influenced by, [B] societal economic capital, [C] social and human capabilities and [D] firm value. The Natural Capital Module consists of eight variables, which causally influence the natural capital stock. In this module, natural capital is specifically focused on the quantity and quality of freshwater resources available.

Natural capital in this system is positively influenced by ecological replenishment, ecosystem services, the quantity of water available, and water quality. Therefore, investments that reinforce these variables have the potential to drive environmental value in the system. Conversely, natural capital is negatively influenced by pollution and water consumption. Therefore, investments to decrease pollution or decrease water consumption have the potential to positively influence the natural capital stock.

While the natural capital stock is influenced directly by ecological replenishment and ecosystem services, other feedback loops also exist between these variables. For example, when ecosystem services and ecological replenishment increase, natural capital is built, which ultimately reinforces ecosystem services and ecological replenishment in a virtuous cycle. The full system causes and consequences of natural capital will be further illustrated in the module interconnectedness section of this report to understand how societal economic capital, social and human capabilities, and firm value are causally related to natural capital.

An illustration of the Natural Capital Module is included on the following page. Cause-trees illustrating the primary variables that are influencing and influenced by natural capital have also been included and can be utilized to identify key leverage points for investments and pathways to value. Furthermore, each variable included in the Natural Capital Module is defined in Table 33 in Appendix D, before the primary causal relationships associated with each variable are outlined in Table 38.

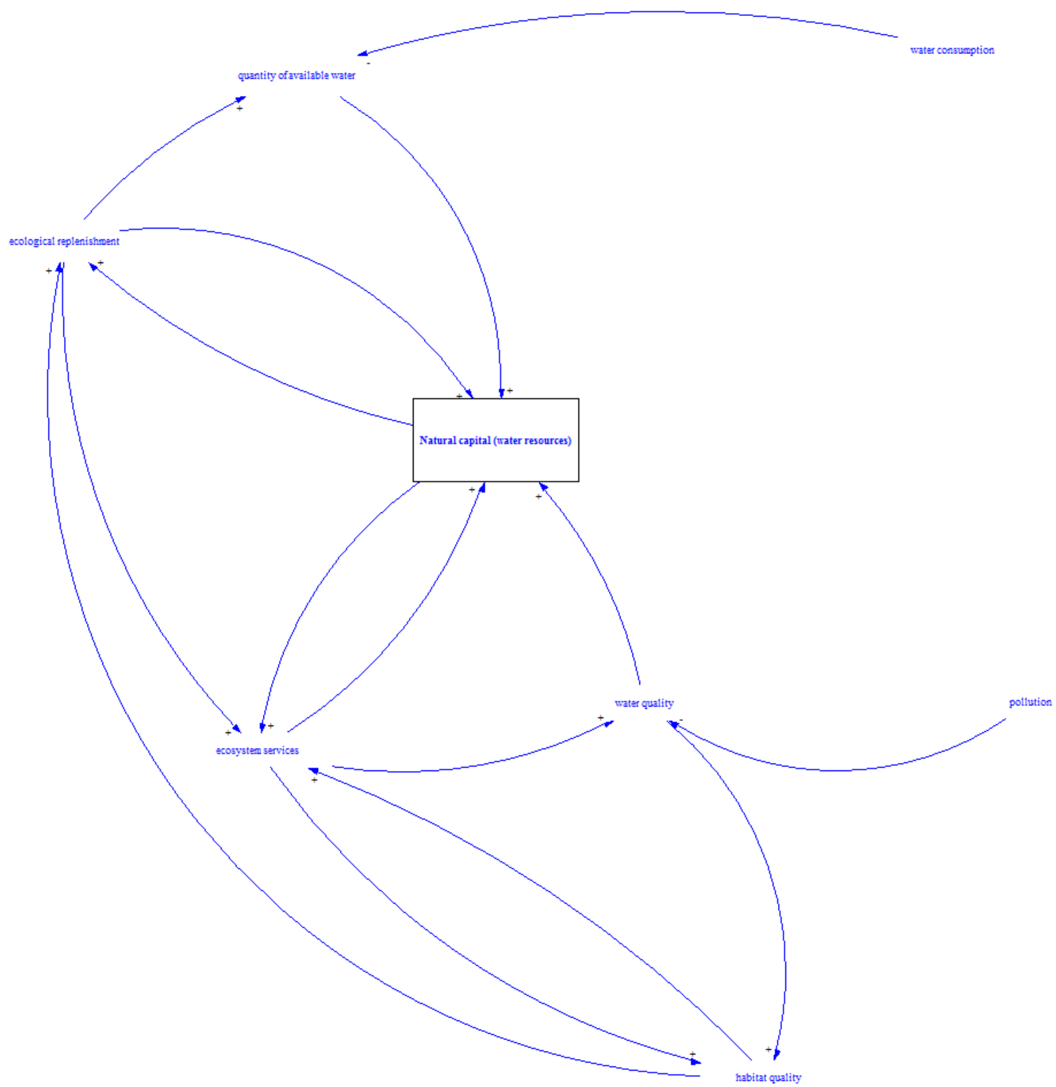


Figure 10. Natural Capital Module

Analyzing causes and consequences of natural capital using cause-trees.

Another way to analyze and draw conclusions from the *Water Stewardship CLD* is to utilize cause-trees to visualize the causes influencing natural capital, and the consequences influenced by natural capital. Cause-trees can also enable pathways to value to be identified and can showcase key variables that can be leveraged for interventions. The intra-module causes influencing natural capital, and the consequences influenced by natural capital are illustrated in the cause-tree diagrams that have been included in the following figures.

Causes “influencing natural capital

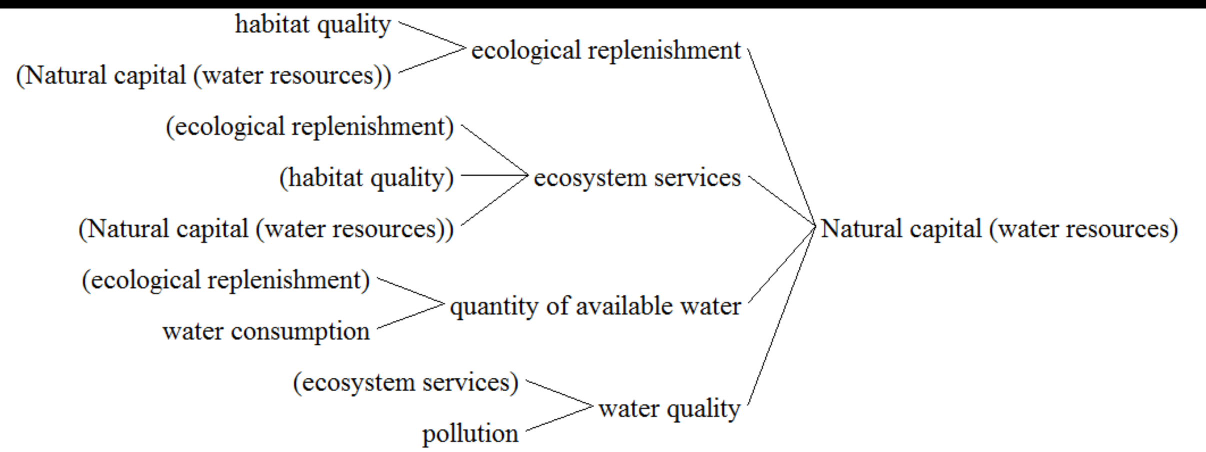


Figure 11. Ecological replenishment, ecosystem services, water quality and the quantity of water available are the primary causes influencing natural capital.

Consequences influenced by natural capital

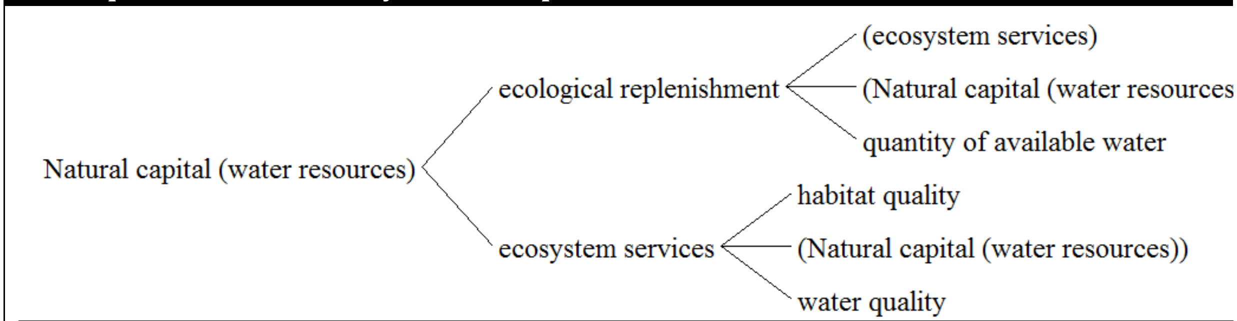


Figure 12. Ecological replenishment and ecosystem services are the primary consequences influenced by natural capital

[B] Societal Economic Capital Module.

Explanation of module.

The purpose of the Societal Economic Capital Module is to demonstrate a simple societal economic capital system that can dynamically influence and be influenced by [A] natural capital, [C] social and human capabilities and [D] firm value. The Societal Economic Capital Module consists of 12 variables, which causally influence the societal economic stock. Societal economic capital specifically refers to the stock of all economic assets held by all members of society including public and private institutions, governments, and firms. Societal economic capital is positively reinforced by four first-order variables including private economic capital, household economic capital, and the availability and access to capital, capital markets and credit. Therefore investments that increase any of the aforementioned variables have the potential to positively reinforce the societal economic capital stock and drive economic value. Conversely, the primary variable that negatively reinforces societal economic capital is debt, which might be accrued when the availability and access to capital, capital markets, and credit increases. Therefore, investments that decrease debt also have the ability to drive positive economic value in the Societal Economic Module.

An illustration of the Societal Economic Capital Module is included on the following page. Cause-trees illustrating the primary variables that are influencing and influenced by societal economic capital have also been included and can be utilized to identify key leverage points for investments and pathways to value. Furthermore, a table defining each variable incorporated into this module is included in Table 34 of Appendix D, before outlining the primary causal relationships within the module in Table 39.

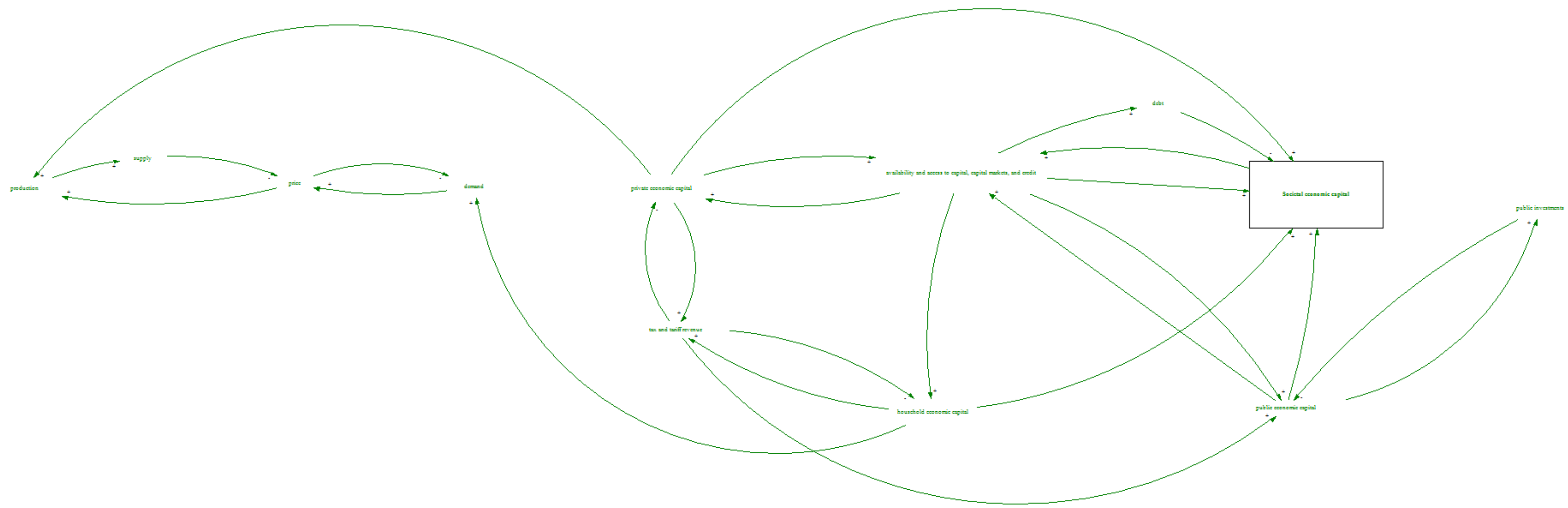


Figure 13. Societal Economic Capital Module

Analyzing causes and consequences of societal economic capital using cause-trees.

Causes influencing societal economic capital

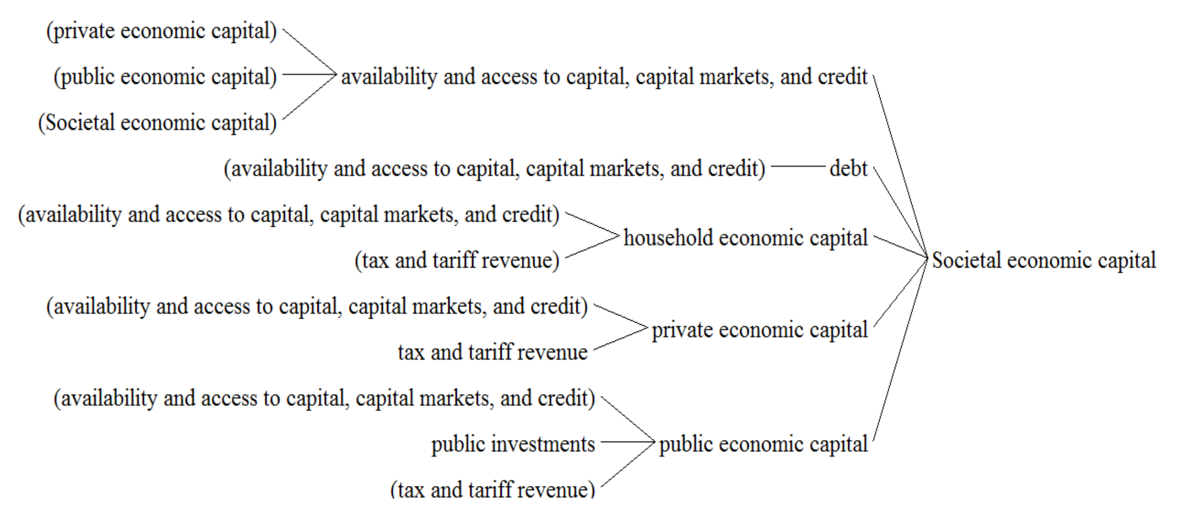


Figure 14: Household, private, and public economic capital are the primary causes influencing societal economic capital

[C] Social and Human Capabilities Module.

Explanation of module.

The purpose of the Social and Human Capabilities Module is to demonstrate a simple social and human capabilities system, which can dynamically influence and be influenced by, [A] natural capital, [B] societal economic capital and [D] firm value. The Social and Human Capabilities Module consists of fifteen variables, which causally influence the social capital and human capital stocks. This module is unique because it contains two stocks, social capital and human capital, which together are important elements within the larger module representing social and human capabilities. In this module, social capital consists of the norms and networks that enable collective action. It encompasses institutions, relationships, and customs that shape the quality and quantity of a society's social interactions.[288] Furthermore, human capital is defined as the skills, knowledge or other intangible assets of individuals that can be used in the creation of economic value.

Social capital (which is one of the two stocks contributing to the Social and Human Capabilities Module) is positively reinforced by six first-order variables, including: the availability and access to infrastructure, the availability and access to local employment opportunities, engaged governance, equity and rights, social cohesion and inclusion, and human capital. Therefore, investments which increase employment, governance, equity, social cohesion, and human capital have the potential to generate significant social and human value in the system, while further building human and social adaptability and reinforcing vital human capital.

Similarly, human capital (which is one of the two stocks contributing to the Social and Human Capabilities module) is positively reinforced by seven first-order variables, including: education and skills, equity and rights, the fulfillment of basic needs, human and social adaptability, physical and psychological well-being, social cohesion and inclusion, and social capital. Investments which reinforce educational attainment, the fulfillment of basic needs, adaptability, and public health also have the potential to drive societal value in this system, which ultimately reinforces both social and human capability. Great examples of an investment that can build both human and social capital are investments in water, sanitation, and hygiene and water for productive use.

In this module, social and human capitals are causally related through a positively reinforcing feedback loop. As social capital increases, human capital increases. Similarly as human capital increases, social capital increases. An illustration of the Social and Human Capabilities Module is included on the following page. Cause-trees illustrating the variables influencing the social and human capital have also been included and can be utilized to identify key leverage points for investments and pathways to value. Furthermore, each variable incorporated into the module is defined in Table 40 in Appendix D, before outlining the primary causal relationships within the module in Table 41.

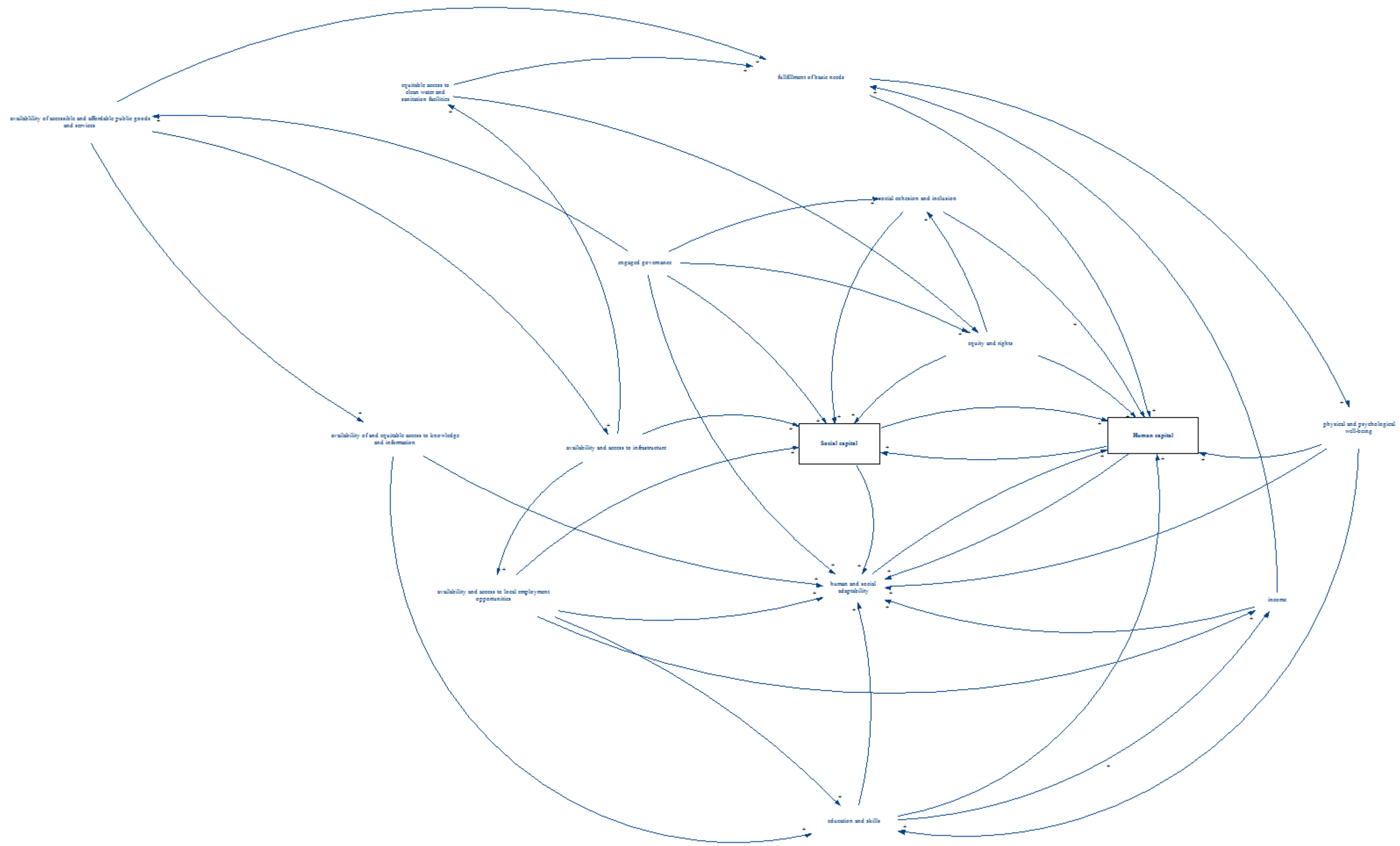


Figure 15. Social and Human Capabilities Module.

Analyzing causes and consequences of social and human capabilities using cause-trees.

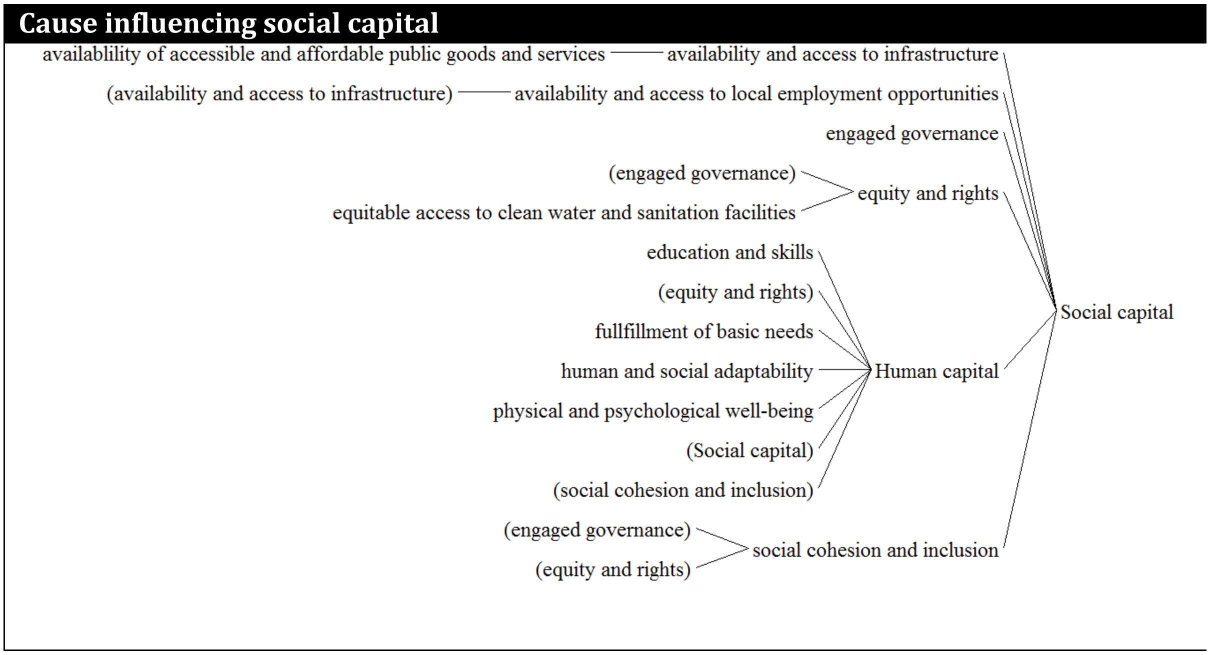


Figure 16. Social capital is influenced by social cohesion and inclusion, human capital, equity and rights, engaged governance, availability and access to infrastructure, and the availability and access to local employment opportunities.

Consequences influenced by social capital

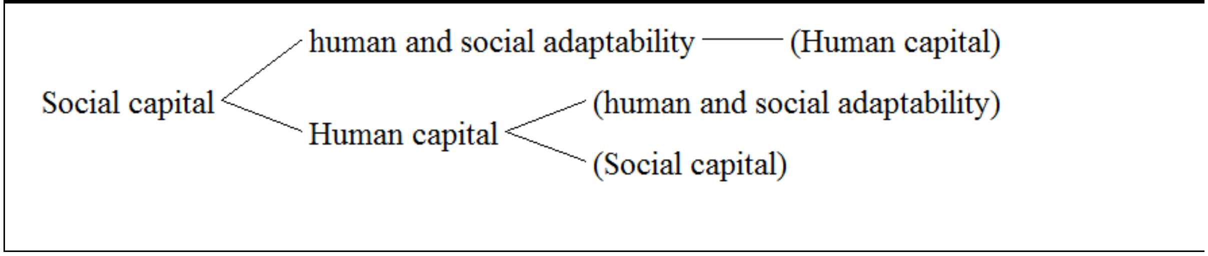


Figure 17. The primary consequences of social capital are increased human capital, and increased human and social adaptabilities.

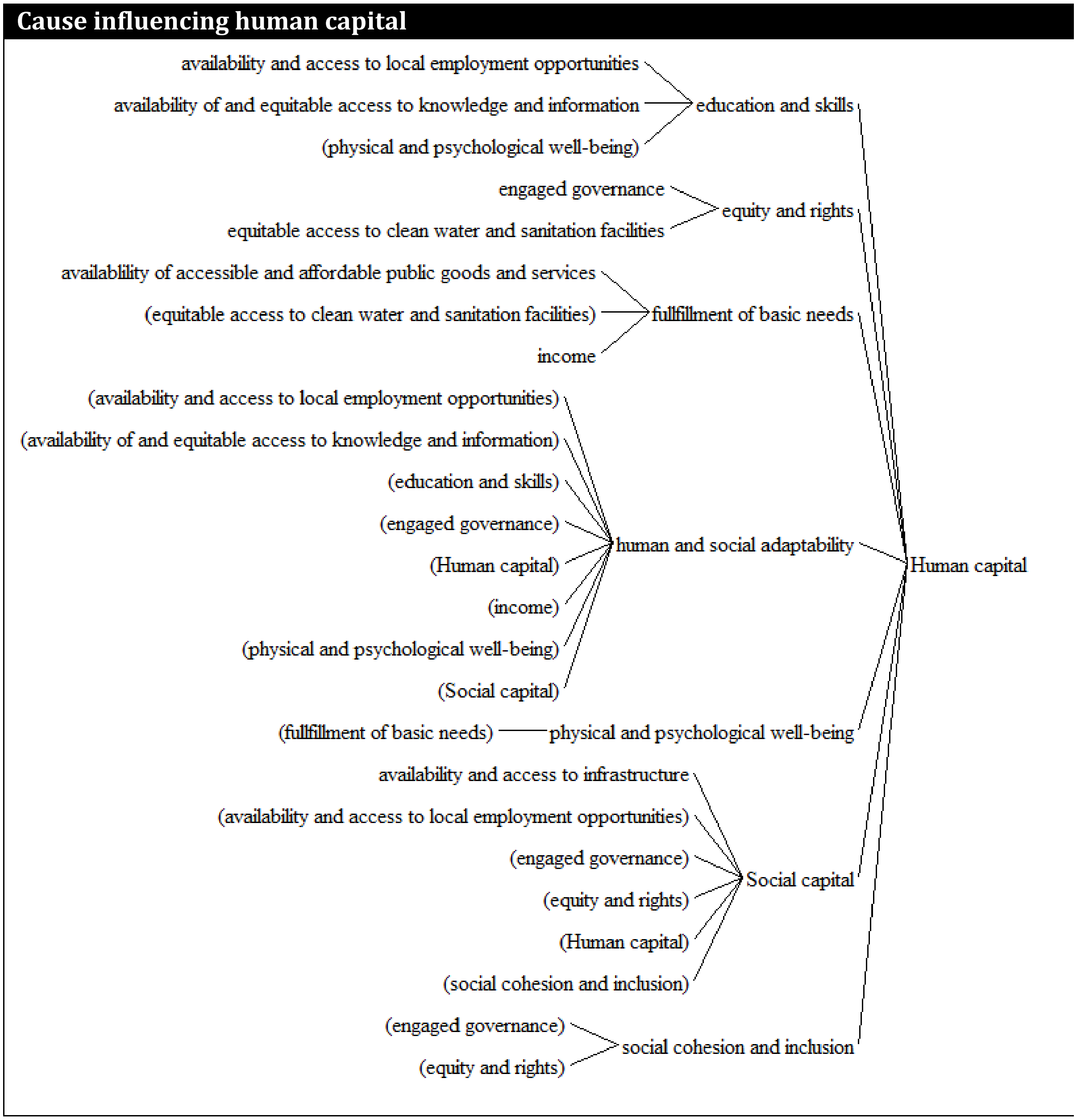


Figure 18. Human capital is influenced by multiple factors including education and skills, equity and rights, fulfillment of basic needs, human and social adaptability, physical and psychological well-being, social capital, and social cohesion and inclusion.

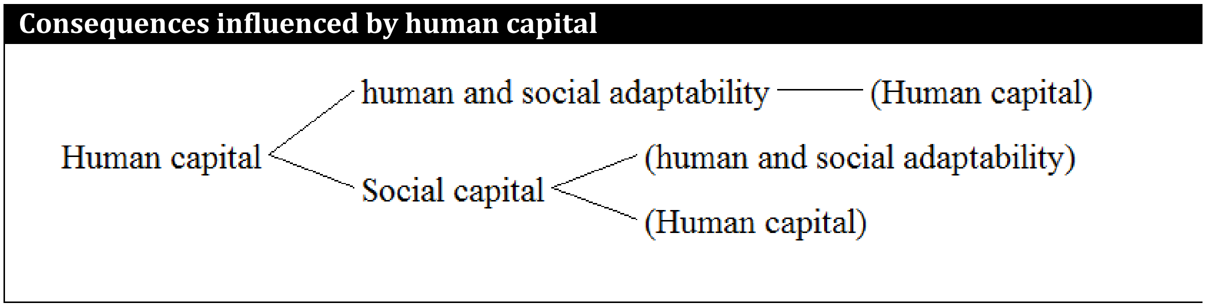


Figure 19. Human capital increases human and social adaptability and builds social capital.

[D] Firm Value Module.

Explanation of module.

The purpose of the Firm Value Module is to demonstrate a simple firm value system that can dynamically influence and be influenced by [A] natural capital, [B] societal economic capital, and [C] social and human capabilities. The Firm Value Module consists of twenty-six variables, which causally influence the firm value stock. In this module, firm value specifically refers to the total value of a firm, as measured by various intangible and tangible metrics.

While numerous variables influence firm value, the stock is only causally connected to two first-order variables in the full Water Stewardship CLD. These variables are competitive advantage and revenues. Therefore, investments which directly or indirectly increase competitive advantage and revenues have the potential to build firm value. Conversely, the two first-order variables that are negatively influencing firm value are risk and costs. Therefore, investments which decrease risk and decrease costs, ultimately have the potential to increase firm value over time. An example of a water-related investment that can help reduce risks and costs is watershed protection. Watershed protection programs function to increase ecological replenishment, which ultimately reinforces the quantity and quality of natural capital available, thus reducing physical water risk. Additionally, social investments in WASH and water for productive use can help increase human capital, which ultimately decreases costs of labor inputs over time. The full potential of these investments will be further explored in latter sections of this report to understand how water-related investments can drive shared value for society, the environment and the firm.

An illustration of the Firm Value Module is included on the following page. Cause-trees illustrating the primary causes of firm value are also included for reference and the identification of key leverage points for investments and pathways to value. Furthermore, definitions of each variable included in the firm value module are included in Table 42 of Appendix D, before outlining the primary causal relationships within the module in Table 43.

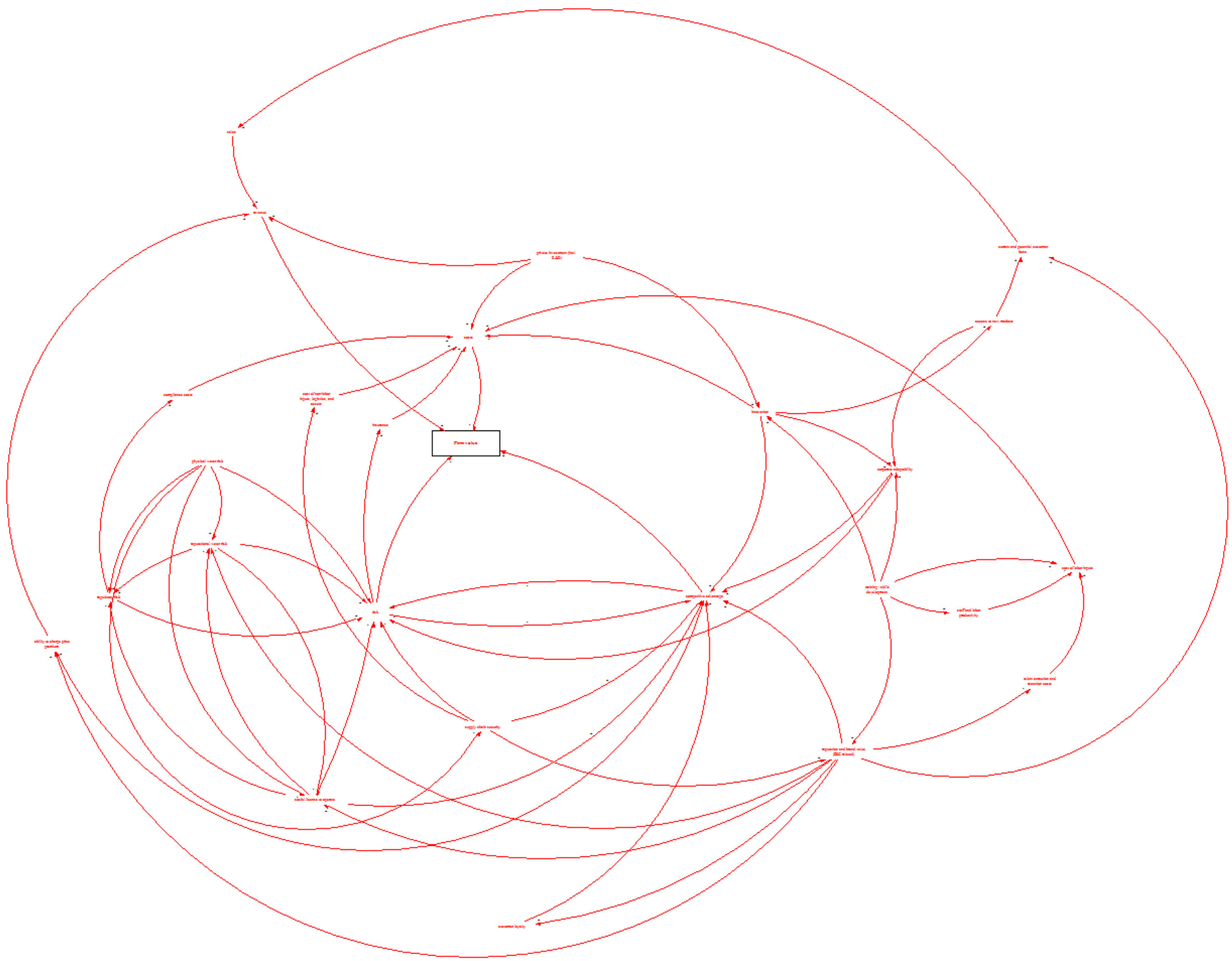


Figure 20. Firm Value Module.

Analyzing causes and consequences of firm value using cause-trees.

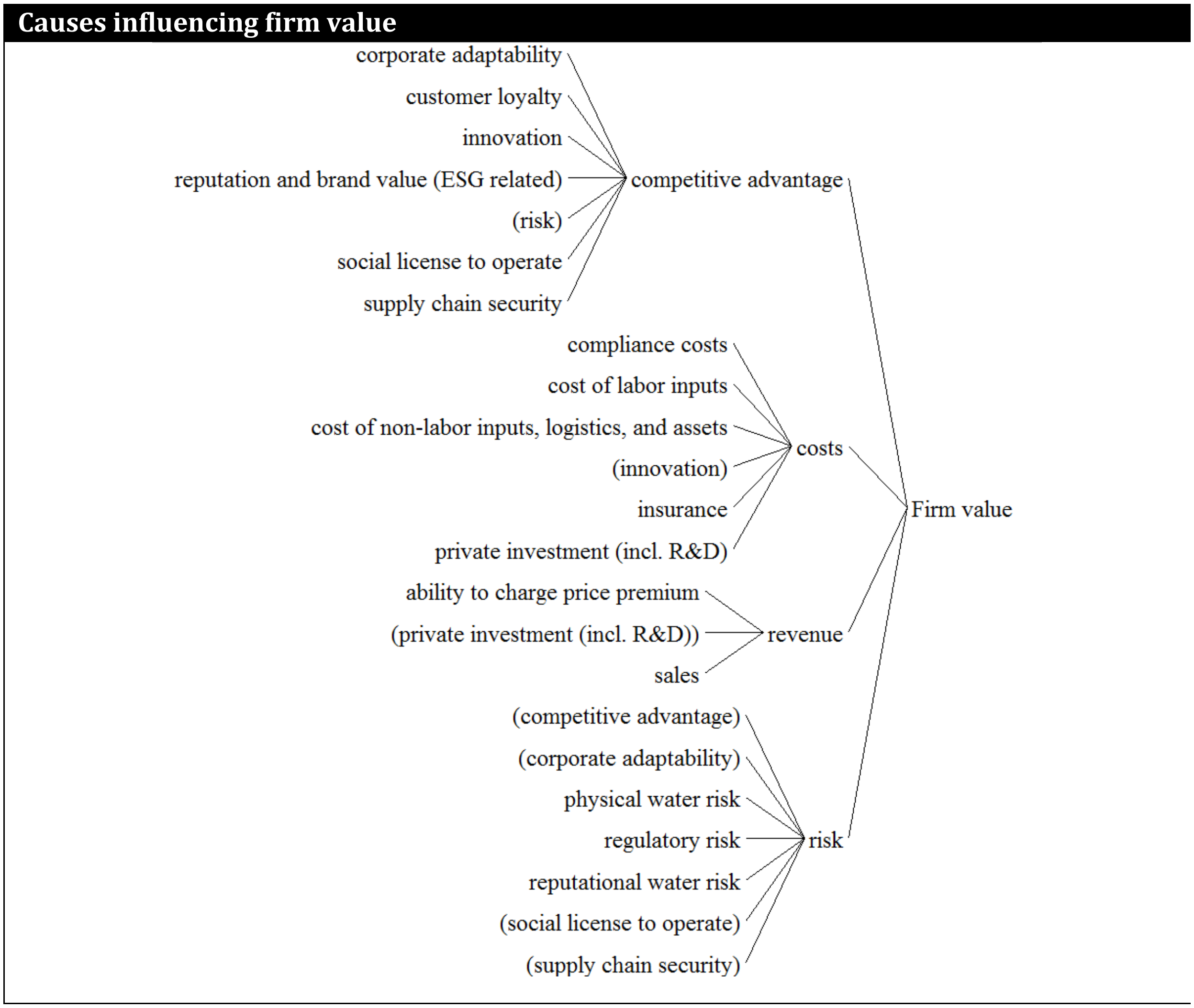


Figure 21. Firm value increases when revenues increase, competitive advantage is built, and both costs and risks are reduced.

Module interconnectedness

In this section, modules are paired with one another and the causal relationships between variables are examined. Cause-trees are also utilized to analyze first and second order causes and consequences associated with interconnected variables. Finally, a discussion of module interconnectedness is provided to summarize key insights gained from examining the causal relationships between variables and stocks in the [A] Natural Capital [B] Societal Economic Capital, [C] Social and Human Capabilities, and [D] Firm Value Modules.

The following relationships are explored in this section:

- **[A: B]** Natural Capital & Societal Economic Capital
- **[A: C]** Natural Capital & Social and Human Capabilities
- **[B: C]** Societal Economic Capital & Social and Human Capabilities
- **[A: D]** Natural Capital & Firm Value
- **[B: D]** Societal Economic Capital & Firm Vale
- **[C: D]** Social and Human Capabilities & Firm Value
- **[A: B: C: D]** Water Stewardship CLD

[A: B] Natural Capital & Societal Economic Capital.

Explanation of modules.

The purpose of this interconnected module is to illustrate the causal connections between the [A] Natural Capital Module and the [B] Societal Economic Capital Module. The connection between the Natural Capital Module and Societal Economic Capital Module showcases the relationship between twenty variables, which influence the natural capital and societal economic capital stocks. Analyzing the relationship between two or modules ultimately enables causal connections to be identified between different modules.

The primary relationships in the interconnected modules showcase how natural capital (water resources) positively increases production, which positively increases societal economic capital. For example, as natural capital increases, the ability to produce also increases; therefore societal economic capital is ultimately increased. However, when natural capital decreases, the ability to produce decreases, which ultimately decreases the societal economic capital stock.

This module also shows that increased demand positively increases production. However, increased production can have adverse effects on natural capital, as production causes an increase in water consumption, which ultimately decreases the quantity of water available. Increased production also increases water pollution, which decreases water quality.

In order to maintain production, sufficient natural capital is needed, therefore, investments that increase ecological replenishment, ecosystem services, water quality the total quantity of water available, and ultimately the stock of natural capital available, are needed to ensure production can continue without causing adverse impacts in the system. One specific intervention that can be leveraged to reinforce natural capital is watershed protection, which improves habitat quality, increases ecosystem services, improves water quality, and ultimately increases ecological replenishment which enables the stock quantity of water available to sustain over time. Furthermore, investments which increase water-use efficiency in production processes also have the potential to reinforce natural capital as net water consumption decreases over time.

Overall, when examining the causal connections between the variables in the natural capital and societal economic capital modules, the relationship between natural capital and economy becomes more apparent and digestible. On the following page, an illustration of the interconnected modules has been included. Furthermore, some of the cause-trees showcasing the causal relationships between the natural capital module and societal economic capital module have been included to showcase first and second order causes and consequences associated with interacting variables in the Natural Capital Module and Societal Economic Capital Module. For the most part, cause trees are represented sequentially to enable pathways to creating shared value to be traced for people, profit, and the planet. A table showcasing the variables that are interacting in this system has also been included in Appendix D, for reference (Table 44).

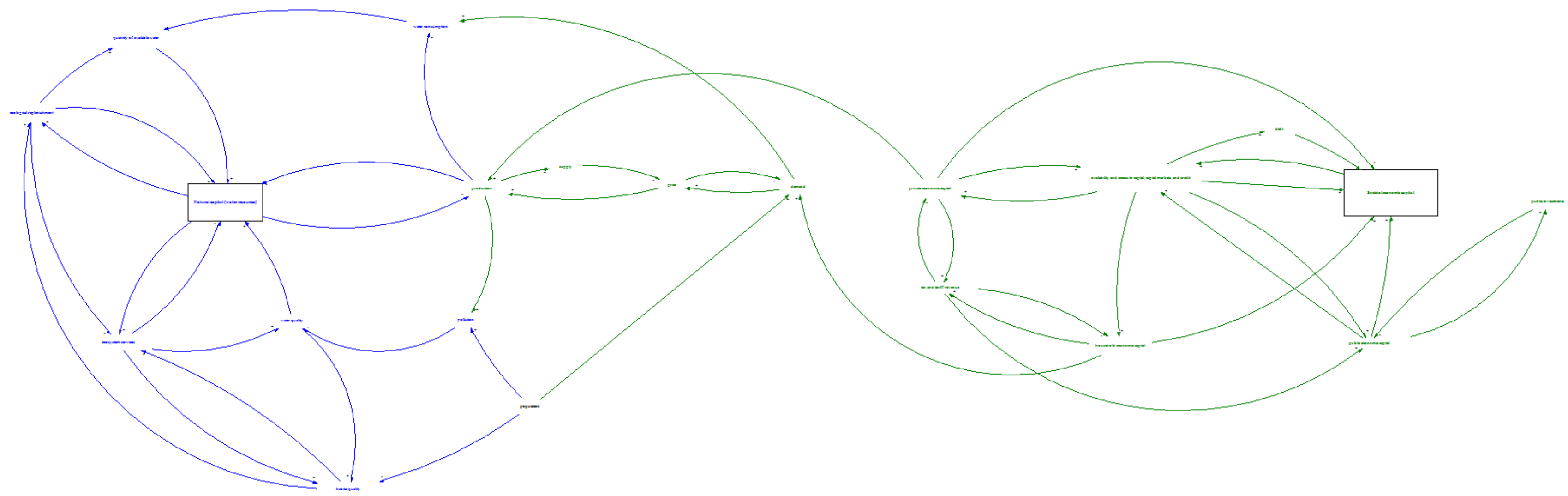


Figure 22. Natural capital and societal economic capital are causally connected.

Analyzing first and second order causes and consequences using-cause trees.

Natural capital positively influences production

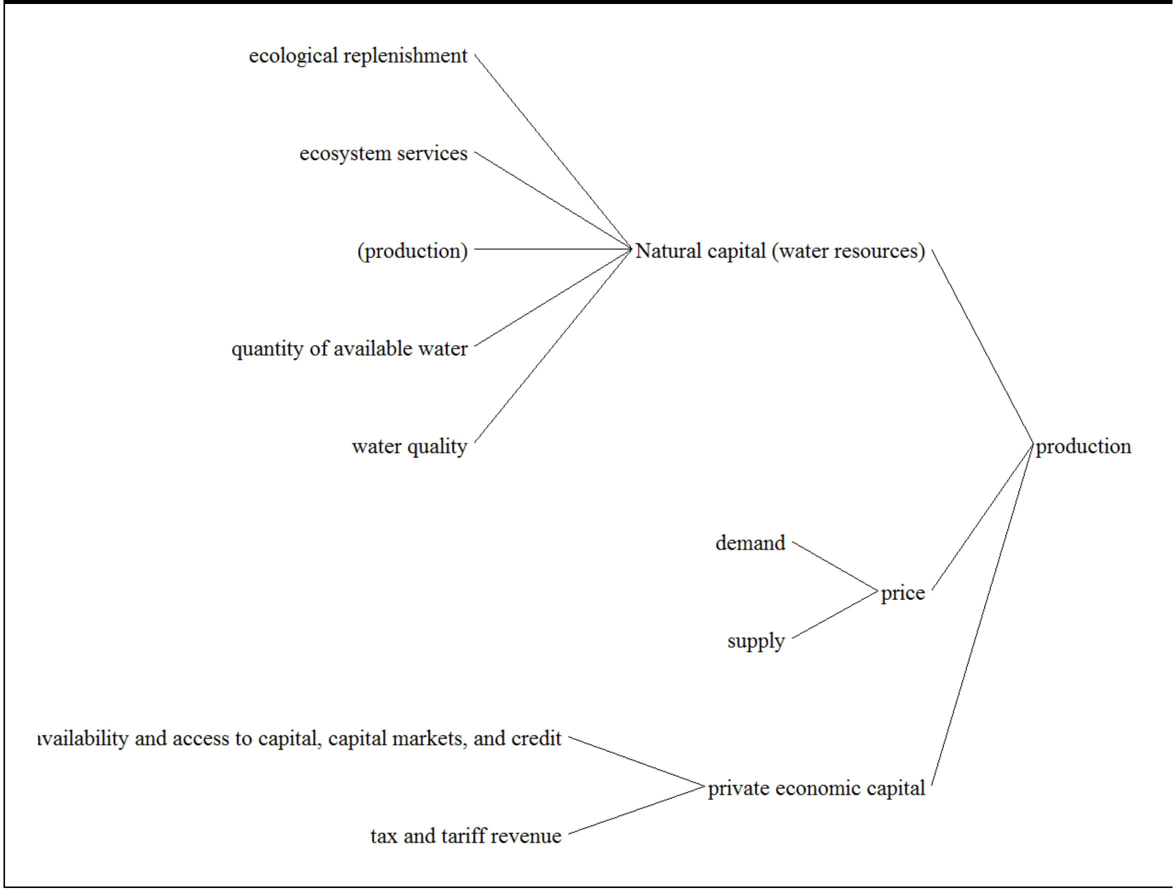


Figure 23. Availability of natural capital influences production.

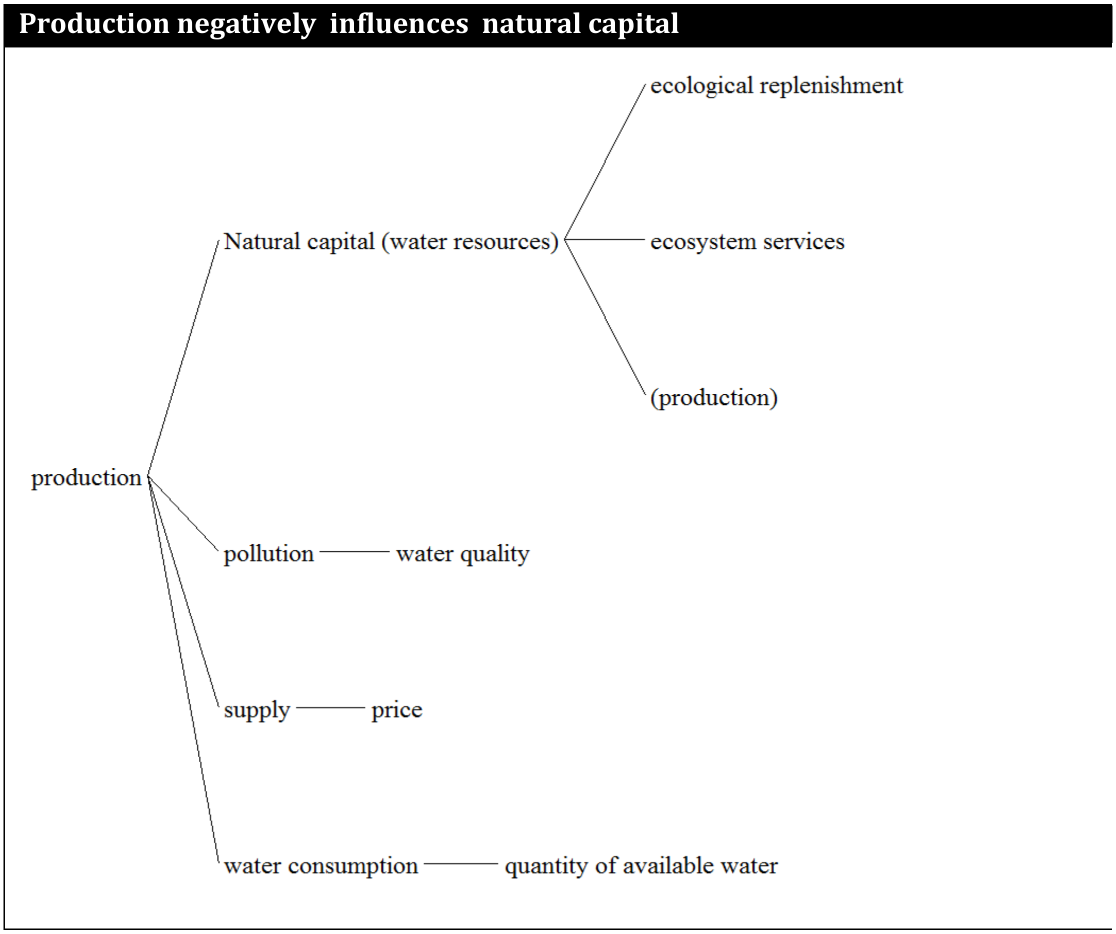


Figure 24. Production inversely impacts natural capital through the consumption of water and the emission of pollutants.

[A: C] Natural Capital & Social and Human Capabilities.

Explanation of modules.

The purpose of this interconnected module is to illustrate the causal connections between the [A] Natural Capital Module and the [C] Social and Human Capabilities Module. The primary relationship between the Natural Capital Module and the Social and Human Capabilities Module is the relationship between natural capital and equitable access to water and sanitation. In this interconnected module natural capital, or water resources, positively influences equitable access to clean water and sanitation facilities. As natural capital increases, the ability to provide equitable access to clean water and sanitation facilities also increases. Therefore, investments in natural capital that increase both the quantity and quality of water available ultimately increase the ability to provide communities with equitable access to WASH.

One adverse effects of increased access to clean water and sanitation facilities is increased water consumption as an increased number of consumers ultimately increases the rate of water consumption and the total quantity of water consumed, which decreases the stock of natural capital available. Therefore, investments in watershed protection, which increase ecological replenishment, ecosystem services, and both the quantity and quality of water available, can be utilized to reinforce the stock of natural capital. These investments will ultimately help enable the provision of clean water and adequate sanitation, while also helping to ensure the long-term sustainability and availability of water resources overtime.

Overall, examining the causal connections between the variables in the natural capital module and social and human capabilities modules enables the examination of relationships between natural capital and social and human capabilities. On the following page, an illustration of the interconnected modules is included. Cause-trees have also been included to illustrate key leverage points and pathways to value through water-related investments. A table showcasing the variables that are interacting in this system has also been included in Appendix D, for reference (Table 45).

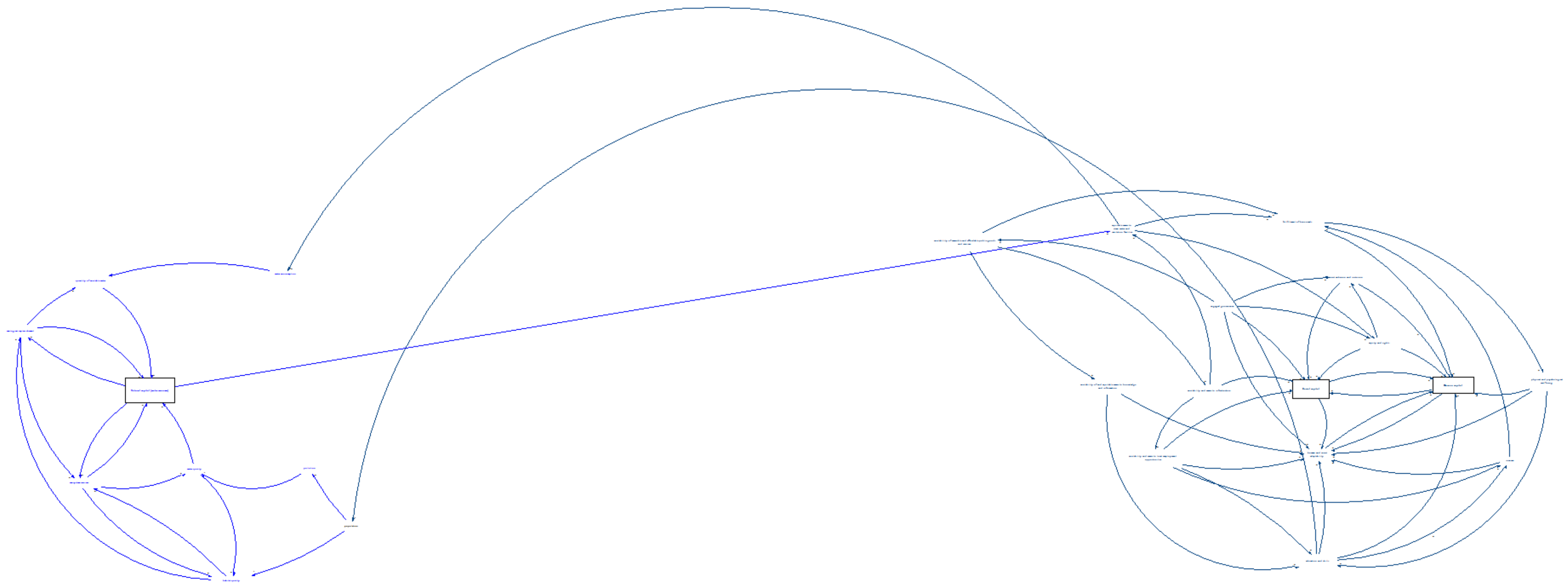


Figure 25. Natural capital and social and human capabilities are causally connected.

Analyzing first and second order causes and consequences using cause-trees.

Natural capital influences equitable access to clean water and sanitation facilities

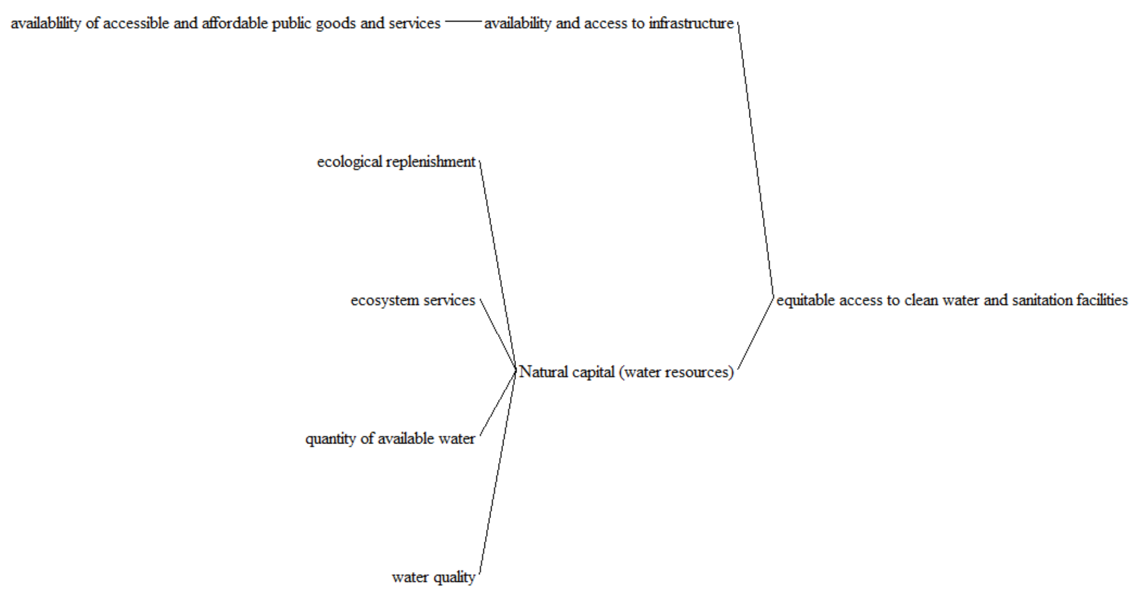


Figure 26. Equitable access to clean water and sanitation is influenced by the availability and access to infrastructure and the availability of natural capital (water resources)

Consequences influenced by equitable access to clean water and santiation facilities

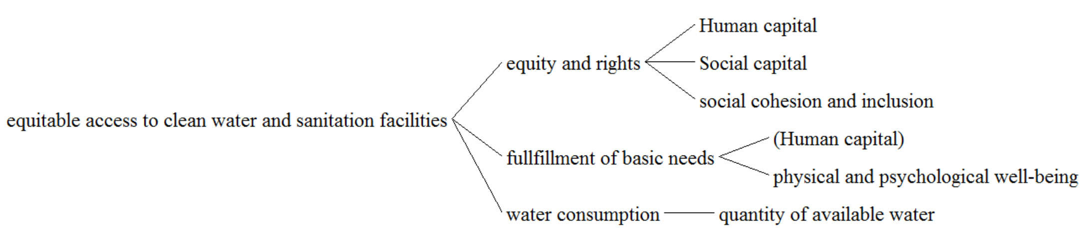


Figure 27. Equitable access to clean water and sanitation facilities increases equity and rights and the fulfillment of basic needs, but also reinforces water consumption.

[B: C] Societal Economic Capital & Social and Human Capabilities.

Explanation of modules.

The purpose of this interconnected module is to illustrate the causal connections between the [B] Societal Economic Capital Module and the [C] Social and Human Capabilities Module. The primary relationship between the Societal Economic Capital Module and the Social and Human Capability Module is the relationship between production and access to local employment opportunities. Within this interconnected module, production positively increases the availability and access to local employment opportunities, which ultimately increases income, and builds household economic capital. Increased household economic capital, builds social and human capital, which ultimately increases demand and reinforces production in a virtuous cycle.

When local employment opportunities are enabled through production there are multiple social and human capital oriented consequences. For example, access to local employment opportunities increases income, the attainment of education and skills, human and social adaptability, and ultimately increases social capital. When communities benefit from employment and increased income, household economic capital is also increased, therefore generating additional social and human capital related benefits. Furthermore, as household economic capital increases over time, household spending on non-essential goods also causally increases, which can generates positive value for the firm.

While production provides multiple societal and economic benefits, increased production can also have adverse effects on natural capital as production can cause an increase in water consumption and a decrease in water quality. Therefore, investments to increase production and provide economic employment to communities should be matched simultaneously with investments in watershed protection and water-use efficiency to offset any negative environmental consequences associated with increased production. When made simultaneously, these investments have the potential to create shared value for people, profits and the planet.

On the following page, an illustration of the interconnected modules has been included. Cause-trees have also been included to illustrate key leverage points and pathways to value through water-related investments. Furthermore, a table showcasing the variables that are interacting between the Societal Economic Capital Module and the Social and Human Capabilities Module was also included in Appendix D, for reference (Table 46).

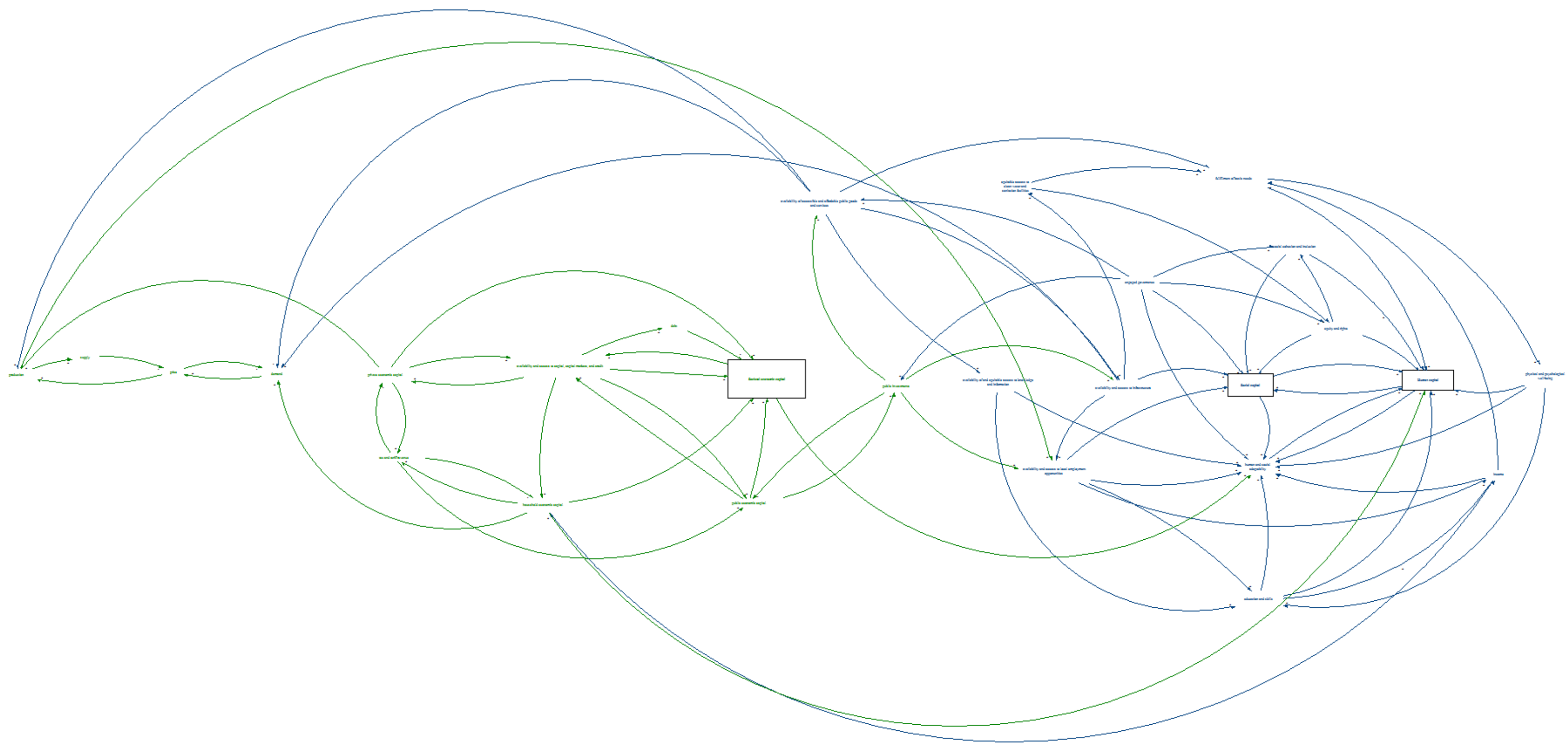


Figure 28. Societal economic capital and social and human capabilities are causally connected.

Analyzing first and second order causes and consequences using cause trees.

Production influences the availability and access to local employment opportunities

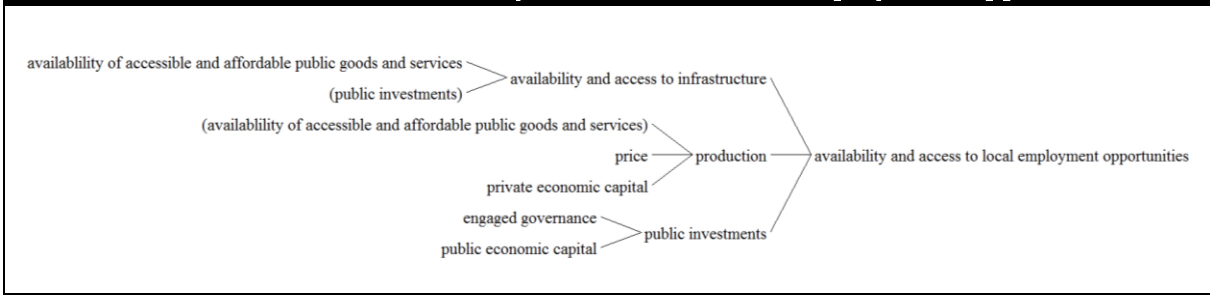


Figure 29. Local employment opportunities are associated with production.

Consequences influenced by the availability and access to local employment opportunities

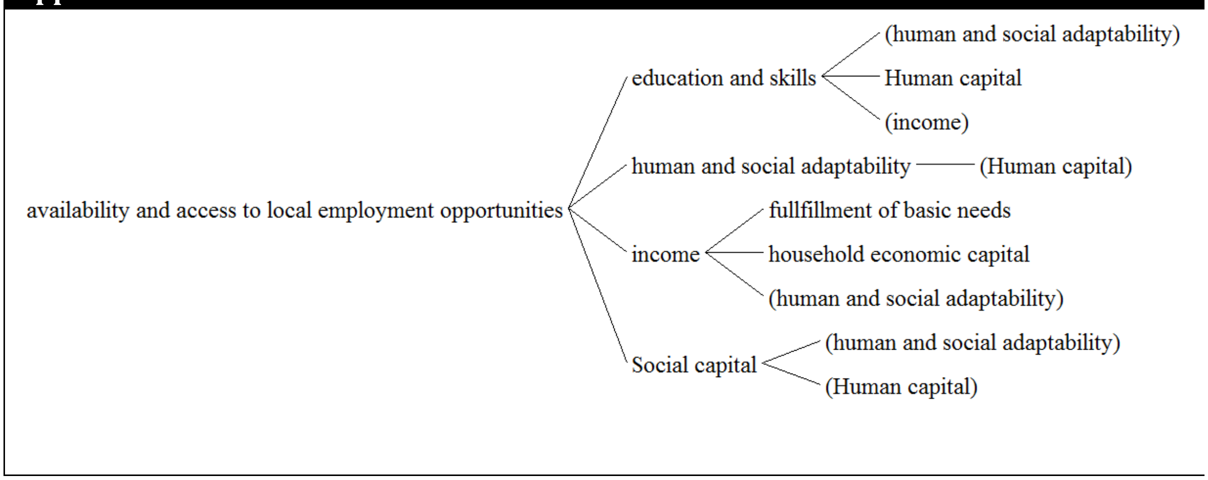


Figure 30. Local employment opportunities increase income, provide opportunities to build education and skills, while increasing social capital, and building human and social adaptability.

Employment increases income, which increases household economic capital.

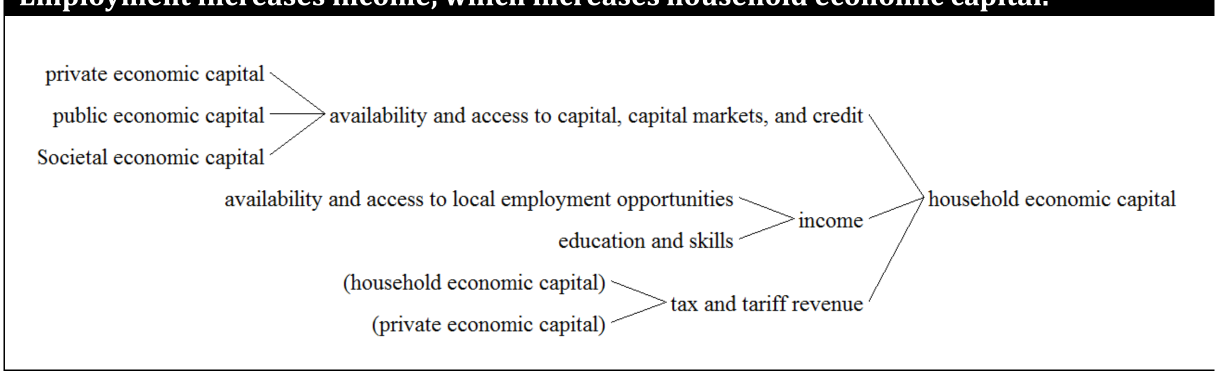


Figure 31. Employment and increased income ultimately increases household economic capital.

Household economic capital builds human and social capital and drives demand.

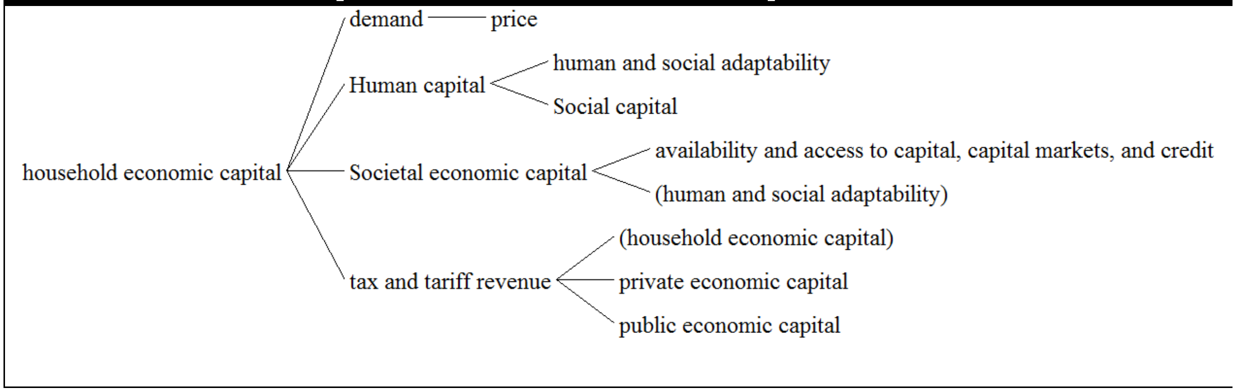


Figure 32. Household economic capital drives demand which creates value for the firm.

[A: D] Natural Capital & Firm Value.

Explanation of module.

The purpose of this interconnected module is to illustrate the causal connections between the [A] Natural Capital Module and the [D] Firm Value Module. The primary relationship between the Natural Capital Module and the Firm Value Module is the relationship between the availability of natural capital and risk at the firm. The quantity and quality of natural capital available influences physical water risk and regulatory water risk, which can generate both risks and opportunities for business operations and supply chains.

Physical water risk occurs when, "water scarcity directly impacts business activities, raw material supply, intermediate supply chain, and product use."[289] Physical water risk can manifest in various ways, depending on the business. While physical risk commonly escalates when there are water scarcity issues, challenges associated with the over consumption of water resources, flooding, pollution and poor water quality can also reinforce physical water risk. In addition to physical water risk, the quantity and quality of freshwater available can also influences the firm by increasing regulatory risk and challenging the firm's social license to operate. When regulatory risk increases, competitive advantage decreases, which ultimately causes negative consequences at the firm. Furthermore, increased insurance and compliance costs associated with regulatory risk can increase total costs, which decreases firm value over time. Investments to decrease both physical and regulatory risk associated with the quantity and quality of water available, can ultimately build competitive advantage, facilitate supply chain security, lower long-term costs and help the firm secure a social license to operate. Some of the cause-trees showcasing the causal relationships between the natural capital module and the firm value module have been included to showcase first and second order causes and consequences associated with the interacting variables. For the most part, cause trees are represented sequentially to enable the identification of key leverage points for intervention and to also enable pathways to shared value to be traced for people, profits and the planet. The variables interacting in this system have been included in Table 47. Variables interacting in the Natural Capital and Firm Value ModulesTable 47 in Appendix D, for reference.

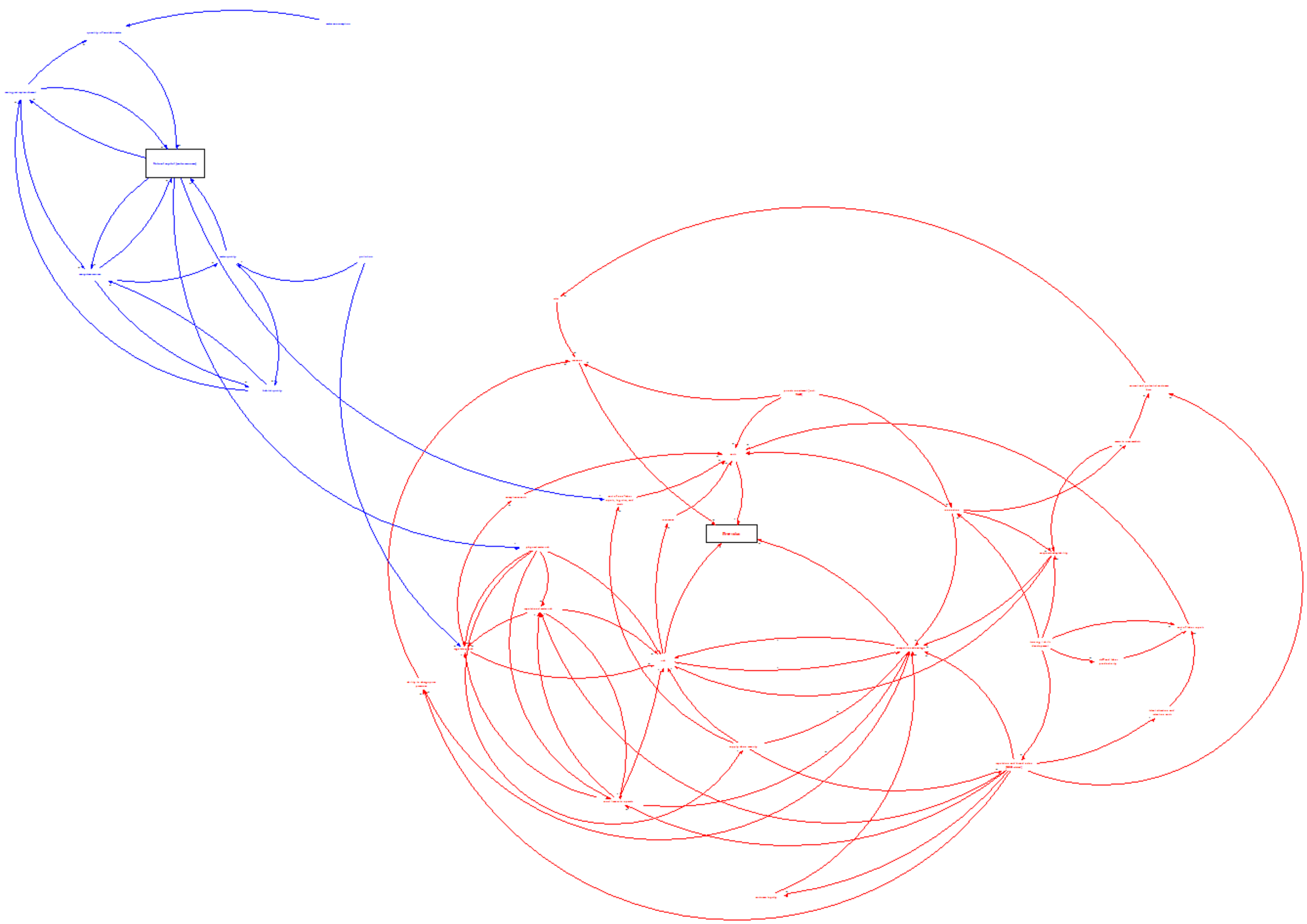


Figure 33. Natural capital and firm value are causally connected.

Analyzing first and second order causes and consequences using cause trees.

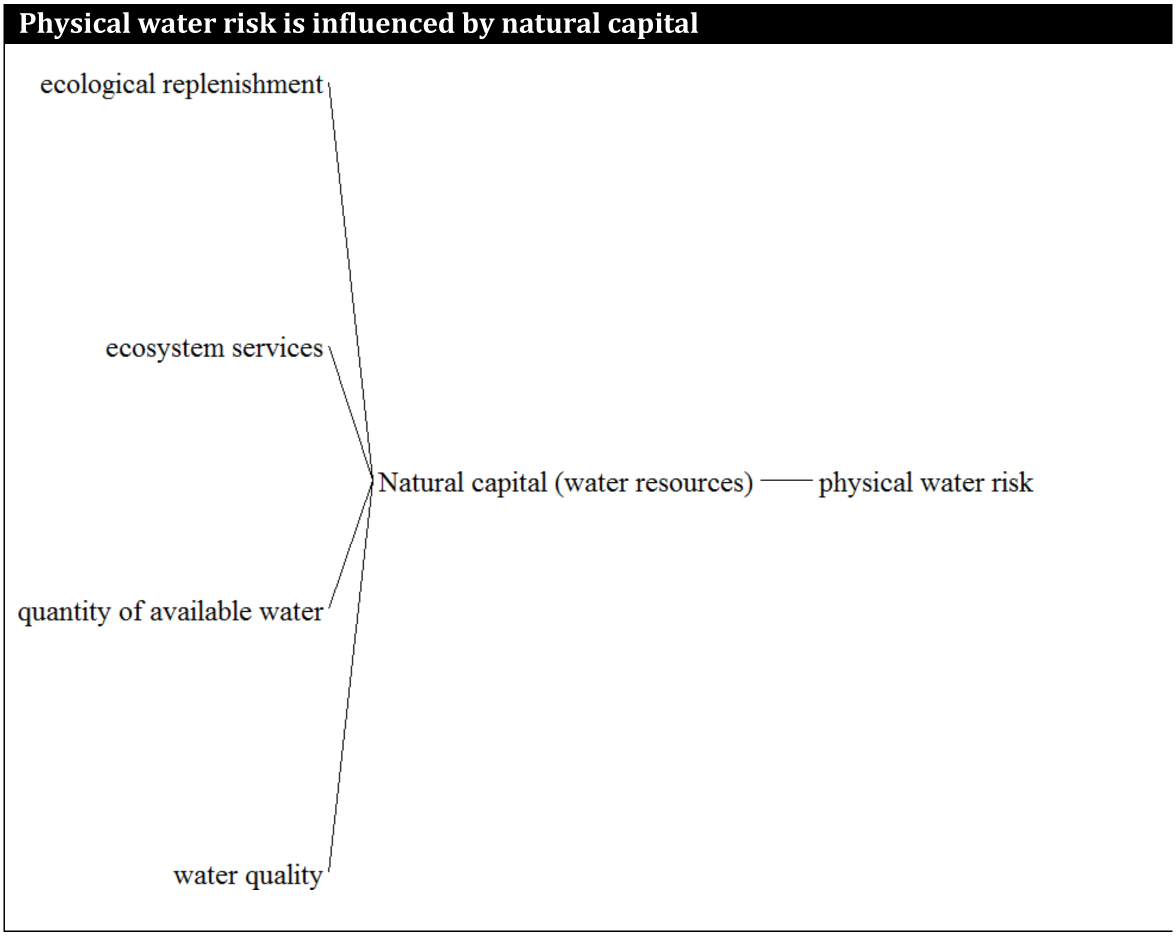


Figure 34. The availability of natural capital (water resources) influences physical water risk in the firm.

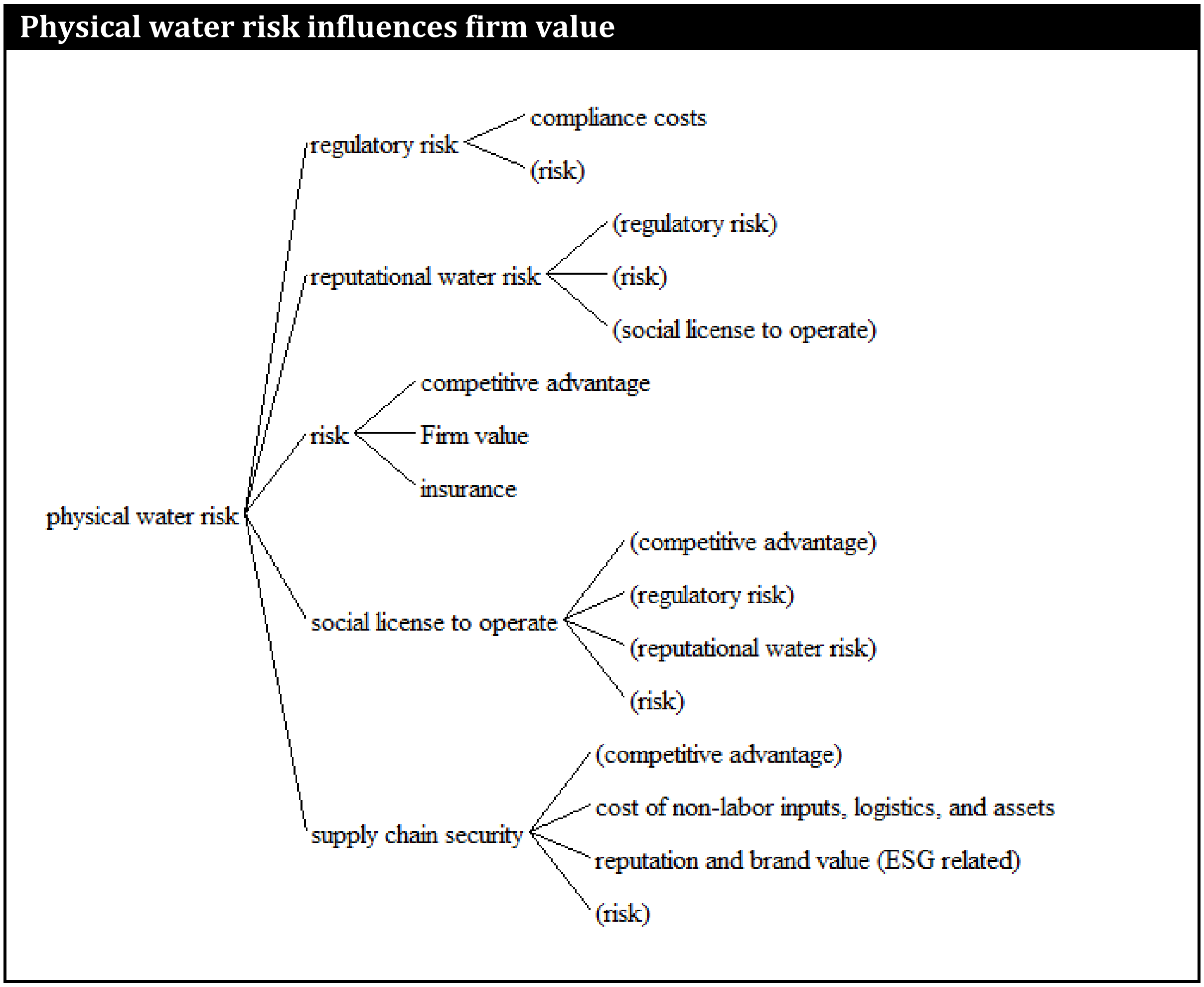


Figure 35. Physical water risk reinforces reputational and regulatory water risk while decreasing supply chain security and weakening the social license to operate.

Regulatory risk is influenced by physical water risk, pollution and reputational water risk

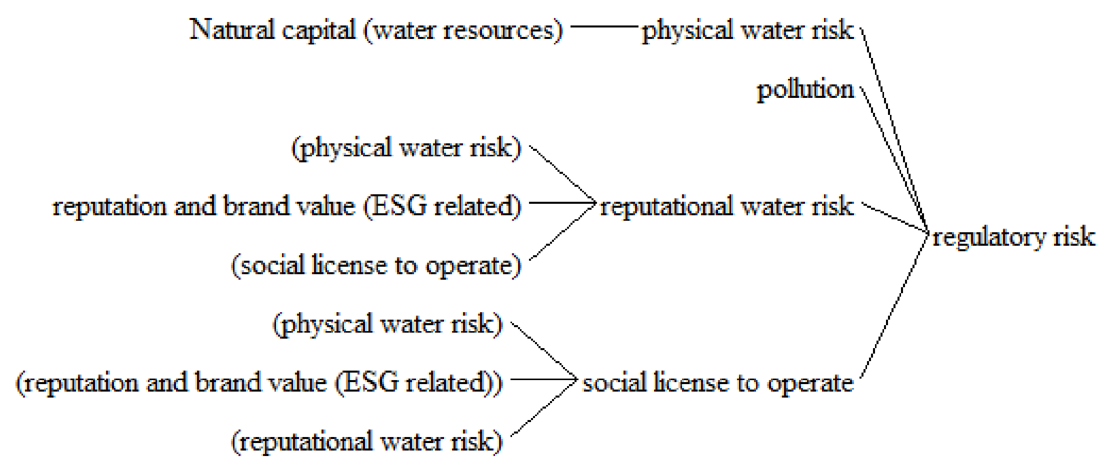


Figure 36. Regulatory risk is caused by physical water risk, pollution, reputational water risk and securing the social license to operate.

Regulatory risk influences firm value

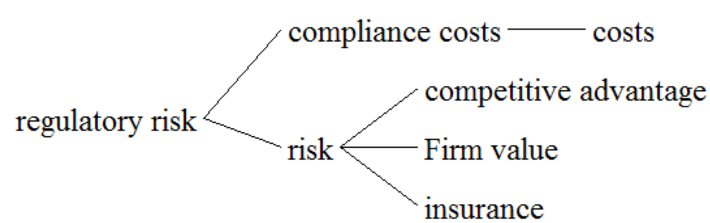


Figure 37. Regulatory risk increases overarching risk and increases compliance costs.

[B: D] Societal Economic Capital & Firm Value.

Explanation of modules.

The purpose of this interconnected module is to illustrate the causal connections between the [B] Societal Economic Capital Module and the [D] Firm Value Module. The primary relationship between the Societal Economic Capital Module and the Firm Value Module is the relationship between household economic capital, demand, and the current and potential customer base at the firm. As household economic capital increases, demand for non-essential goods increases, which ultimately builds the market or customer base that the firm can leverage. Ultimately, when increased demand is coupled with an increase in customer base, sales increase, which can increase revenues for the firm and build firm value over time.

As revenues increase and firm value is reinforced, the private economic capital available for investment also increases, which spurs innovation within the firm. Similarly as private economic capital increases, the ability to invest in production also increases, which enables other societal benefits associated with building societal economic capital and social and human capital to be generated. As stated previously, production is causally linked to the availability and access to local employment opportunities, which generates societal economic capital overtime. Furthermore, when societal economic capital builds, the availability and access to capital, capital markets and credit increases, which further reinforces household economic capital, societal economic capital, and the firm's access to capital.

Overall, examining the causal connection between variables in the societal economic capital module and firm value modules enables the relationships between society, economy, and business to become more apparent and digestible. On the following page, an illustration of the interconnected modules has been included. Furthermore, cause-trees are included and represented sequentially to enable the identification of key leverage points for interventions and to also enable pathways to firm value to be traced. When following the pathways to value illustrated by this series of cause-tree diagrams, access to new markets, increased demand, increased price, and increased reputation and brand value ultimately increases the current and potential customer base (Figure 40). When the current and potential customer base is coupled with increased demand, sales increase (Figure 41) which ultimately builds private economic capital (Figure 42). In order to determine which investments are appropriate for driving demand, it is important to identify key leverage points that can be intervened upon to build firm value. Tables showcasing the variables that are interacting in the system have also been included in Appendix D, for reference (Table 48).

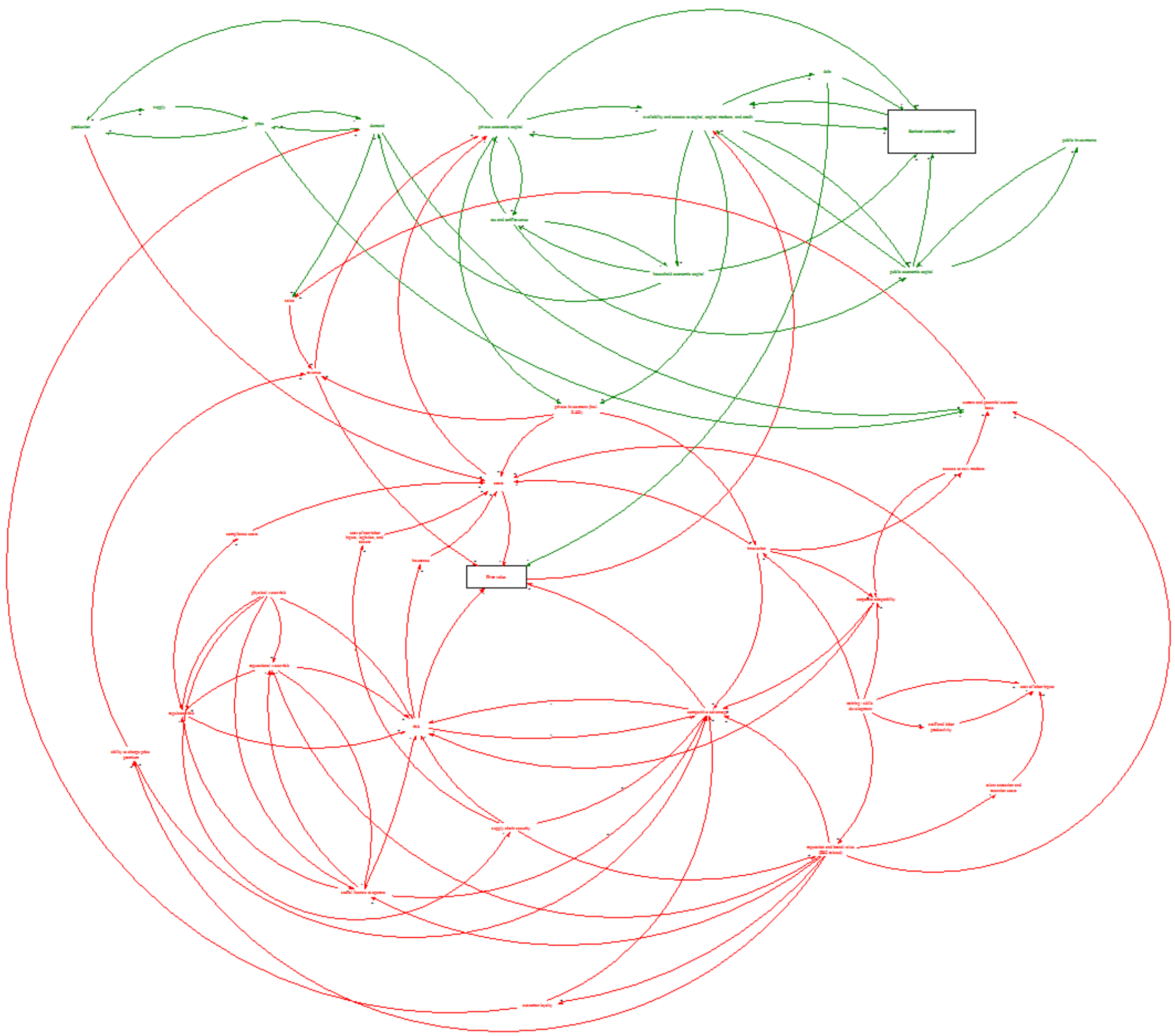


Figure 38. Societal economic capital and firm value are causally connected.

Analyzing first and second order causes and consequences using cause trees.

Household economic capital drives demand and builds current and potential customer base.

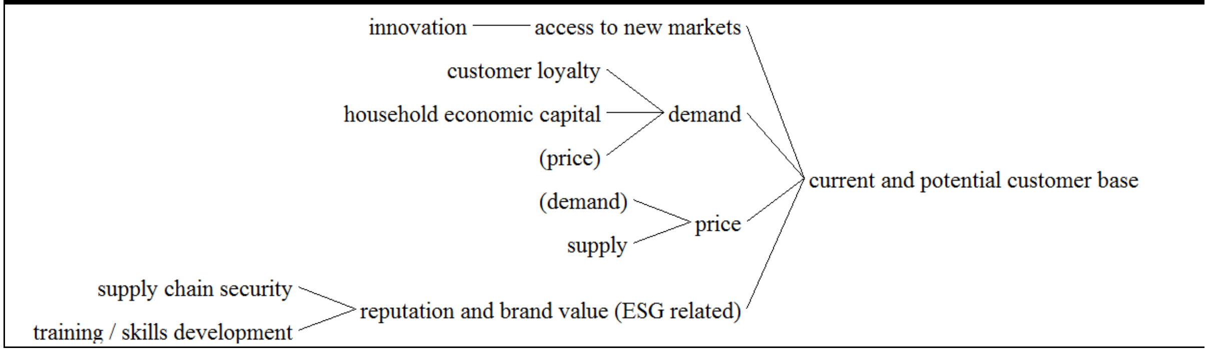


Figure 39. Current and potential customer base is related to reputation and brand value.

Demand coupled with an increased customer base drives sales

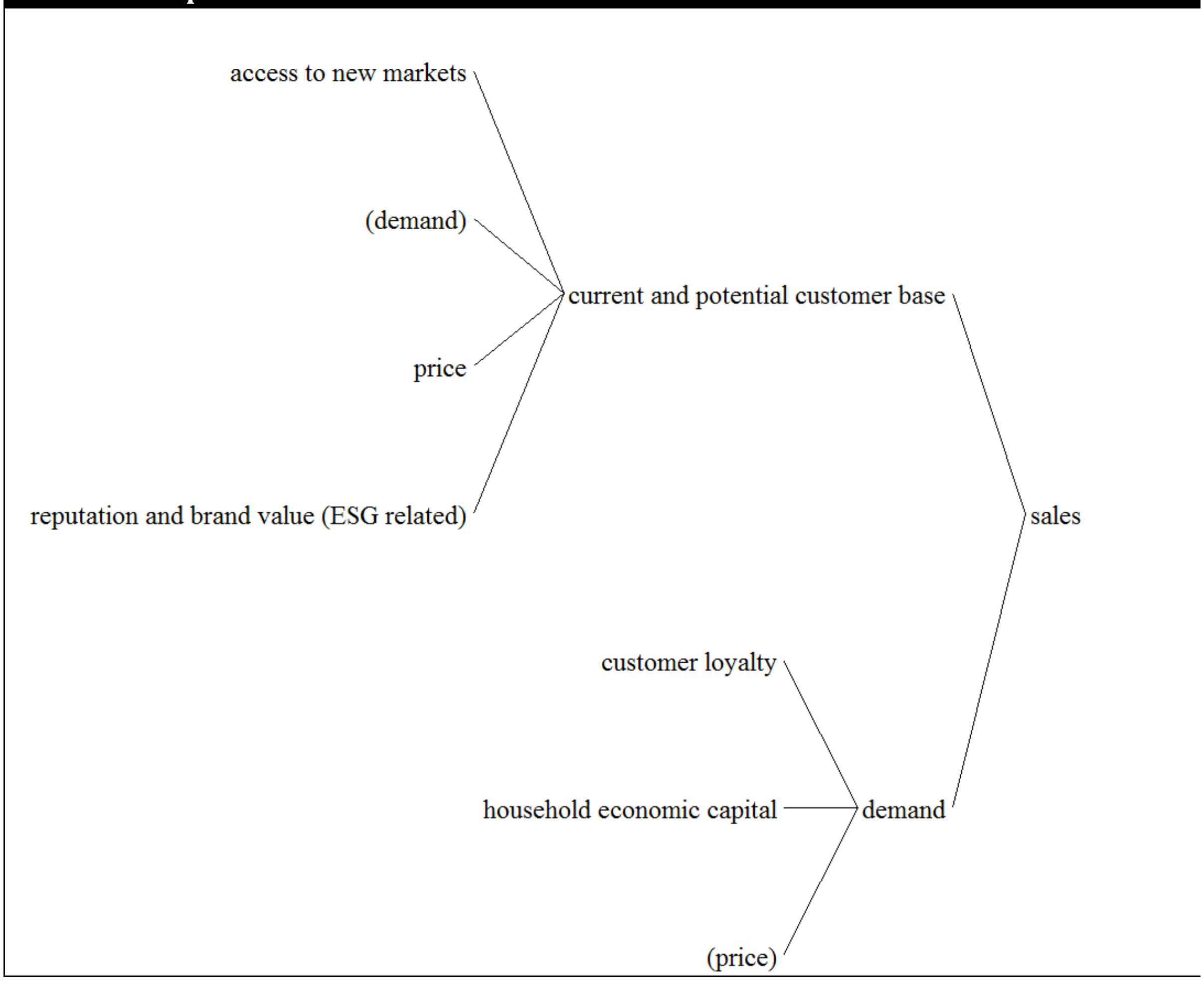


Figure 40. Increased household economic capital drives demand, and ultimately increases sales.

Continue tracing the pathway to firm value through Figure 42.

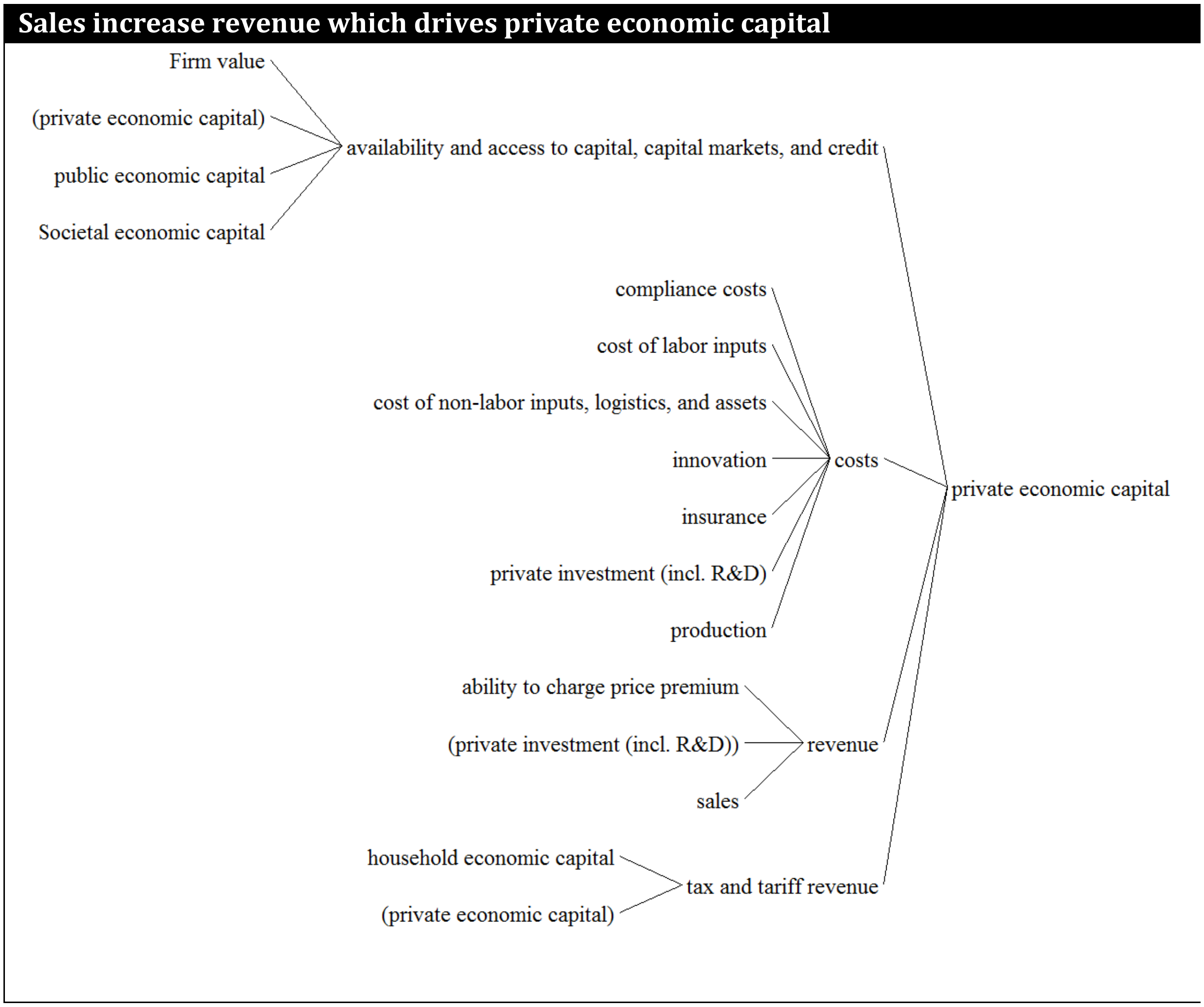


Figure 41. Increased sales build private economic capital.

Increased private economic capital facilitates production, which builds societal economic capital and increases availability and access to capital, capital markets and credit.

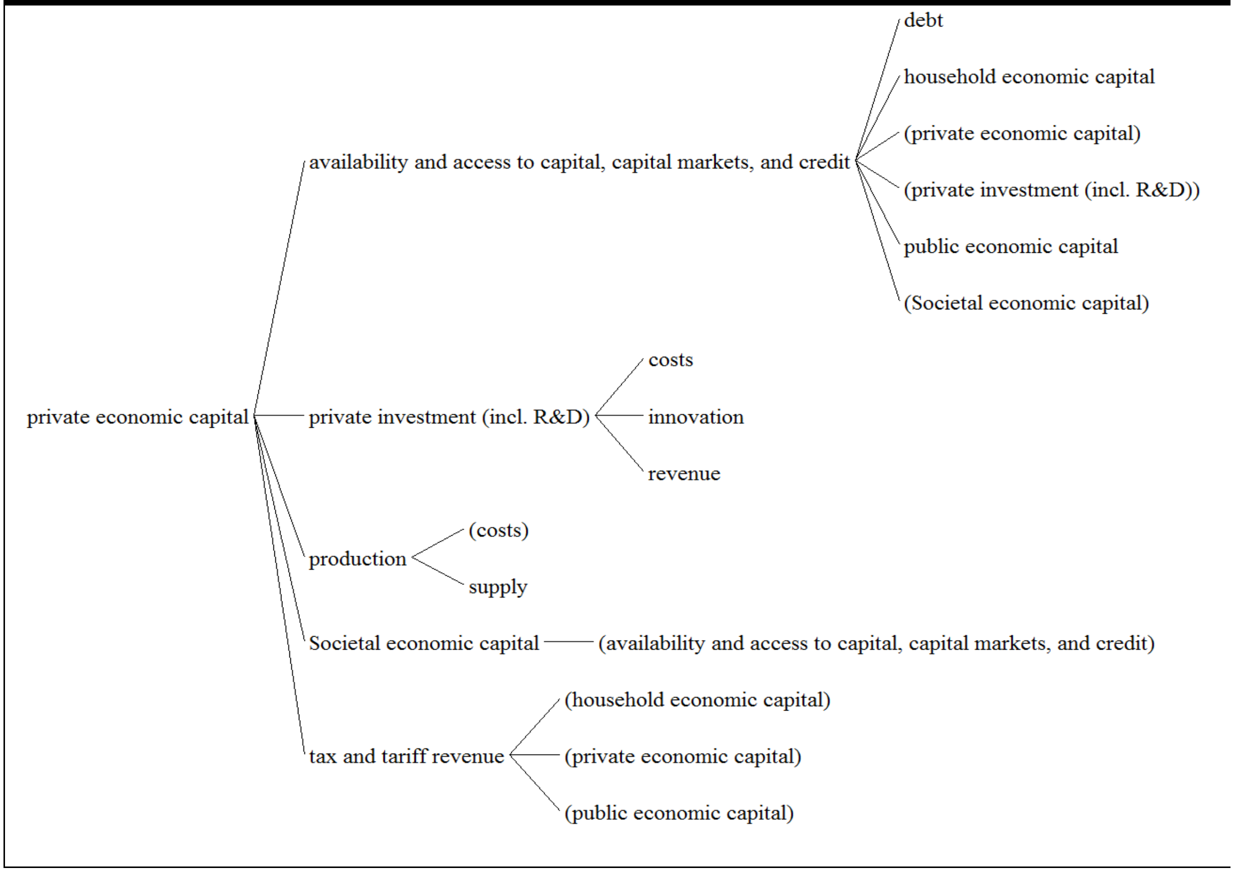


Figure 42. Private economic capital increases the capital available for private investment, while also enabling production.

[C: D] Social and Human Capabilities & Firm Value.

Explanation of module.

The purpose of this interconnected module is to illustrate the causal connections between the [C] Social and Human Capabilities Module and the [D] Firm Value Module. The primary relationship between the Social and Human Capabilities Module and the Firm Value Module is the relationship between human capital and the firm's ability to secure a social license to operate. Furthermore, human capital within the Social and Human Capabilities Module is also causally linked to the costs of labor inputs at the firm.

The level of human capital that is present in an area where a firm is attempting to conduct business operations or obtain supply chain inputs, ultimately influences the firm's social license to operate. Therefore, when the firm makes investments to increase human capital, the likelihood of securing a social license to operate increases, while also generating increased reputation and brand value. Furthermore, when a firm is able to secure a social license to operate, competitive advantage is gained and both reputational and regulatory risk is mitigated.

In addition to increasing the likelihood of securing and maintaining a social license to operate, investments in human capital can also decrease the costs of labor inputs at the firm as staff and labor productivity increases and the cost of talent attraction and employee retention decreases. One of the key water-related investments that can build human capital is investing in the equitable access of water and sanitation, which enables fulfillment of basic needs, increases physical and psychological well-being, and builds human capital, which increases productivity over time. Similarly, investing in education and skills can build human capital and have similar effects on talent and retention costs and overall staff and labor productivity. Some of the second-order variables that can be leveraged to increase education and skills include availability and access to local employment opportunities, availability and equitable access to knowledge and information, increased physical and psychological well-being and investments in training/skill development at the firm. Ultimately, investments that build human capital can increase staff and labor productivity while also decreasing the costs of talent attraction and employee retention can decrease the costs of labor inputs, which generate value through the manifestation of costs savings in the firm.

On the following page, an illustration of the interconnected modules has been included. Cause-trees have also been included and are represented sequentially to enable the identification of key leverage points for interventions and to also enable pathways to value to be traced from investments that build human capital. A table showcasing the variables that are interacting in this system has also been included in Appendix D for reference (Table 49).

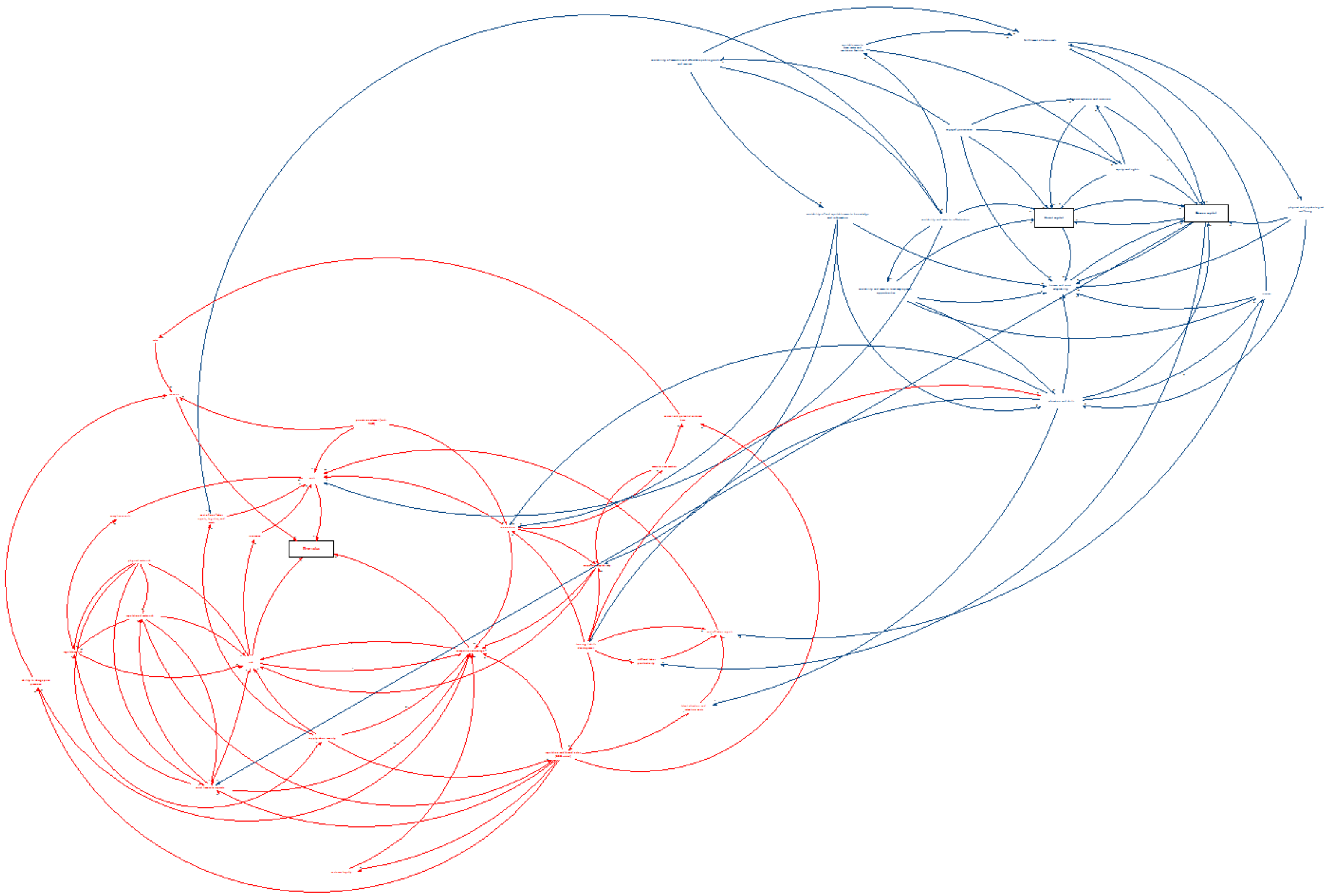


Figure 43. Social and human capabilities are causally connected to firm value.

Analyzing first and second order causes and consequences using cause trees.

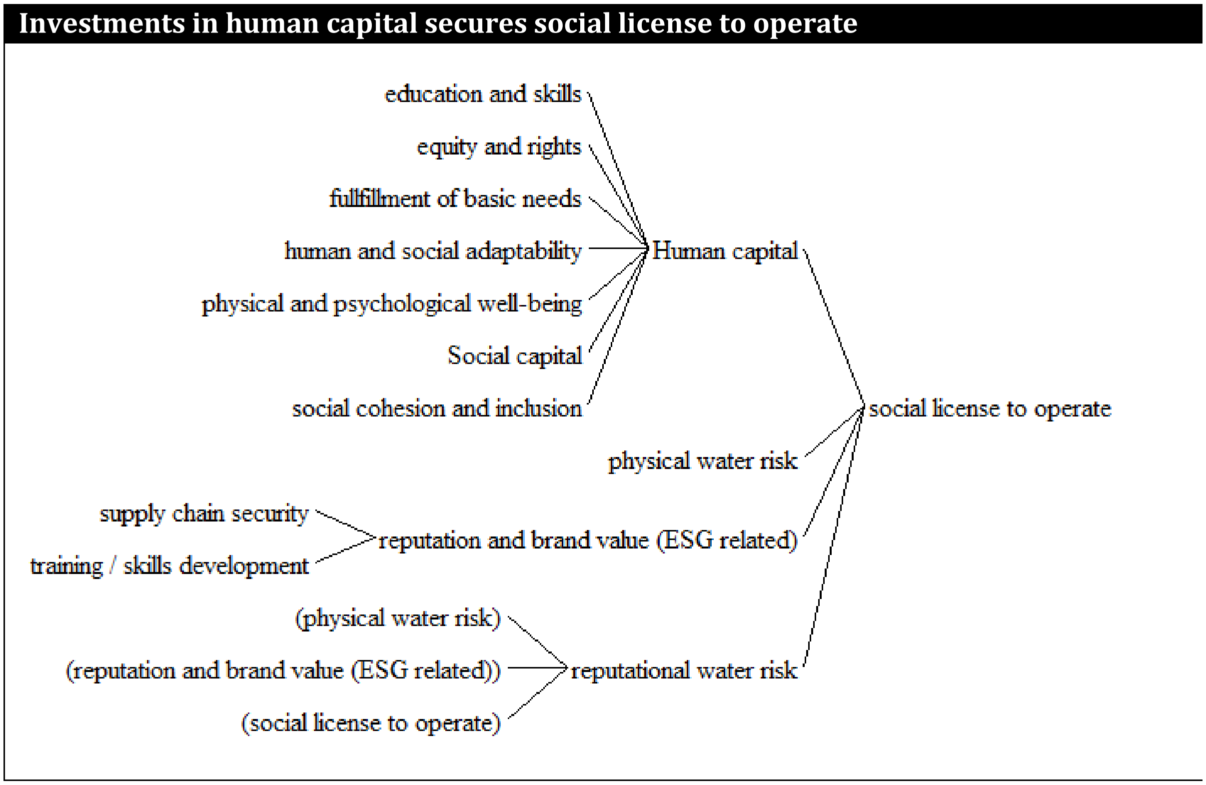


Figure 44. Physical water risk, reputational water risk, brand value and the status of human capital influence a firm's ability to secure a social license to operate.

Obtaining social license to operate reduces risks and increases competitive advantage

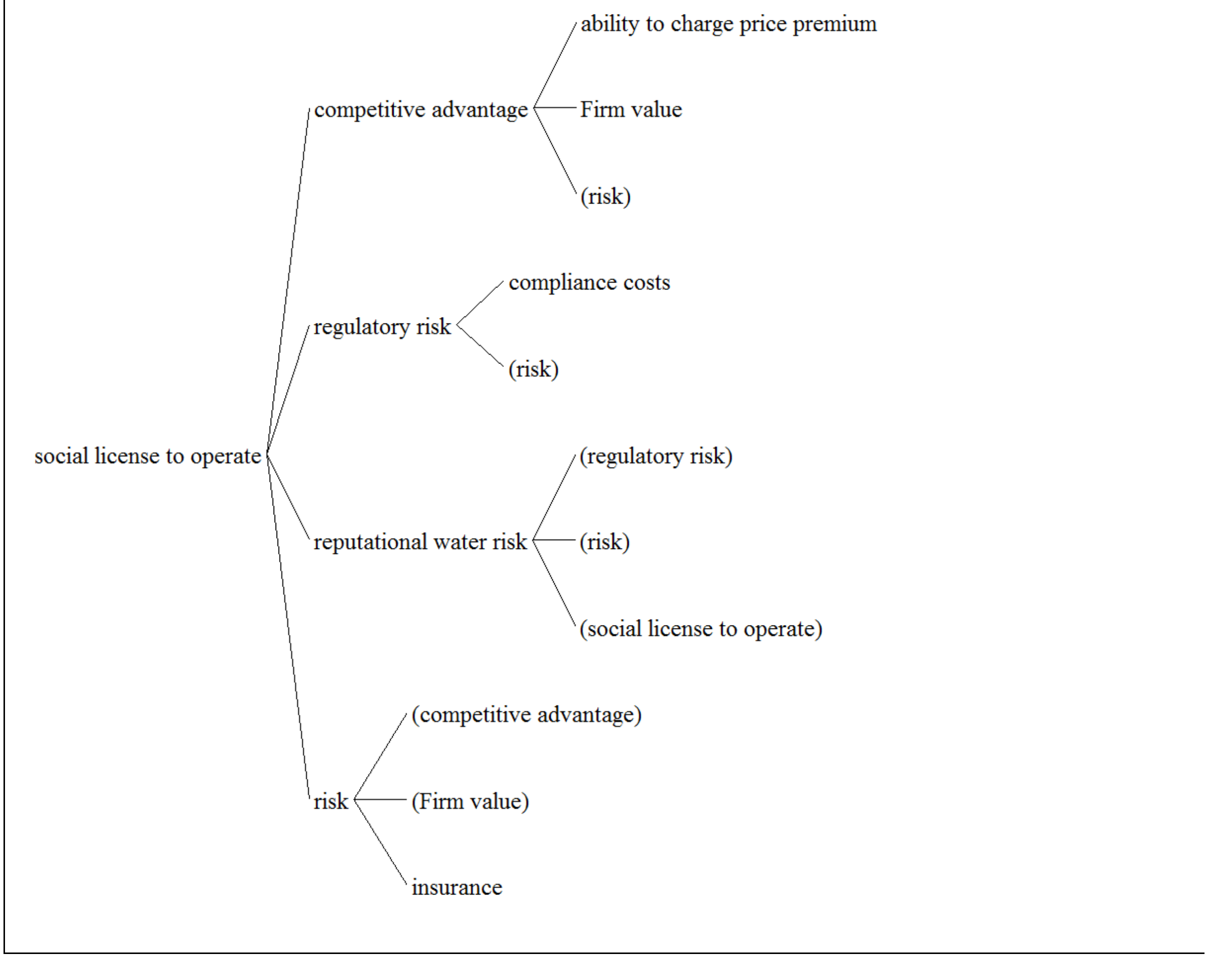


Figure 45. Securing a social license to operate reduces regulatory and reputation risk while creating competitive advantage.

Education and skills decrease talent attraction and retention costs

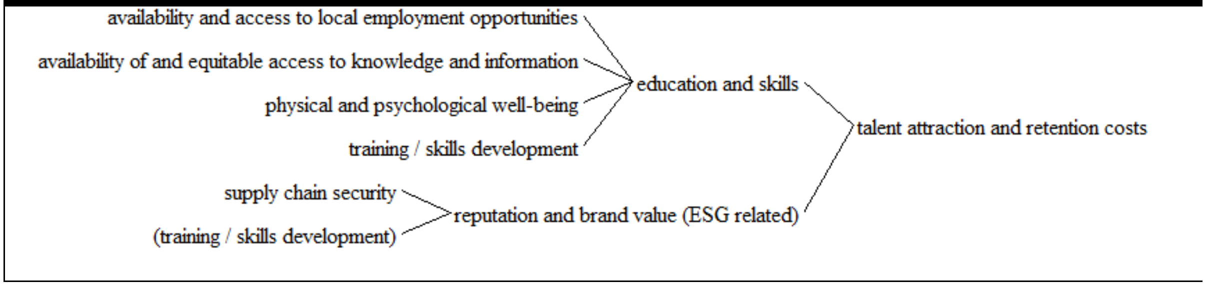


Figure 46. Investing in education and skills decreases the costs to attract talent and retain employees.

Staff and labor productivity increases with human capital

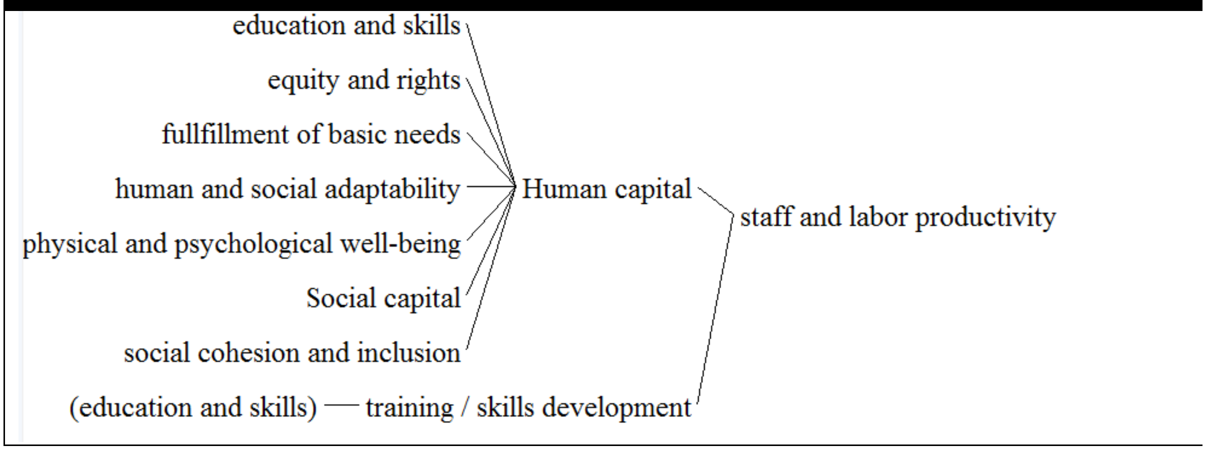


Figure 47. Elevating human capital by investing building social and human capabilities increases staff and labor productivity at the firm.

Costs of labor inputs decreases with investment in human capital, which drives staff and labor productivity and reduces costs of talent attraction and retention

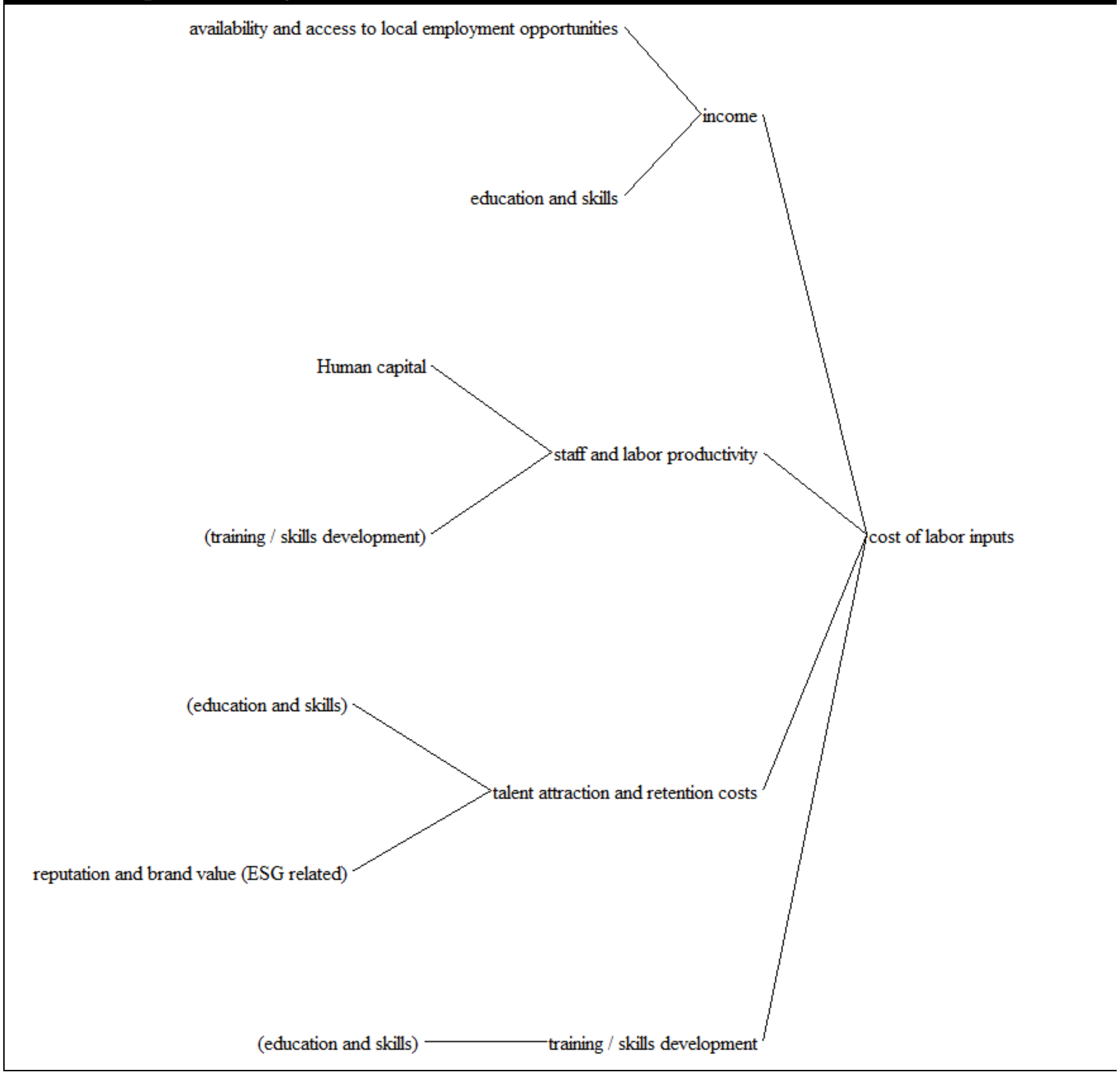


Figure 48. Costs of labor inputs decrease when staff and labor productivity increases.

[A: B: C: D] Water Stewardship CLD.

Explanation of Water Stewardship CLD.

The purpose of the full Water Stewardship CLD is to illustrate the causal connections between the [A] Natural Capital Module, the [B] Societal economic Capital Module, the [C] Social and Human Capabilities Module and the [D] Firm Value Module. The connection between the Natural Capital Module, the Societal Economic Capital Module, the Social and Human Capabilities Module and the Firm Value Module, showcases the relationship between fifty seven variables, which influence the natural capital, societal economic capital, social and human capital, and firm value stocks. Analyzing the relationship between the four modules ultimately enables causal connections to be identified between different modules, while also enabling the identification of pathways to value through investing in water stewardship.

Overall, when examining the causal connections between the variables in these modules, the relationships between people, planet, and profits remain complex, but with further analysis and the identification of feedback loops and key leverage points, the relationships can become more apparent and digestible. On the following page, an illustration of the final *Water Stewardship CLD* is included. A table showcasing the full list of variables that are interacting in this complex system has also been included in Appendix D, for reference (Table 50).

Following the illustration of the final Water Stewardship CLD, opportunities to intervene in the system to drive positive value will be explored by examining key feedback loops, identifying high leverage points, and exploring water-related investments that have the potential to generate shared value for society, the environment, and for business. The specific water-related investments that are explored include: watershed protection, water for productive use, and water, sanitation and hygiene (WASH). Additional leverage points will also be described in the context of complex systems, before utilizing inferences from the Water Stewardship CLD and results from the spatial assessments to identify specific water-related investments that could drive shared value in different regions of Africa.

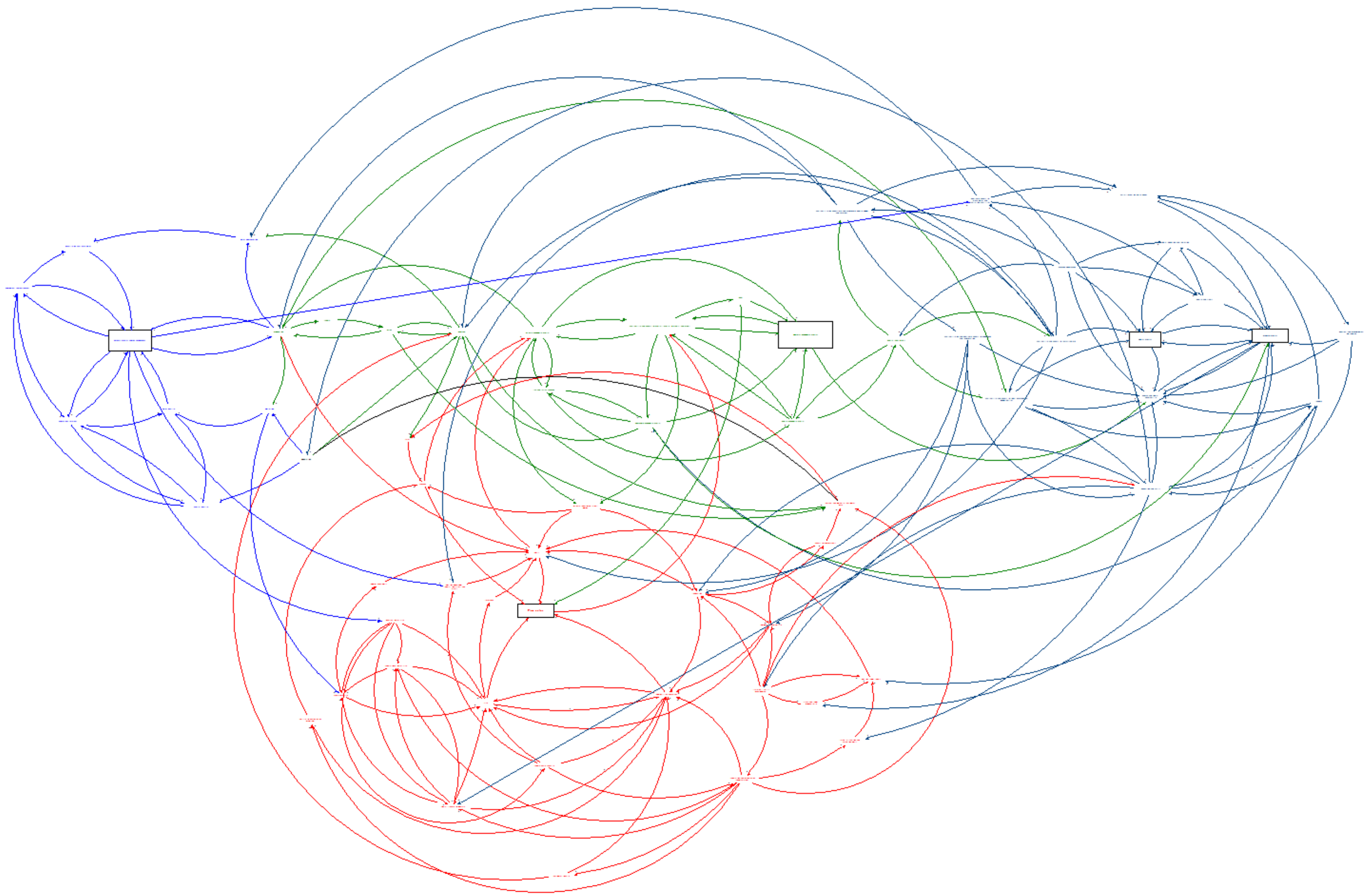


Figure 49. Full Water Stewardship CLD.

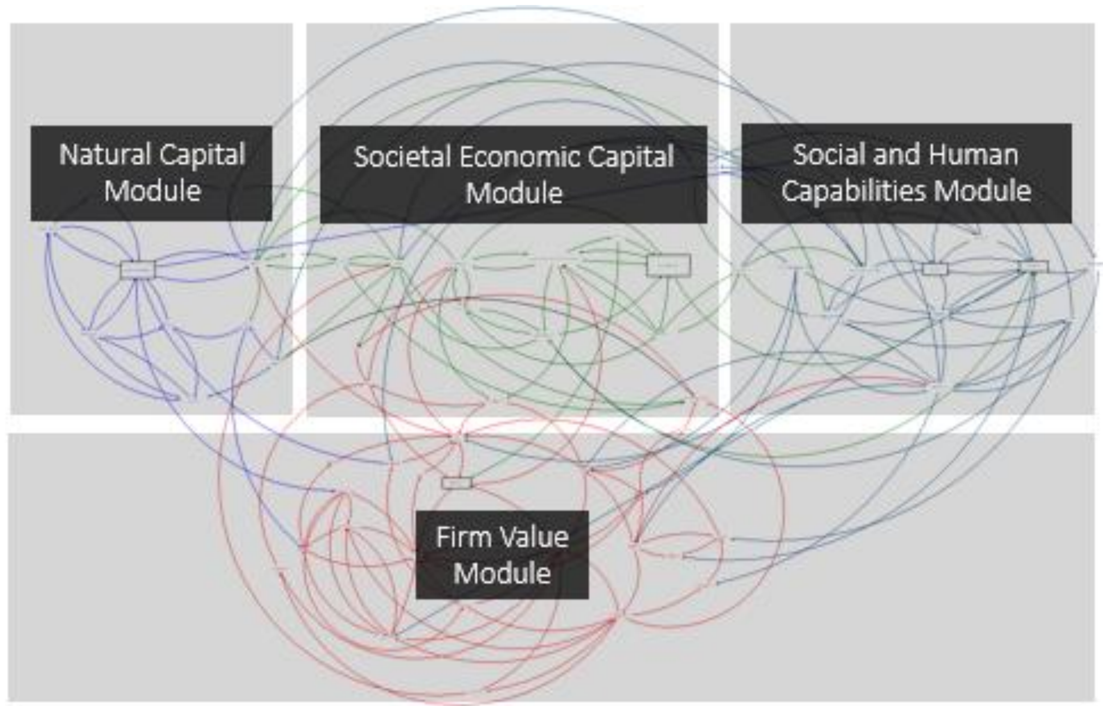


Figure 50.The full Water Stewardship CLD consists of four interconnected modules.

Intervening in a system to drive positive value

The *Water Stewardship CLD* contains multiple feedback loops and key leverage points that can be manipulated or intervened upon, to change the behavior of the system. The ultimate goal is to identify key leverage points, where water-related investments or interventions, can be used to drive pathways to shared value for people, profits and the planet.

Leverage points can be thought of as, "places within a complex system where a small shift in one variable can produce large, systemic change."[290] Although there is not a universal formula to identify leverage points, one of the best mechanisms to intervene in a dynamic system is to identify positive, reinforcing feedback loops, and identify variables that can be intervened upon to further reinforce the loop. Additionally, identifying key leverage points and corresponding interventions that have the ability to change the behavior of a balancing loop, is also another option that can be leveraged to drive positive value.[291]

In order to identify key leverage points in the *Water Stewardship CLD*, strong feedback loops were identified to understand the balancing and reinforcing nature of variables within the [A] Natural Capital Module, the [B] Societal Economic Capital Module, the [C] Social and Human Capabilities Module and the [D] Firm Value Module. Once strong feedback loops were identified, opportunities to intervene in the full Water Stewardship CLD are explored using The Coca-Cola Africa Foundation's Replenish Africa Initiative.

Feedback Loops & Interventions

Analyzing the Replenish Africa Initiative's ability to create shared value.

The interventions that are explored in this section are programs that are currently being implemented by The Coca-Cola Africa Foundation's Replenish Africa Initiative (RAIN). The primary programmatic investments that are currently being implemented by RAIN include:

- Watershed Protection
- Water, Sanitation and Hygiene (WASH)
- Productive Use of Water

In the remainder of this analysis, RAIN's investments in these areas are examined using the *Water Stewardship CLD* to understand how water-related investments can change the behavior of feedback loops, while driving positive value for the environment, society, and business.

Watershed protection investments are introduced first, and cause trees illustrating the first order-causes and consequences associated with the key leverage point variable for watershed protection are included to trace pathways to value from watershed protection. Additionally, the feedback loops that are influenced by the key leverage points are included to showcase how investments in watershed protection have the opportunity to change the behavior of a dynamic, social, economic, and environmental system.

Secondly, WASH and water for productive use programs are introduced simultaneously and cause trees illustrating the first-order causes and consequences associated with the key leverage point variables are included to trace pathways to value from WASH and water for productive use investments. Additionally, the feedback loops that are influenced by the leverage points are included to showcase how investments in WASH and water for productive use have the opportunity to drive positive value in a system.

Watershed protection.

According to the United States Environmental Protection Agency, a watershed is, "that area of land, a bounded hydrologic system, within which all things are inextricably linked by their common water course and where, as humans settled, simple logic demanded that they become part of a community."[292]

Within the Replenish Africa Initiative, watershed protection programs establish new or enhance existing watershed management practices by improving environmental stewardship and community health.[293] Some examples of these activities include the conservation of wetlands, in-stream flow restoration, reforestation, and afforestation. These investments are associated with a number of water quantity and water quality benefits including decreased pollutant loading, reduced storm water runoff, reduced flood hazard, and increased groundwater recharge. Details pertaining to specific watershed protection activities and corresponding benefits associated with watershed protection, can be further explored in the *Quantifying Replenish Benefits in Community Water Partnership Projects* report, which was prepared for The Coca-Cola Company by LimnoTech in collaboration with The Nature Conservancy.[294]

Key leverage point for investments in watershed protection.

Within the *Water Stewardship CLD,* the variable serving as the key leverage point for investments in watershed protection is the habitat quality variable. The habitat quality variable is defined as, "the quality of both terrestrial and aquatic habitats, including both undeveloped and developed areas." This variable is located in the natural capital model and is causally related to ecological replenishment, ecosystem services and water quality.

The first-first order causes influencing habitat quality are ecosystem services and water quality. As ecosystem services increase, habitat quality increases. Similarly, as water quality increases, habitat quality increases. The first-order consequences associated with the habitat quality included ecosystem services and ecological replenishment. Notice that there is a positive feedback loop existing between habitat quality and ecosystem services. As habitat quality increases, ecosystem services increase, which ultimately enables habitat quality to be positively reinforced. In addition to influencing ecosystem services, habitat quality is also positively linked to ecological replenishment. As habitat quality increases, ecological replenishment increases, which has a positive influence on the quantity of water available and the final natural capital stock. This relationship can be observed in

Table 51 in Appendix D, which showcases the first-order causes and consequences of habitat quality. Furthermore, a cause tree showing the first and second-order consequences linked to the habitat quality leverage point is included to start tracing pathways to value from investments in watershed protection.

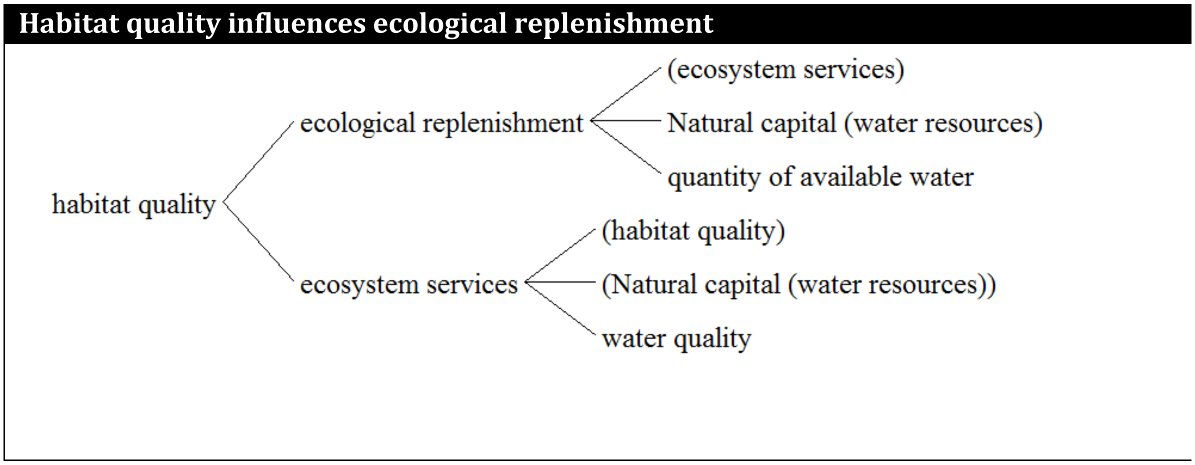


Figure 51. Habitat quality builds natural capital.

In the following section, key feedback loops that contain and are influenced by the habitat quality leverage point have been included to demonstrate how investments in watershed protection can change the behavior of strong feedback loops in the *Water Stewardship CLD.* The polarity of each feedback loop (balancing or reinforcing) has been included in the description to understand the behavior of the loop.

Discussion.

Investments in watershed protection are predominantly useful in balancing feedback loops that contain the natural capital stock. These loops often rely on the availability of natural capital, and the activities within the loops ultimately decrease the availability of natural capital. Investments in watershed protection function in the system by influencing the habitat quality variable, which ultimately increases ecological replenishment, and increases the quantity of water available, which regenerates the natural capital stock. Overall, investments in watershed protection require the use of multiple variables to intervene in the *Water Stewardship CLD*. Together; these variables form a positive, reinforcing feedback loop that can be meshed with a negative, balancing feedback loop to influence its behavior. Ultimately, the investment in watershed protection has the ability to change the behavior of the balancing feedback loop that is dependent on the natural capital stock, by increasing the availability of natural capital.

An example of this relationship is illustrated below using a loop that was introduced earlier.

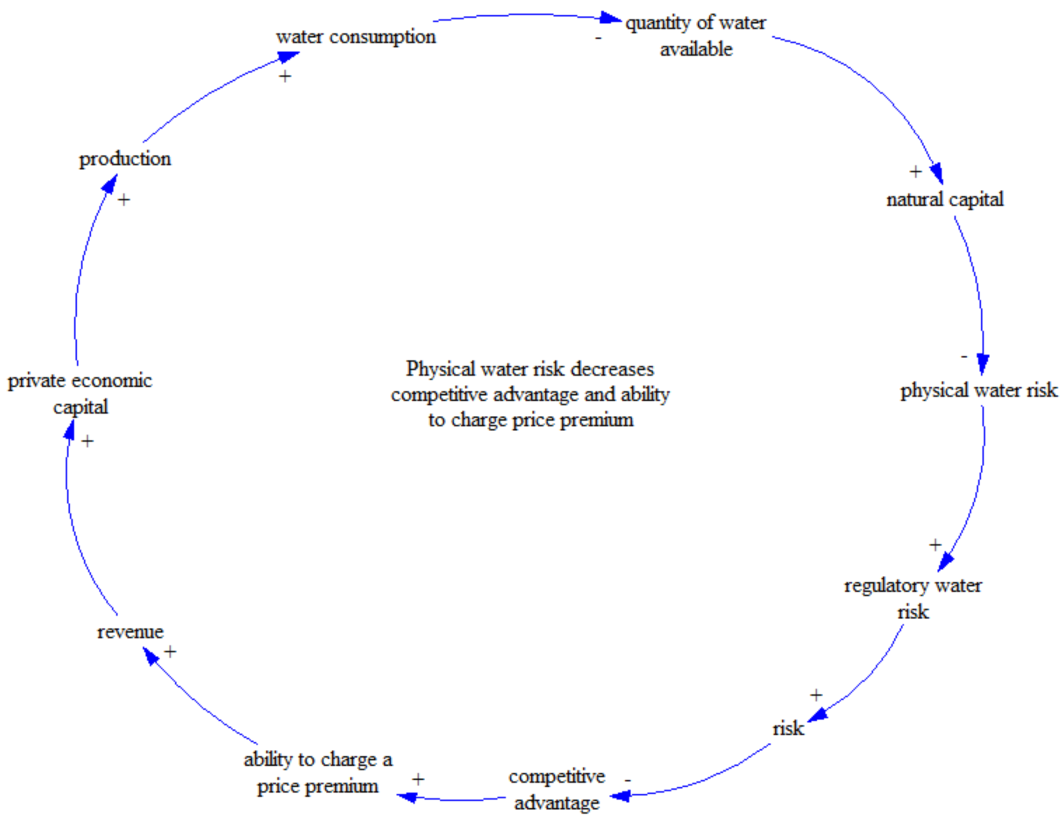


Figure 52. Example of balancing loop that could benefit from investments in watershed protection.

In this loop, production consumes water, which decreases the quantity of water available, and ultimately decreases the total natural capital available. When the rate of water withdrawal surpasses the rate of replenishment, water stress is manifested. This decrease in natural capital is manifested as physical water risk and regulatory water risk, which has numerous impacts on business and society.

To change the behavior of this balancing loop, the positive, reinforcing, watershed protection intervention is added to increase the quantity of water available, which ultimately increases natural capital. Together, the watershed protection loop and the loop showcasing the relationship between production and water risk, can function in a manner where the rate of water replenishment is greater than or equal to the rate of withdrawal.

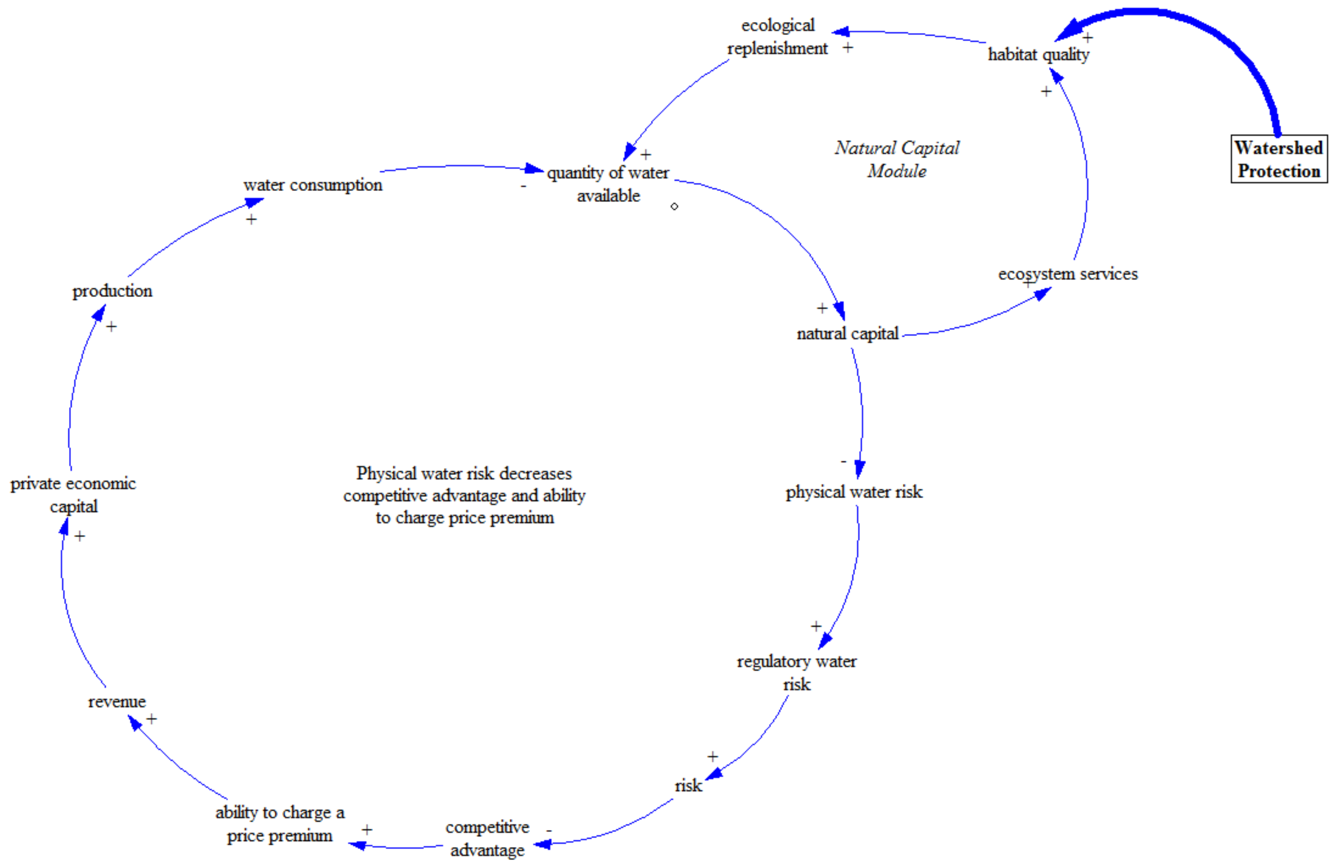


Figure 53. Positive, reinforcing, investments in watershed protection can counterbalance depletion of natural capital.

Overall, investments in watershed protection can influence water-related risk, supply chain security, competitive advantage, and the firm's ability to secure a social license to operate to continue production. Without investing in watershed protection to build natural capital, vital inputs, or stocks, needed for production (natural capital) can be adversely affected. Investing in watershed protection is vital as, ""Global water use has been growing at more than twice the rate of population in the last century." Furthermore, by 2025, two-thirds of the world's population will be experiencing water stressed conditions and 1.8 billion people will be living in countries or regions with absolute water scarcity."[295] According the UNEP, In Africa, it is expected that 75 to 250 million people will be living in areas with water stress by 2020, which reinforces the need to invest in watershed protection to avoid social risks associated with water scarcity and lack of watershed protection.

Water, sanitation and hygiene.

According to the World Health Organization, nearly 1 billion people lack access to an improved drinking water resource and 2.5 billion people lack access to improved sanitation.[296] Drinking water resources are considered improved when they are adequately protected from external contamination and individuals have reliable access to 20 liters of water less than 1 kilometer from its place of use.[297] Similarly, sanitation facilities are considered improved when the infrastructure hygienically separates human waste from human contact.[298] The CDC has stated that, "global access to safe water, adequate sanitation and proper hygiene education can reduce illness and death from disease, leading to improved health, poverty reduction and socio-economic development."[299]

The Replenish Africa Initiative (RAIN) is improving access to sustainable clean water for 6 million people in Africa by the end of 2020. RAIN is also actively improving sanitation and hygiene infrastructure and behaviors in beneficiary communities for positive impacts on health and development. Today, nearly 90% of RAIN projects have WASH components.[300] The Coca-Cola Africa Foundation's recent $35 million commitment to RAIN at the World Water Forum in Daegu, South Korea builds on their original investment of $30 million to launch the program in 2009.[301] This expansion, along with $50 million in co-finance and the support of more than 140 partners,[302] will enable RAIN to improve water access for 6 million people, economically empower up to 250,000 women and youth, and return 18.5 billion liters of water to nature and communities by the end of 2020.[303] To date, RAIN has reached more than 1.5 million people with sustainable clean water access.

Table 8. Examples of improved and unimproved water and sanitation infrastructure.

Improved sources of drinking-water	**Improved sanitation**[304]
Piped water into dwelling	Flush toilet
Piped water to yard/ploy	Piped sewer system
Public tap or standpipe	Septic tank
Tube well or borehole	Flush/pour flush to pit latrine
Protected dug well	Ventilated improved pit latrine
Protected spring	Pit latrine with slab
Rainwater	Composting toilet
Unimproved sources of drinking-water	**Unimproved sanitation**
Unprotected spring	Flush/pour flush to elsewhere
Unprotected dug well	Pit latrine without slab
Cart with small tank/drum	Bucket
Tanker-truck	Hanging toilet or hanging latrine
Surface water	
Bottled water	No facilities or bush or field

RAIN uses a standard of at least 20 liters of clean water per person per day from a supply within one kilometer or 30 minutes of round trip travel time (including queuing) of the user's dwelling. In contexts with limits on water access (e.g., schools and clinics)

RAIN uses a standard of five liters per person per day. These standards are in line with recommendations from leading organizations including the WHO and UNICEF.

Key leverage point for investments in water sanitation, and hygiene (WASH). Within the *Water Stewardship CLD,* the key leverage point for investments in WASH is the equitable access to water and sanitation facilities variable. The equitable access to water and sanitation facilities variable is defined as, "the extent to which both clean, safe drinking water and improved sanitation facilities and infrastructure are available and easily accessible by all members of a society." This variable is located in the social and human capabilities module and is causally related to multiple variables. The first-order causes influencing equitable access to WASH are the availability and access to infrastructure variable, and natural capital. Similarly, the first-order consequences stemming from equitable access to clean water and sanitation facilities is fulfillment of basic needs and equity and rights.

These relationships can be observed in Table 25, which showcases some of the first-order causes and consequences of equitable access to clean water and sanitation facilities. Furthermore, cause trees showing the first and second-order causes and consequences associated with the equitable access to WASH leverage point are included to start identifying pathways to value from investing in water, sanitation, and hygiene.

First and second-order causes of equitable access to clean water and sanitation

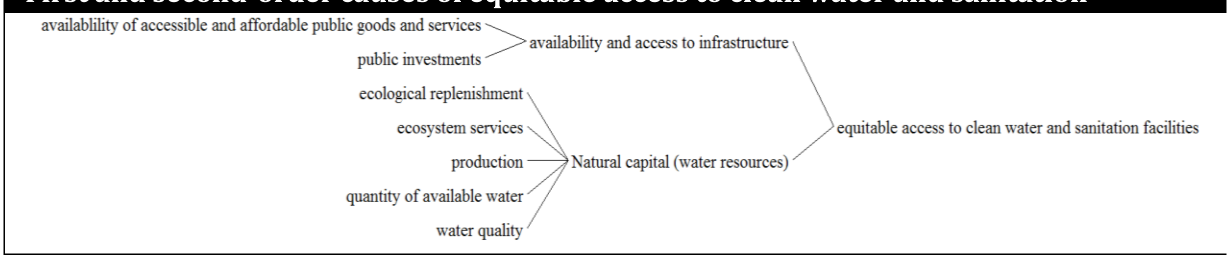


Figure 54. Natural capital and availability and access to infrastructure are needed to provide equitable access to WASH

First and second-order consequences stemming from equitable access to clean drinking water and sanitation

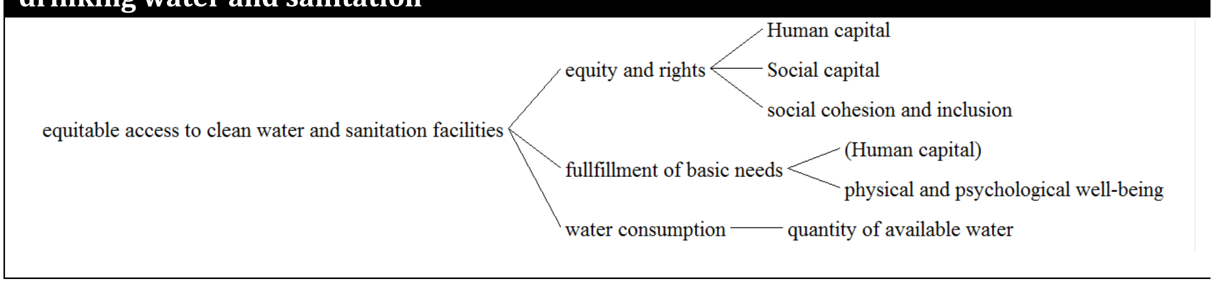


Figure 55. Equitable access to WASH increases builds human capital.

Water for productive use.

In the broadest sense, water productivity relates to the net socioeconomic and environmental benefits achieved through the use of water for agriculture, livestock, crops, agro-forestry and mixed systems.[305] According to Coca-Cola, the Replenish Africa Initiative programs that focus on providing water for productive use function to promote efficient and sustainable use of water for economic development. [306]

Some examples of water for productive use projects include irrigation system improvements (conversion of flood irrigation to drip irrigation), rainwater harvesting, water reuse, and repairing identifiable leaks. Details pertaining to specific water for productive use investments and corresponding benefits can be further explored in the *Quantifying Replenish Benefits in Community Water Partnership Projects* report which was prepared for The Coca-Cola Company by LimnoTech in collaboration with The Nature Conservancy.[307]

Key leverage point for investments water for productive use.

Within the *Water Stewardship CLD,* the key leverage point explored for investments in water for productive use is the fulfillment of basic needs variable. The fulfillment of basic needs variable is defined as, "the extent to which basic human needs, such as food, water, clothing, shelter, and security are fulfilled for all members within a society or region." This variable is located in the social and human capabilities module and is causally related to multiple variables.

The first-order causes influencing the fulfillment of basic needs leverage point is equitable access to clean water and sanitation facilities, income, and the availability of accessible and affordable public goods and services. Similarly, the first-order consequences stemming from fulfillment of basic needs is human capital, and physical and psychological well-being.

These relationships can be observed in Appendix D in Table 52 which showcases the first-order causes and consequences associated with the fulfillment of basic needs leverage point. Cause trees showcasing the first and second-order causes and consequences of fulfillment of basic needs are also included to start identifying pathways to value from investing in water for productive use.

Following the cause-trees, key feedback loops that contain and are influenced by the equitable access to WASH and fulfillment of basic needs variables have been included to demonstrate how investments in WASH and water for productive use can change the behavior of strong feedback loops in the *Water Stewardship CLD.* The polarity of each feedback loop (balancing or reinforcing) has been included in the description to understand the behavior of the loop.

Figure 56. Equitable access to clean water and sanitation facilities and income enable the fulfillment of basic needs.

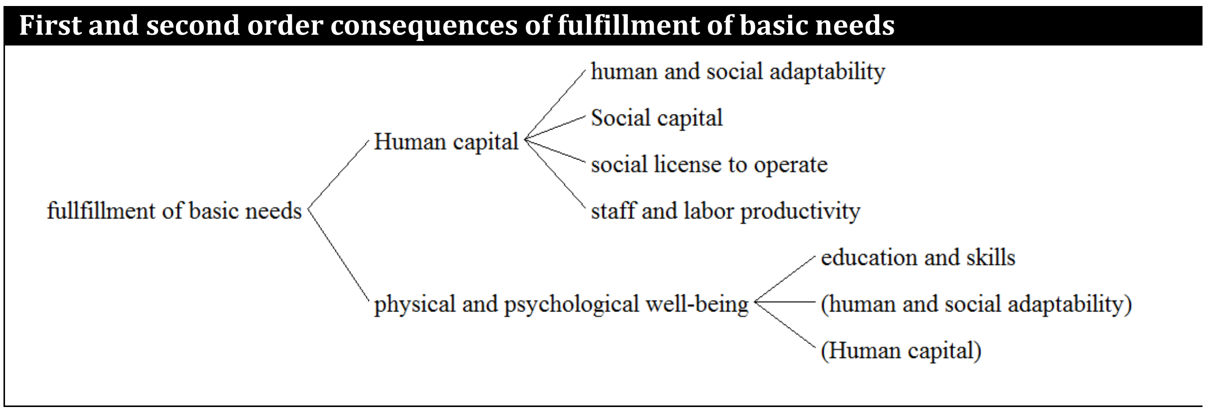


Figure 57. Fulfillment of basic needs improves physical and psychological well-being and builds human capital.

Discussion.

Within this analysis, water for productive use investments were specifically examined in the context of sustainable agriculture projects. It is important to note that water for productive use investments can also help provide fulfillment of basic needs through urban leak repair, which reduces the amount of water lost during distribution from source to tap. Overall, investments in WASH and investments in water for productive use follow similar pathways to value. Investments in WASH increase equitable access to water and sanitation, which ultimately reinforces the fulfillment of basic needs variable. Similarly, investments in water for productive use, specifically investments in sustainable agriculture, can increase agricultural productivity, which increases food access, and ultimately reinforces fulfillment of basic needs.

In the *Water Stewardship CLD,* fulfillment of basic needs is positively linked to physical and psychological well-being. Therefore, when basic needs are fulfilled, communities are healthier and have a higher well-being, which can cause other positive societal, social, and human capital consequences. In the *Water Stewardship CLD,* increased physical and psychological well-being is consequentially linked to increased education and skills, which influences income and drives household economic capital.

Furthermore, increasing education and skills can also increase human and social adaptability, which ultimately builds human capital and increases productivity.

An example of the relationship between education and skills, human capital, societal economic value, and firm value can be examined in the feedback loops illustrated in Figure 102 through Figure 109 (located in Appendix D) which shows the relationship between human capital and business value. To demonstrate how water-related, corporate social investments can build human capital and drive firm value, WASH and water for productive use investments were incorporated into the loops to trace pathways to value for people and profits. In addition to increasing productivity and reducing costs of labor inputs for the firm, these corporate social investments can also build firm value as corporate investments to build human capital are also linked to the firm's ability to secure and maintain a social license to operate.

Finally, one implication of WASH interventions and water for productive use interventions is that increasing the number of people with equitable access to WASH and water for productive use can increase water consumption. However, depending on the context of the investment, some can also increase the quantity of water available by decreasing the amount of water lost to the environment from leaks in the distribution system.

Overall, there are numerous societal economic, and social and human capital benefits associated with obtaining equitable access to WASH and increasing water for productive use. However, understanding that these interventions can potentially increase water consumption, and decrease the finite stock of natural capital available, it is important to make simultaneous investments in watershed protection to facilitate ecological replenishment and reinforce the quantity of water available, which will help ensure long-term availability of natural capital for communities and business.

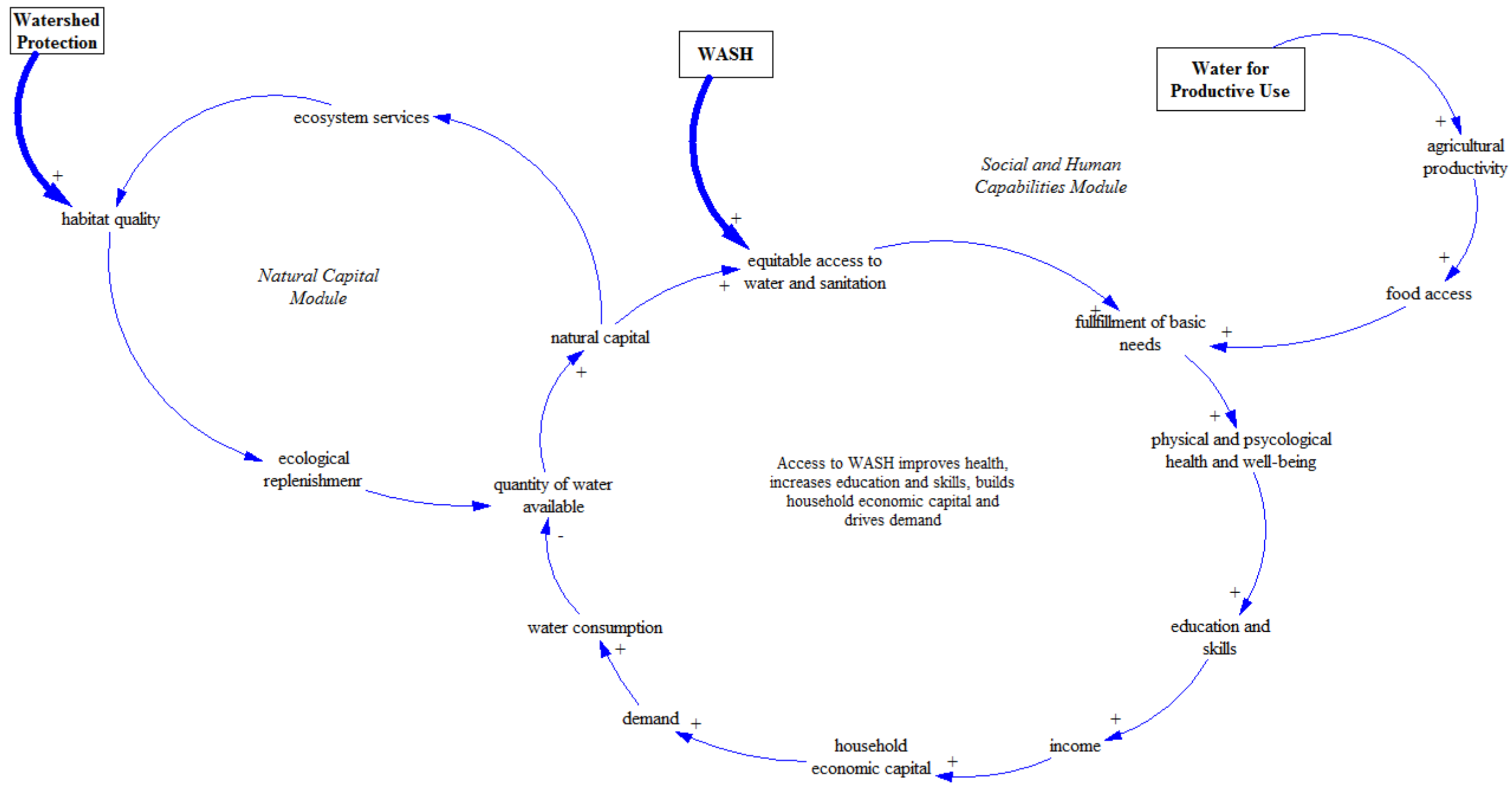


Figure 58. Investing in WASH, water for productive use, and watershed protection simultaneously can help balance complex systems that are dependent on water resources.

Overall, investments in water for productive use and sustainable agriculture have potential to create environmental, social and economic value. Social value can be generated from increased food security, which helps fulfill basic needs and improve physical health. Furthermore, household economy can benefit as farmers are provided with access to improved irrigation and watering infrastructure to sustain crop and livestock production. Finally, environmental value can be generated as the quantity of water that is withdrawn annually for agriculture can potentially decrease from investments in water for productive use and sustainable agriculture. Furthermore, these strategic investments in water stewardship can enable greater quantities of water to be allocated toward domestic and industrial uses, which can facilitate the generation of social and business value.

Ultimately, decreasing the quantity of water utilized by agriculture, through investments in water for productive use and sustainable agriculture, can mitigate potential physical risks and reputational risks that could be imposed on businesses that are interested in operations or sourcing supplies from an agriculturally dominated country. Reducing physical water risks through stewardship can help ensure, long-term, sustainable availability of water resources to support operations and supply chains, while also reducing any reputational challenges that could stem from adding industrial users to the finite water supply. Furthermore, in consideration of population growth and domestic water needs/food security needs, investments in sustainable agriculture and water for productive serves as a proactive risk management strategy to ensure long-term availability of water resources for domestic, agricultural, and industrial users towards the future.

In conclusion, tracing water-related investments through the *Water Stewardship CLD* helps illustrate pathways to creating shared value through investing in watershed protection, water for productive use, and WASH. Overall, the programmatic areas that are being implemented through the Replenish Africa Initiative do have the potential to create positive value in *the Water Stewardship CLD* for people, profits and the planet. However, it is important to consider the importance of simultaneously implementing watershed protection programs with WASH and water for productive use programs, to offset the potential unintended consequences that increasing WASH and water for productive use can have on natural capital.

Additional leverage points that could be explored in the *Water Stewardship CLD and* the Replenish Africa Initiative are discussed in the following section.

Additional leverage points.

In the context of complex systems, a leverage point refers to a location in the structure of the system where a solution or an intervention can be applied to change the behavior of the system. A high leverage point is one in which a small amount of change causes a large change in system behavior, and a low leverage point is one in which a small amount of change causes a small change.[308] For example: if the goal was to change the direction a ship was headed in, a low leverage point could be pushing on the side of the ship, while a high leverage point would be moving the rudder by spinning the wheel.[309] Higher level leverage points, by virtue of their ability to effect wider systems-level change, are the target to aim for, especially with regard to deeply rooted systemic problems.

When attempting to address problems associated with limited access to and use of sustainable solutions for clean drinking water and improved sanitation facilities, low leverage solutions may be effective in reducing the 'symptoms,' of the problem, but have less chance of creating sustainable long-term solutions. That is, low leverage solutions may increase access and use in the short-term (and possibly even the longer-term), but are less likely to address the root causes of the problem. If the root causes of the problem remain unaddressed, then the sustainability of the solution may be significantly undermined, or worse, further problems may unexpectedly arise.

Based on the list of general leverage point categories proposed by Meadows,[310] the report team has outlined several solutions that could be implemented within the context of water stewardship. The list of leverage points (in decreasing order of effectiveness)[311] is restated below for reference.

1. Transcending paradigms (becoming unattached to any one particular paradigm)
2. The mindset or paradigm out of which the system – its goals, structures, rules, delays, parameters – arises
3. The goals of the system
4. The power to add, change, evolve, or self-organize system structure
5. The rules of the system (such as incentives, punishments, constraints)
6. The structure of information flows (who does and does not have access to what kinds of information)
7. The gain around driving positive feedback loops
8. The strengths of negative feedback loops, relative to the impacts they are trying to correct against
9. The lengths of delays, relative to the rate of system change
10. The structure of material stocks and flows (such as transport networks, population age structures)
11. The sizes of buffers and other stabilizing stocks, relative to their flows
12. Constants, parameters, numbers (such as subsidies, taxes, standards)

Water stewardship programs, such as Coca-Cola's RAIN program, are in fact already making use of some of these solutions, and a few such instances are highlighted below. This list aims to describe the leverage points and highlight RAIN's use of several and should not be considered an evaluation, recommendation or case study on how RAIN aligns with these leverage points. The leverage point categories are presented in increasing order (i.e., #12 is the lowest leverage category, increasing up to #2, the highest category with an identified solution. Solutions closer to #2 are more likely to address root causes than solutions closer to #12). Please note that the list that follows is by no means exhaustive, and many more potential solutions remain un-described.

12. Numbers: constants and parameters such as subsidies, taxes, and standards[312]

a) *Set internal price for water*: establishing an internal regional price for freshwater that better reflects actual scarcity and internalizes previous externalities. Similar to the way many companies have set an internal price on carbon even in the absence of a market price. Incorporating this internal price on water into shadow profit and loss statements, as in the example of Puma,[313] could reduce all forms of water-related risk: physical, regulatory, and reputational, as well as potentially establishing a company as an innovator and leader in the area of water resources management.

b) *Increase funding for water stewardship programs*: more funding for water stewardship programs, whether from a company itself, co-funding partners, government partners, or other sources could increase the pool of resources that can be brought to bear on the water crisis. *Addressed by TCCAF's recent announcement of additional RAIN funding through 2020, along with TCCAF's goal of securing 2:1 matching funds on future programs.*

c) *Raise minimum standards*: higher minimum standards for the number of people with access to clean drinking water and improved sanitation facilities (government standards, program standards, donor standards, NGO standards, etc.)

d) *Raise efficiency standards*: higher minimum standards for freshwater use efficiency in industrial and/or agricultural processes as well as for new or existing buildings. *Currently part of the RAIN program under the water for productive use category.*

11. Buffers: The sizes of stabilizing stocks relative to their flows

a) *Withdraw only from secondary buffer*: instead of withdrawing water directly from groundwater aquifers (where applicable), establish or use a secondary freshwater containment mechanism, either naturally occurring or artificially constructed. Freshwater from a rainwater catchment system could also supplement this stock to further reduce the burden on groundwater. This secondary containment would act as a buffer, and reduce risks to groundwater from sudden or unexpected changes in water demand or supply.

10. The structure of material stocks and flows and nodes of intersection (such as transport networks, population age structures, flow of nitrogen through soil)[314]

a) *Build more WASH infrastructure*: increasing the available infrastructure for clean drinking water and for sanitation facilities, including water distribution systems, sewerage networks, wastewater treatment systems and investments in reducing non-revenue water. *Many RAIN projects take this approach, through partnerships with local governments and utilities, which have the ultimate responsibility for service.*

9. The lengths of delays, relative to the rate of system changes[315]

a) *More frequent data collection*: increasing the frequency of data collection activities would provide more current data to decision-makers and project managers, and could serve as an opportunity to connect with relevant stakeholders and solicit their feedback. *As RAIN works with utilities in peri-urban and urban settings, its access to data is increasing.*

b) *More frequent progress reviews*: conducting more frequent progress evaluations with project managers and administrators, with donors, and with end-users could reduce the delay in identifying obstacles and challenges, increasing the responsiveness of project management. *Currently, GETF conducts weekly reviews with implementation partners and provides monthly reports to TCCAF.*

8. The strength of negative feedback loops, relative to the impacts they are trying to correct against[316]

a) *Monitoring systems:* establish permanent freshwater data monitoring and logging systems at key locations, capable of capturing relevant data points such as information on water quality and flow rate or aquifer volume. The collected data could be used by a business to dynamically respond to changes in the freshwater supply, or within water stewardship programs to both assess community needs as well as monitor important ecosystem attributes. Further, as data of this sort is notoriously limited throughout much of the African continent, the data from such a monitoring system could be used by researchers around the world or even become a revenue stream.

b) *Negative impact fees or pollution taxes:* paying fees or taxes for negative impacts and freshwater-related externalities would create or strengthen a balancing feedback loop, limiting the externalities as well as providing funding for possible solutions. In areas without strong governance systems, the internal price on water could be used as a basis to self-impose impact fees. The funds raised in this manner could also be automatically channeled into water stewardship programming.

7. The gain around driving positive feedback loops[317]

a) *Soil improvement*: incorporating soil improvement activities, into new or existing programmatic solutions could reduce negative impacts to water quality, improve habitat quality, increase biodiversity, enhance ecosystem services, or enable greater agricultural productivity. Soil quality is part of a reinforcing feedback loop: as soil quality goes down, erosion increases, which means it can support less vegetation, which leads to more runoff, and in turn more erosion and worse soil quality. Thus, decreasing the power of this feedback loop could be a powerful means to improve freshwater resources and natural capital, as well as contribute to social value through agriculture or any of a variety of ecosystem services. *Certain RAIN projects, such as RAIN Burkina Faso, have incorporated soil improvement initiatives either directly or indirectly.*

b) *Lobby governments for greater equity*: individuals and groups that are wealthy or powerful tend to be able to secure the means for more wealth and more power far easier than do those who lack wealth or power. This is a systems structure known as "success to the successful." Anti-poverty programs, or programs designed to improve access to water and sanitation, can be thought of as "weak negative loops that try to counter these strong positive ones."[318] Rather than focus all attention on these weaker negative loops, "[i]t would be much more effective to weaken the positive loops."[319] One way to work towards weakening the positive loops is to lobby governments for greater equity and less biased treatment towards the impoverished. *Certain RAIN projects have included an advocacy component, for instance working with utilities to expand service into impoverished areas.*

c) *BoP market strategies*: economically empower people towards the base of the economic pyramid (BoP) by designing innovative market based interventions and solutions. Taking this approach, if done successfully, can yield powerful results: creating a sustainable funding source for WASH interventions, and economically empowering beneficiaries while also creating goodwill towards the company – a situation which could easily lead to greater sales, greater customer loyalty, and greater profitability. If designed and executed successfully, this could create a virtuous cycle.

6. The structure of information flows (who does and does not have access to information)[320]

a) *Dynamic water pricing*: providing information to the users of an aquifer regarding the quantity and quality of available water can be an important first step and enable more effective and responsive resource management. However, a "tragedy of the commons" scenario could easily develop, in which informing users of a dropping water level sparks a race to the bottom. Instead, setting a dynamic water price that rises steeply as the pumping rate begins to exceed the recharge rate would be more effective.[321]

b) *Require intake to be downstream from outflow*: require industrial plants that source freshwater from rivers to locate water intake pipes immediately downstream from their own outflow pipes. This would create an immediate and powerful incentive to reduce pollution externalities.[322]

5. The rules of the system (incentives, punishments, constraints)[323]

a) *Local accountability*: while end-users of drinking water or sanitation solutions may have at best only a limited ability to hold local, regional, or national governance structures accountable, large companies are likely to have considerably greater influence. Accordingly, using that influence to encourage governance institutions (perhaps through lobbying or active political support or opposition) to account for the needs of those who have been underserved or marginalized (and thus have suffered from limited water and sanitation access) could create a significant incentive for those institutions to become more inclusive and promote greater equity in resource allocation. *RAIN projects often engage governments during implementation and leverage The Coca-Cola Company's convening power to secure government support.*

4. The power to add, change, evolve, or self-organize system structure[324]

a) *Sponsor resource governance institutions:* sponsor culturally appropriate local, regional, or trans-boundary water resource governance institutions. Sponsorship could include any number of approaches, such as providing access to relevant and timely water monitoring data, providing access to experts and decision-makers, encouraging the autonomy and supporting an official mandate for such a group or institution, or providing trained facilitators and guidance. In this way, local water consumers (or their representatives) could be empowered to self-organize and develop their own systems for the management and governance of freshwater resources.

3. The goals of the system[325]

a) *Create or shift policy towards focus on shared value*: change corporate strategy to no longer approach water stewardship projects as strictly philanthropic endeavors (if applicable). While some businesses approach water stewardship in this way, the shared value paradigm advises businesses to pursue activities that simultaneously benefit both business and society. This would mean pursuing WASH-related projects (or other water stewardship projects) as a means to creating long-term business value, rather than only doing so as a philanthropic activity. Further clarifying that the business is only one out of many stakeholders, and that its interests do not override or take precedence over the interests of other stakeholders could provide one balancing mechanism to prevent excessive focus on creating business value.

    i. *Give end-users oversight authority*: if left unchecked and unregulated, a corporation may very well move to eliminate all competition.[326] However, balancing feedback loops typically prevent this from happening. Similarly, ensuring that robust and reliable information feedback is accessible, and then making it so that the beneficiaries of a project have oversight authority over a corporate funded or sponsored project could be one mechanism to balance competing interests. In this way, projects may be prevented from straying too far towards creating only business value (and neglecting social value) or too far towards creating only social value (and neglecting business value). *RAIN projects work with a local steering committee composed of community members who have the ability to provide input on project implementation.*

2. The mindset or paradigm out of which the system — its goals, structure, rules, delays, parameters — arises[327]

a) *Non-anthropocentric paradigms:* while admittedly more abstract than the previous interventions, finding ways to promote worldviews that are less anthropocentric (for example, more bio-centric paradigms, which do not reduce the natural world down to simple inputs for human purposes)[328] is one way to shift mindsets away from freshwater exploitation, towards more balanced management of water resources. For instance, this could be attempted by offering lectures or discussions on such topics.

Intersection of spatial assessments and value creation model.

After identifying and mapping the social, environmental and economic risks and opportunities on the African continent in the Spatial Assessments section of this report, areas with high water risk and high economic opportunity were identified in order to suggest appropriate water-related investments that have the potential to drive shared value for the economy, the environment, and society.

In order to characterize pathways to value from water-related investments, the social, economic and environmental landscape of the top 10 most 'globally competitive' countries in Africa were explored. These countries were determined using data from the World Economic Forum's Global Competiveness Report for 2014-2015.[329] Additionally, the environmental, social and economic context associated with eight additional countries that were listed by The World Bank as the top 10 countries in Africa for Ease of Doing Business, and Africa's top 10 countries for investment according to consulting firm KPMG were also analyzed.[330, 331] Additional countries were included in this analysis due to their promising economic potential, and the opportunity to help improve their global competitiveness through water-related investments.

Top 10 most 'globally competitive' countries in 2014-2015[332] (In descending order)

1. **Mauritius** - Top 10 Ease of Doing Business and Top 10 for Investment list
2. **South Africa -** Top 10 Ease of Doing Business and Top 10 for Investment list
3. **Rwanda-** Top 10 Ease of Doing Businesses list
4. **Morocco**
5. **Botswana**- Top 10 Ease of Doing Business and Top 10 for Investment list
6. **Algeria**
7. **Tunisia**
8. **Namibia**- Top 10 Ease of Doing Businesses list
9. **Kenya** - Top 10 Ease of Doing Business and Top 10 for Investment list
10. **Seychelles**- Top 10 Ease of Doing Businesses list

Additional countries that were not in the top 10 for global competitiveness include:

- **Zambia**- Top 10 Ease of Doing Business list (#11 in World Economic Forum's Global Competiveness ranking)
- **Ghana-** Top 10 Ease of Doing Business and Top 10 for Investment list (#14 in World Economic Forum's Global Competiveness ranking)
- **Ethiopia-** Africa's Top 10 for Investment (#19 in World Economic Forum's Global Competiveness ranking)
- **Tanzania**- Africa's Top 10 for Investment (#21 in World Economic Forum's Global Competiveness ranking)
- **Uganda-** Top 10 Ease of Doing Business list (#22 in World Economic Forum's Global Competiveness ranking)

- **Nigeria**- Africa's Top 10 for Investment (#27 in World Economic Forum's Global Competiveness ranking)
- **Mozambique-** Africa's Top 10 for investment(#31 in World Economic Forum's Global Competiveness ranking)
- **Angola-** Africa's Top 10 for Investment (#35 in World Economic Forum's Global Competiveness ranking)

In order to determine the potential to create shared value through water-related investments in the aforementioned countries, spatial assessments were conducted to understand baseline environmental, social, and economic conditions in each of the countries. Elements considered in the spatial assessments include:

Social & Economic

- Global competitiveness, using the World Economic Forum's Global Competitiveness Index (GCI)
- Ease of doing business and Africa's top 10 for investment from KPMG
- Demographic data on total population, urban population and rural population
- Data on the number of pupils in primary schools and the percentage of female pupils
- Social capacity-- using a composite, Social Capacity Index (SCI)
- Percentage of total population with access to improved sources of water
- Percentage of rural and urban population with access to improved sources of water
- Percentage of total population with access to improved sanitation
- Percentage of rural and urban population with access to improved sanitation
- Benefit to cost ratio for investments in drinking water and sanitation, respectively

Environmental

- State of freshwater resources, using a composite State of Freshwater Resource Index (SOFI)
- Total annual water withdrawal
- Percentage of total annual water withdrawal dedicated to agricultural, domestic and industrial uses
- Average Precipitation in depth (mm per year)
- Upstream watershed protection (mapped quantitatively at basin level and discussed qualitatively)
- Agricultural land (sq. km) and percentage of land area devoted to agricultural uses

Data was collected on these elements due to their potential to illustrate opportunities for investment in water stewardship in Africa. The ultimate goal is to analyze environmental, social and economic data on a country level for the 18 countries that were deemed the most emergent economically and the most ripe for business investments. This analysis enabled specific water-related investments to be prioritized, while shedding light on opportunities to maximize shared value creation for the environment, society, and business.

The specific water stewardship-related investments that will be discussed in this section include:

1. Water for productive use/sustainable agriculture
2. Water, sanitation and hygiene (WASH)
3. Watershed protection

Investing in water for productive use and sustainable agriculture

When analyzing potential to create value from investments in water for productive use and sustainable agriculture in Africa's top 10 most globally completive nations, the top 10 for ease of doing business, and Africa's top 10 for investment, the following countries were in the top 10 for most agricultural land (sq. km) in Africa, greater than 50% percent of land area dedicated to agriculture, and the top 10 for highest percent of total annual water withdrawal dedicated to agriculture.

Table 9. Countries in the top 10 for most agricultural land (sq. km) in Africa

Country	Rank	Agricultural land (sq. km)
South Africa	#2	963,410
Nigeria	#3	720,000
Angola	#4	561,900
Mozambique	#5	499,500
Algeria	#10	414,320

Table 10. Countries with greater than 50% of land area dedicated to agriculture

Country	Total land dedicated to agricultural uses (%)
South Africa	79.41 %
Nigeria	79.05%
Rwanda	75.26%
Uganda	71.37%
Ghana	68.99%
Morocco	68.12%
Tunisia	64.87%
Mozambique	64.51%

Table 11. Countries in the top 10 for highest percent of total annual water withdrawal dedicated to agriculture

Country	Rank	Total annual water withdrawal dedicated to agricultural uses including livestock and irrigation (%)
Ethiopia	#7	93.73%
Tanzania	#10	89.35%

Table 12. Countries with over 50% of total annual water withdrawal dedicated to agriculture

Country	Total annual water withdrawal dedicated to agricultural uses - livestock and irrigation (%)
Morocco	87.31%
Kenya	79.16%
Mozambique	78.04%
Tunisia	75.96%
Zambia	73.28%
Namibia	69.76%
Rwanda	68%
Mauritius	67.72%
Ghana	66.64%
South Africa	62.69%
Algeria	61.69%
Nigeria	53.75%

In conclusion, all of the countries listed above could benefit from investments in water for productive use or sustainable agriculture practices. However, of specific interest are South Africa, Nigeria and Mozambique. These countries are in the top 10 for the greatest sq. km of agricultural land in Africa, with over 50% of total land area dedicated to agriculture, and over 50% of total water withdrawals allocated to agricultural purposes, which includes irrigation and livestock watering. In addition to South Africa, Nigeria and Mozambique, of secondary interest are: Namibia, Ethiopia, Kenya and Morocco, which could also benefit from investments in water for productive use and sustainable agriculture considering that over 50% of the country's total land area is dedicated to agriculture and over 50% of total water withdrawal is dedicated to agricultural uses.

Relevant data used to determine which countries to prioritize for investments in water for productive use and sustainable agriculture can be obtained by viewing Table 53 and Table 54 in Appendix D.

Investing in water, sanitation and hygiene (WASH)

When analyzing potential to create value from investments in *water, sanitation and hygiene* in Africa's top 10 most globally completive nations, the top 10 for ease of doing business, and Africa's top 10 for investment, data on the percent of the total population with access to improved sources of water indicated that only one country (Mauritius) had 100% of the total population with access to improved sources of water. Therefore, investments in water sanitation and hygiene, specifically improved drinking water access, have the potential to generate significant social value in Africa, especially considering that many of the countries are considered the top 10 most populous countries in Africa.

Table 13. Countries with less than 90% of total population with access to improved sources of drinking water

Country	Population in 2013 and percent with access to improved sources of water	Urban population and percent with access to improved sources of water	Rural population and percent with access to improved sources of water	Number of pupils in primary school and percentage of females
Mozambique	25,833,752 (49%)	8,181,291 (80%)	17,652,461 (35%)	5,359,019 (47.49% female)
Ethiopia	94,100,756 (52%)	17,493,331 (97%)	76,607,425 (42%)	14,532,477 (47.62% female)
Tanzania	49,253,126 (53%)	14,872,474 (78%)	34,380,542 (44%)	8,247,172 (50.45% female)
Angola	21,471,618 (54%)	9,123,290 (68%)	12,348,328 (34%)	5,026,803 (38.9% female)
Kenya	44,353,691 (62%)	10,990,845 (82%)	33,362,846 (55%)	7,150,259 (49.16% female)
Zambia	14,538,640 (63%)	5,819,381 (85%)	8,719,259 (49%)	4,105,913 (49.97% female)
Nigeria	173,615,345 (64%)	80,025,257 (79%)	93,589,099 (49%)	21,558,460 (46.66% female)
Rwanda	11,776,522 (71%)	3,164,234 (81%)	8,612,288 (68%)	2,394,674 (50.7% female)
Uganda	37,578,876 (75%)	5,801,051 (95%)	31,777,825 (71%)	8,098,177 (50.11% female)
Morocco	11,776,522 (84%)	19,540,825 (98%)	13,467,325 (64%)	4,021,052 (47.62% female)
Ghana	29,904,598 (87%)	13,660,790 (93%)	12,243,808 (81%)	4,105,913 (48.94% female)

After obtaining data on **percent of total annual water withdrawals dedicated to domestic uses** for 52 countries the following countries had over 25% of their of total water withdrawal dedicated to domestic uses

Table 14. Countries with over 25% of total annual water withdrawal dedicated to domestic uses

Country	Total annual water withdrawal dedicated to domestic uses (%)
Uganda	47.7%
Angola	41.05%
Seychelles	41.05%
Botswana	40.72%
Nigeria	31.27%
South Africa	31.23%
Mauritius	29.52%
Namibia	25.35%

After obtaining data on the benefit to cost ratio for investments in drinking water supply interventions, the following countries had the highest ratio

Table 15. Countries with the highest benefit to cost ratio for investments in drinking water supply interventions

Country	Benefit to cost ratio for investments in drinking water supply interventions
Ghana	5.8
South Africa	4.7
Nigeria	4.4
Mauritius	4.2

The only countries with a benefit cost ratio that was less than 2:1 for investments in drinking water supply interventions include:

Table 16. Countries with a benefit cost ratio of less than 2:1 for investments in drinking water supply interventions

Country	Benefit to cost ratio for investments in drinking supply interventions
Zambia	1.9
Uganda	1.7
Morocco	1.6
Rwanda	1.5
Tanzania	1.4
Ethiopia	0.8

The data utilized to determine the opportunity to create value from investments in improved access to drinking water supply for all of the countries included in this analysis can be obtained by viewing Table 55 and Table 56 in Appendix D. Demographic data to contextualize each country can be obtained by viewing Table 61.

Similarly, after obtaining data on the percent of the total population with access to improved sources of sanitation for 55 countries, none of the countries in the analyses had achieved 100% access to sanitation. Therefore, investments in water sanitation and hygiene, specifically improved sanitation, have the potential to generate significant social value.

The only countries with over 90% of their populations with access to improved sanitation are:

Table 17. Countries with over 90% of total population with access to improved sanitation

Country	Population in 2013 and percent with access to improved sanitation	Urban population and percent with access to improved sanitation	Rural population and percent with access to improved sanitation	Number of pupils in primary school and percentage of females
Seychelles	89,173 (97%)	No data	No data	8,695 (50.13% female)
Algeria	39,208,194 (95%)	27,253,616 (98%)	11,954,578 (88%)	3,451,588 (47.54% female)
Mauritius	1,296,303 (91%)	518,249 (92%)	778,054 (90%)	113,634 (49.18% female)
Tunisia	10,886,500 (90%)	7,234,732 (97%)	3,651,768 (77%)	1,046,671 (48.21% female)

Countries that scored considerably low for access to improved sanitation (75%) were**:**

Table 18. Countries with less than 75% of total population with access to improved sanitation

Country	Population in 2013 and percent with access to improved sanitation	Urban population and percent with access to improved sanitation	Rural population and percent with access to improved sanitation	Number of pupils in primary school and percentage of females
Tanzania	49,253,126 (12%)	14,872,474 (25%)	34,380,542 (7%)	8,247,172 (50.45% female)
Ghana	29,904,598 (14%)	13,660,790 (20%)	12,243,808 (8%)	4,105,913 (48.94% female)
Mozambique	25,833,752 (21%)	8,181,291 (44%)	17,652,461 (11%)	5,359,019 (47.49% female)
Ethiopia	94,100,756 (24%)	17,493,331 (27%)	76,607,425 (23%)	14,532,477 (47.62% female)
Nigeria	173,615,345 (28%)	80,025,257 (31%)	93,589,099 (25%)	21,558,460 (46.66% female)
Kenya	44,353,691 (30%)	10,990,845 (31%)	33,362,846 (28%)	7,150,259 (49.16% female)
Namibia	2,308,315 (32%)	1,029,098 (56%)	1,274,217 (17%)	415,454 (49.11% female)
Uganda	37,578,876 (34%)	5,801,051 (33%)	31,777,825 (34%)	8,098,177 (50.11% female)
Zambia	14,538,640 (43%)	5,819,381 (56%)	8,719,259 (34%)	4,105,913 (49.97% female)
Angola	21,471,618 (60%)	9,123,290 (87%)	12,348,328 (20%)	5,026,803 (38.9% female)
Rwanda	11,776,522 (64%)	3,164,234 (61%)	8,612,288 (64%)	2,394,674 (50.7% female)
Botswana	2,021,144 (64%)	1,140,799 (78%)	870,345 (42%)	330,775 (48.75% female)
South Africa	52,981,991 (74%)	33,796,152 (82%)	19,185,839 (62%)	7,004,482 (48.5% female)
Morocco	11,776,522 (75%)	19,540,825 (85%)	13,467,325 (63%)	4,021,052 (47.62% female)

After obtaining data on the benefit to cost ratio for investments in sanitation interventions, the following countries had the highest ratios

Table 19. Countries with the highest benefit to cost ratio for investments in sanitation interventions

Country	Benefit to cost ratio for investments in sanitation interventions
Angola	20.34
Mauritius	17.75
Botswana	16.31
Namibia	11.33
South Africa	7.49

The only countries with a benefit cost ratio that was less than 2:1 for investments in sanitation interventions include

Table 20. Countries with a benefit to cost ratio of less than 2:1 for investments in sanitation interventions

Country	Benefit to cost ratio for investments in sanitation interventions
Mozambique	1.71
Uganda	1.55
Tanzania	1.32

Data utilized to determine opportunities to invest in sanitation can be obtained by viewing Table 57 and Table 58 in Appendix D.

In conclusion, investments in water and sanitation have the opportunity to generate significant social, economic and environmental benefits in Africa. Of specific interest are Tanzania, Ethiopia, Nigeria, Kenya and Uganda. Regardless of the Benefit to Cost ratios determined by WHO, these countries should be prioritized for WASH investments because they are in the top 10 most populous countries in Africa, and less than 50% of the total population has access to improved sanitation facilities, and less than 75% of the total population has access to improved water sources. In addition to the high level of need and large populations, these countries were also included in the top 10 for Ease of Doing Business and Africa's top 10 for investment list by KPMG.[333]

Investing in watershed protection

When analyzing the potential to create value from investments in watershed protection in Africa's top 10 most globally completive nations, the top 10 for ease of doing business, and Africa's top 10 investment, the State of Freshwater Resources Index, the total quantity of water withdrawn annually, and average annual precipitation was considered to determine the value creation potential from investments in watershed protection. Most of the countries included in our analyses were actually in the bottom 50% for overall state of freshwater resources, which indicates that investments in watershed protection have the potential to create value within these countries to improve their overall state of freshwater resources.

Specific countries that ranked in the bottom 50% (out of 53) were:

Table 21. Countries in the bottom 50% for Overall State of Freshwater Resources

Country	Rank (out of 53)	Additional information
Seychelles	#53	
Mauritius	#49	
Algeria	#46	• Listed in bottom 50% for lowest average annual precipitation. • Ranked #7 for highest total quantity of water withdrawn with 5.723 billion cubic meters of water withdrawal annually. • Most water withdrawal is dedicated to agriculture (61.69%), followed by 24.4% dedicated to domestic uses and 14.58% dedicated to industry
Morocco	#45	• Listed in bottom 50% for lowest average annual precipitation. • Ranked #5 for highest quantity of water withdrawn with 12.51 billion cubic meters of water withdrawal annually. • Most water withdrawal is dedicated to agriculture (87.31%), followed by 9.81% dedicated to domestic uses and 2.85% dedicated to industry
South Africa	#44	• Listed in bottom 50% for lowest average annual precipitation. • Ranked #6 for highest quantity of water withdrawn with 12.5 billion cubic meters of water withdrawal annually. • Most water withdrawal is dedicated to agriculture (62.69%), followed by 31.23% dedicated to domestic uses and 6.048% dedicated to industry
Tunisia	#41	• Listed in bottom 50% for lowest average annual precipitation
Kenya	#38	• Listed in bottom 50% for lowest average annual precipitation
Namibia	#33	• Listed in bottom 50% for lowest average annual precipitation
Ghana	#32	
Tanzania	#30	• Ranked#10 for highest quantity of water withdrawn with 5.184 billion cubic meters of water withdrawal annually. • Most water withdrawal is dedicated to agriculture (89.35%), followed by 10.17% dedicated to domestic uses and 0.48% dedicated to industry
Nigeria	#29	• Ranked #4 for highest quantity of water withdrawn with 13.11 billion cubic meters of water withdrawal annually. • Most water withdrawal is dedicated to agriculture (53.75%), followed by 31.27% dedicated to domestic uses and 14.99% dedicated to industry
Angola	#28	
Rwanda	#26	

Of specific interest are Nigeria, Tanzania, South Africa, Morocco, and Algeria. All of these countries score in the bottom 50% for overall State of Freshwater Resources, and they were also in the bottom 50% for average annual precipitation. Furthermore, these countries were listed in the top 10 for highest total water withdrawal annually. These countries could reap significant benefits from watershed protection investments to help offset future challenges with water scarcity stemming from climate change, industrialization, economic growth and demographic transition. Additionally, when qualitatively looking at the level of upstream protection in these countries, the overall upstream protection of land in the watersheds is low. Algeria, Morocco and South Africa are particularly low, compared to Nigeria and Tanzania. Therefore investments in watershed protection have the potential to create significant value in these countries.

Information on opportunity to create value from investments in watershed protection for all of the countries included in this analysis can be obtained by viewing Table 59 and Table 60.

Case Study

The Replenish Africa Initiative: Corporate Community Programming

The Replenish Africa Initiative (RAIN) is a leading multi-stakeholder water stewardship partnership that will improve access to sustainable clean water for 6 million people in Africa by the end of 2020. As The Coca-Cola Africa Foundation's (TCCAF) flagship program, RAIN is building sustainable communities, catalyzing investment in clean water access, improving water and sanitation access for school children, and empowering women and youth through clean water access and entrepreneurship.

TCCAF's recent $35 million commitment to RAIN at the World Water Forum in Daegu, South Korea builds on their original investment of $30 million to launch the program in 2009.[334] This expansion, along with $50 million in co-finance and the support of more than 140 partners,[335] will enable RAIN to improve water access for 6 million people, economically empower up to 250,000 women and youth, and return 18.5 billion liters of water to nature and communities by the end of 2020.[336] To date, RAIN has reached more than 1.5 million people with sustainable clean water access.

RAIN programs can be organized into three categories:

- **Water, Sanitation and Hygiene (WASH) –** Improve access to water and sanitation and promote improved hygiene behaviors for positive impacts on health and development (Approximately 90 percent of RAIN projects have WASH components).
- **Watershed Protection –** Establish or enhance sustainable water management practices and improve environmental stewardship and community health.
- **Productive Use of Water –** Promote efficient and sustainable use of water for economic development.[337]

RAIN Water for Schools

Within the WASH investment category, one of the programs that functions to increase safe drinking water access and sanitation in Africa is the RAIN Water for Schools program, which is predominantly implemented in South Africa. In 2010, The Coca-Cola Africa Foundation and The Coca-Cola Company committed to providing water, sanitation, and hygiene programming in 100 schools throughout South Africa. In addition to these initial 100 schools, the Replenish Africa Initiative is sponsoring improved water and sanitation facilities in 100 additional schools throughout the rest of Africa, which will result in at least 200 total schools benefiting from Coca-Cola's corporate social investments.[338] According to The Coca-Cola Africa Foundation:

> "Many schools in South Africa do not have access to clean drinking water due to their remote location or lack of municipal supply infrastructure. In fact, contaminated drinking water and inadequate sanitation are major contributors

to Africa's high child mortality rate. Easily treatable waterborne illnesses also leave millions of children with chronic malnutrition. These associated health and environmental risks, together with the lack of appropriate facilities, generally result in high absenteeism rates in schools, especially among girls."[339]

WASH in schools programming in South Africa is particularly because of a number of factors:

- Population size
- School population
- Limited access to water and sanitation
- High benefit to cost ratio
- Etc.

According to World Bank Data, South Africa was the fifth most populous country in Africa with a population of 52,981,991. South Africa ranked second in urban population with 33,796,152 people living in urban centers compared to 19,185,839 rural dwellers. In addition to being ranked high for total population, South Africa is ranked number eight for the number of pupils in primary school, with 7,004,482 children enrolled. Only 48.5% of these pupils are female, which suggests opportunity to increase the enrollment of females to reach an even 1:1 enrollment ratio of females to males. Considering South Africa's large population, only 95% of the total population of 52,981,991 has access to improved water resources, with 88% of the rural population having access and 99% of the urban population having access. According to the World Health Organization, the benefit to cost ratio for investments in drinking-water interventions in South Africa is 4.7, In addition to drinking-water needs, only 74% of the total population of South Africa has access to improved sanitation, with 62% of the rural population having access to improved sanitation and only 82% of the urban population having access to improved sanitation. The benefit to cost ratio for investments in improved sanitation interventions in South Africa is 7.49, which suggests that investing in sanitation can yield a stronger return over time. RAIN Water for Schools in South Africa aims to help decrease the total percent of the population without access to improved water and sanitation facilities in schools, while also generating social and economic benefits from improving public health and increasing productivity. Associated social and economic goals associated with RAIN Water for Schools will be discussed in latter sections of this case study.

Program Goals

The World Health Organization and UNICEF have published data linking inadequate water and sanitation to decreased school attendance. According to WHO/UNICEF, "Surveys from 45 developing countries show that women and children bear the primary responsibility for water collection in the majority of households. This is time not spent working at an income-generating job, caring for family members, or attending school."[340] The United Nations Development Program has similarly reported that, "443 million school days are lost each year due to water-related illness." [341]

In addition to school days lost, diarrhea stemming from water-borne illness is the second leading cause of death among children under five in the world: around 1.5 million deaths each year - nearly one in five childhood deaths – are caused by diarrhea. It kills more children than malaria, AIDS, and measles combined.[342] This equates to an estimated 4,100 children under the age of five dying each day from diarrhea, globally.[343]

The Coca-Cola Africa Foundation's investments in water, sanitation and hygiene in schools in South Africa aims to reduce the disproportionate burden that lack of access to sanitation and water bears on children. The World Health Organization and UNICEF have consistently emphasized that, "sanitation and proper hygiene are crucial to diarrhea prevention," and "it is estimated that improved sanitation facilities can result in an average reduction in cases of diarrhea of more than one-third."[344] Furthermore, according to the World Health Organization, "successfully halving the proportion of those globally without access to safe drinking water and adequate sanitation by 2015 is estimated to result in 272 million more school attendance days a year."[345] With 443 million school days lost each year globally from water-related illness, Coca-Cola's investments in the RAIN Water for Schools program aims to diminish the barrier that water, sanitation and hygiene commonly imposes on early childhood education.

Some of the water, sanitation and hygiene (WASH) interventions implemented in schools include the, "installation of rainwater harvesting technology, drilling wells or boreholes, fixing dilapidated water supply equipment and providing adequate sanitation facilities."[346]Another key need within schools is training to ensure long term operation and maintenance of water infrastructure, which RAIN also supports through sustainability training. Coca-Cola works intimately with partners that are experts in WASH programming to develop and execute hygiene education programs in schools. Some of the partners engaged with the South Africa RAIN Water for Schools program include H2O for Life, The Mvula Trust, and The Republic of South Africa's Department of Basic Education. According to Coca-Cola and their aforementioned partners, the way to a healthy school is through the provision of facilities, health education, promoting correct use, and ensuring maintenance and cleaning (Figure 59).

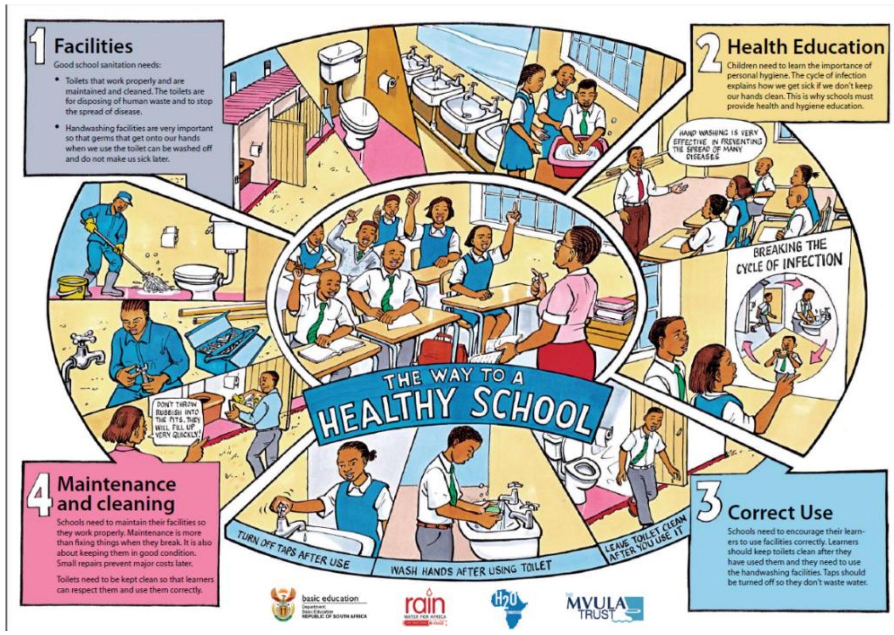


Figure 59: Poster showcasing the four elements of a healthy school[347]

Community Benefits Generated from RAIN Water for Schools

While Coca-Cola's investments in South African schools are intended to directly benefit the children attending the schools, there are other community benefits that may also be generated. For example, creating a water access point at a rural school can benefit the entire community, since the populations living around the school sometimes receive access to an improved source of water that is closer to their community and safer for consumption than the previous source.

Additionally, malnutrition due to dirty water, inadequate sanitation, and poor hygiene is estimated to lead to the deaths of an additional 2,350 children under the age of five each day, globally.[348] In addition to receiving access to improve drinking water and improved sanitation facilities, many schools have used their newfound access to improved water sources to use water for productive uses, such as supporting school agricultural activities that supplement school nutrition programs. In this way, Coca-Cola's RAIN Water for Schools program in some cases also serves as a food access program as community members become engaged in local agricultural activities.

Finally, beyond these benefits, there are a large number of children in these schools with HIV/AIDS who require food when taking their anti-retroviral medication. Therefore, receiving access to water and food through RAIN can promote other public health benefits. Furthermore, educational elements of programs that promote sanitary and hygienic behaviors in schools can transfer into the broader community. Children that have successfully adopted sanitary and hygienic behaviors often become educators within their families and communities and can promote behavior change.

Spatial Analysis

Overall, South Africa's freshwater resources are in a poor state, but the country is socially capable and competitive. It has a high probability of water stewardship success, and a moderate need for water stewardship. There is more need for improved sanitation facilities than for improved water sources, though over 2 million people need improved water sources.

The World Economic Forum graded South Africa as a 4.35, on a scale of 1-7 (1 is low/bad and 7 is high/good), in their 2014-2015 *Global Competitiveness Index* (GCI).[349] This score earned South Africa 2nd place out of 38 African countries in terms of competitiveness. Although the score was only slightly above the half-way mark of 4.0, implying that South Africa does not have a very high competitiveness, it has the second highest competitiveness within Africa, only being outdone by Mauritius. Within the three sub-indices of the GCI and out of 38 countries in Africa, South Africa ranked 9th for Basic Requirements, 1st for Efficiency Enhancers, and 1st for Innovation & Sophistication Factors.[350]

These GCI rankings imply that South Africa's relatively high competitiveness is mostly due to factors that enhance efficiency and encourage innovation & sophistication. Regarding basic requirements, South Africa lags behind 8 other countries in Africa. Since Africa is treated as being at the "efficiency-driven" stage of development in the *Global Competitiveness Index*, the weight for efficiency enhancers is greater than the weight for basic requirements, implying that the country should work on enhancing its efficiency in order to continue to build its competitiveness.[351] Although this does not mean that South Africa should stop improving basic requirements and addressing those needs in the country, it could be construed that way.

The *State of Freshwater Resources Index* (SOFI) scored South Africa at 0.44, on a scale of 0 to 1 (0 is low/bad and 1 is high/good), and ranked it 44th out of 51 countries (or 53 countries including Seychelles and Cape Verde) (Table 22). South Africa's SOFI score is less than half of the difference between the lowest and highest scores within Africa, which implies that the country does not have a very good command of its freshwater resources or that it may be in danger of resource changes due to increased stress from climate changes, such as decreased rainfall, increased inter-annual or seasonal variability, or increased temperatures.

The *Social Capabilities Index* (SCI) developed by the University of Michigan team gave South Africa an overall SCI score of 0.71, on a scale of 0 to 1 (0 is low/bad and 1 is high/good), and ranked it 7th out of 54 countries (Table 22). Among the seven components of SCI, South Africa ranked in the top 10 countries for all component except the *Happy Planet Index*, in which it ranked 36th.

Risk-wise, South Africa deals with a large number of floods, moderate drought, high variability in precipitation between years, and some high water stress. On the other hand, the country has low seasonal variability and large amounts of water in many areas. Overall, climate may be variable from year to year, causing floods and droughts, but the internal (not coastal) areas of the country have decent amounts of water. It is unknown from these maps how much of that water is used for agricultural purposes.

Table 22. South Africa's score and rankings for the three major composite indices (and their components) used to assess environmental, social, and business aspects of development on the African continent in this report.[d] The higher the rank (closer to 1st), the better South Africa was assessed for that indicator or index compared to the rest of the continent.

		Score	Rank	Total countries included in ranking
Global Competitiveness Index (GCI) (score: 1 – 7)	**GCI**	4.35	2nd	38
	Sub-index A: Basic Requirements	4.30	9th	38
	Sub-index B: Efficiency Enhancers	4.45	1st	38
	Sub-index C: Innovation & Sophistication Factors	4.07	1st	38
State of Freshwater Resources Index (SOFI) (score: 0 – 1)	**SOFI**	0.44	44th	51*
	Falkenmark Indicator	0.01	38th	51*
	Use-to-Resources Ratio	0.99	42nd	51
	Import Dependence Ratio	0.64	33rd	48*
	Groundwater Quantity per Capita	0.02	21st	48
	Water Pollution Level	0.54	47th	48
Social Capabilities Index (SCI) (score: 0 – 1)	**SCI**	0.71	7th	53
	African Infrastructure Development Index	0.75	2nd	52
	Human Development Index	0.50	9th	52
	Gender Inequality Index	0.38	8th	39
	Ibrahim Index of African Governance	0.89	4th	52
	Social Progress Index	0.67	3rd	37
	Happy Planet Index	0.14	36th	42

With data from the WHO/UNICEF Joint Monitoring Programme (JMP) for Water Supply and Sanitation, the report team examined descriptive statistics about South Africa regarding population with access to improved water sources and improved sanitation facilities in comparison with those available for the rest of the continent.[352]

[d] * = For SOFI, this is the number of countries after removing the extremely low-value outliers of Seychelles and Cape Verde, if present, which only contained data for 1 or 2 of the 5 SOFI components. If this symbol is not included in a SOFI cell in the "total countries" column, then neither Seychelles nor Cape Verde had data for that component.

South Africa ranked 7th for percentage of the total population with access to improved water sources and 9th for percentage of the total population with access to improved sanitation facilities (Table 23). Although the country ranks high within the continent, five percent of the South African population—approximately 2,649,100 people—still require improved access to drinking water sources. Additionally, 26% of the population—approximately 13,775,318 people—still require access to improved sanitation facilities.

Table 23. Percentage of populations with access to improved water sources (IWS) and improved sanitation facilities (ISF) in South Africa, with ranks for comparison to 54 other African countries. 2012 estimates are taken from the WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation.

	Access to improved water sources (%)	South Africa's IWS rank	Access to improved sanitation facilities	South Africa's ISF rank
Urban population	99%	5th	82%	10th
Rural population	88%	8th	62%	10th
Total Population	95%	7th	74%	9th

Site Visits

In October 2014, the University of Michigan team traveled to South Africa with Kyle Sucher from Global Water Challenge to visit communities benefitting from the Replenish Africa Initiative, and to more specifically visit primary schools engaged in South Africa's RAIN Water for Schools Program. In total, six schools were visited throughout Johannesburg, Port Elizabeth, Durban/Greytown and Cape Town. At each school, relevant stakeholders were interviewed, including principals and implementing partners. Furthermore, the team was able to observe water stewardship interventions in the primary schools, which provided an opportunity to further understand RAIN's approach to implementing water, sanitation and hygiene programming in South African primary schools and draw lessons on RAIN's broader work across Africa.

Greater Johannesburg Area.

Thabo Tona.

Located in a peri-urban community on the edge of municipal water supply, Thabo-Tona, was identified as one of the 100 schools in South Africa to benefit from Coca-Cola's RAIN Water for Schools program. Prior to the 2009 RAIN Water for Schools intervention, clean water supply was intermittent with low pressure because of the high number of illegal water connections in the informal settlement. In the daytime, water usage in the area was high, reducing the amount of water available for use at the one functional tap and newly constructed ablution facilities. The school-feeding program had to rely on this intermittent supply and students did not have enough water for drinking, hand washing or flushing, forcing them to forego proper hygiene practices. As a result, students used pit latrines and temporary chemical toilets and drew water from one tap that did not have proper drainage. Specific interventions implemented at this school included constructing raised water storage tanks to improve pressure at the school, connecting the ablution block to the sewer network, expanding tap stands, installing drainage at all taps and training the school management in sustainable operations and maintenance. The community adjacent to the school was considered an informal settlement, and most of the community surrounding the school had children enrolled. Indicators of school ownership and intervention uptake were apparent by adaptations that had been made to the water storage tower. For example, the school had retrofitted the water storage tower to fit the water delivery truck that would bring water to the school to supplement the piped water supply. Furthermore, ownership was indicated by the school's small gardens, which utilized water for productive uses, such as growing food and supplementing school and community nutrition.

Port Elizabeth.

Charles Duna Primary School.

Principal Nombulelo Sume manages Charles Duna Primary School. Located in an urban area, Charles Duna Primary School faced challenges of low water pressure, which had significant consequences for all water, sanitation and hygiene infrastructure at the school. Principal Sume approached Coca-Cola with a request for support and as a result, RAIN Water for Schools launched a program to rehabilitate and construct water storage tanks and taps, refurbish toilets, construct hand-washing stations and support gardening work. School leaders were also trained in sustainable operations and maintenance of the new and refurbished infrastructure. The school has used its increased water access for productive uses, and small gardens have been established to generate produce to supplement school and community nutrition. In addition to benefitting from Coca-Cola's RAIN program, Charles Duna is benefitting from investments in healthy and active living programming. These investments are made through Coca-Cola Fortune, which is the local bottling partner. Like the water stewardship and replenishment goals, the healthy and active living program is a part of Coca-Cola's "Me, We, World" framework, which was briefly described in the introduction section. More specifically, this program is sponsored under the "Me" portion of the framework, which focuses on enhancing personal well-being. While the short-term critical needs for water and sanitation facilities appear to have been met at Charles Duna, Mrs. Sume alluded to ongoing challenges with storm water and flooding in the school yard.

JK Zondi Primary School.

JK Zondi is managed by Principal George Norkie. Located in an urban area, JK Zondi received water and sanitation interventions as part of the RAIN Water for Schools program. Specific interventions implemented at this school included improvements to existing water infrastructure, and the refurbishment of toilets and hand-washing stations. School leaders were also trained in sustainable operations and maintenance of the new and refurbished infrastructure. In addition to improved access to water and sanitation, the school showed ownership of newfound water access points by using the improved water source for productive uses. Small gardens were incorporated into the school yard to supplement school nutrition programs. The principal of the school noted that absenteeism had decreased after receiving access to water and sanitation programming as part of RAIN Water for Schools.

Durban/Greytown.

Ngome Primary School.

Located in a rural, arid area near Durban, Ngome Primary School benefitted from construction of new and refurbishment of existing WASH infrastructure. Similar to other schools benefitting from RAIN Water for Schools, Ngome is using their water source for productive uses and a large garden was built to supplement school and community nutrition. School leaders were also trained in sustainable operations and maintenance of the new and refurbished infrastructure.

Macongco Primary School.

Located in a rural, upland, mountainous area near Greytown, the Macongo Primary School benefitted from a connection to the municipal water supply, construction of additional water tanks and taps, and refurbishment of rainwater harvesting and sanitation facilities. School leaders were also trained in sustainable operations and maintenance of the new and refurbished infrastructure.

Cape Town.

Nebo Primary School

Located in an urban, impoverished area near Coca-Cola's Peninsula Beverages bottling partner, Nebo Primary School received programmatic investments in refurbishment of water and sanitation infrastructure. School leaders were also trained in sustainable operations and maintenance of the rehabilitated infrastructure. Unlike the other schools observed, the challenge at Nebo Primary School was not solely water access; the school also faced challenges related to the degradation and theft of infrastructure that had been previously installed at the school. Furthermore, Nebo Primary School was different than other schools visited because the neighboring community was reportedly not as engaged in the school's water programming. For example, theft of copper piping and toilet seats was reported, which led to the installation of PVC piping and non-removable toilet seats. According to the principal, the surrounding community suffered from substance abuse problems, which was a major contributor to the theft problem and low levels of community support for the school or for education in general.

Creating value from investments in water, sanitation, and hygiene (WASH)

In the remainder of this case study, The Replenish Africa Initiative's RAIN Water for Schools Program will be analyzed using the *Water Stewardship CLD* to understand how investments in water, sanitation and hygiene (WASH) in schools can create shared value in Africa.

Within the *Water Stewardship CLD,* the key leverage point for investments in WASH is the equitable access to water and sanitation facilities variable. In addition to the equitable access to WASH variable, the fulfillment of basic needs variable is another leverage point where investments in RAIN Water for Schools can be implemented to create shared value. Within the model, the equitable access to water and sanitation facilities variable is defined as, "the extent to which both clean, safe drinking water and improved sanitation facilities and infrastructure are available and easily accessible by all members of a society." This variable is located in the Social and Human Capabilities module and is causally related to multiple variables within the full value creation model. Similarly, the fulfillment of basic needs variable is defined as the extent to which basic human needs, such as food, water, clothing, shelter, and security are fulfilled for all members within a society or region. It is important to note that most of the schools benefitting from RAIN Water for Schools utilized increased WASH access to enable productive use of water, specifically agricultural practices, which generates other societal benefits associated with increased access to food. The primary causes and key leverage points associated with providing equitable access to clean water sanitation facilities can be viewed in the cause-trees below. The primary leverage points for increasing WASH include increasing the quantity and quality of water available, and increasing the availability and access to infrastructure. Furthermore, some of the benefits associated with equitable access to WASH, including fulfillment of basic needs, and increased equity and rights, can be viewed by examining the cause-trees.

First and second-order causes of equitable access to clean water and sanitation

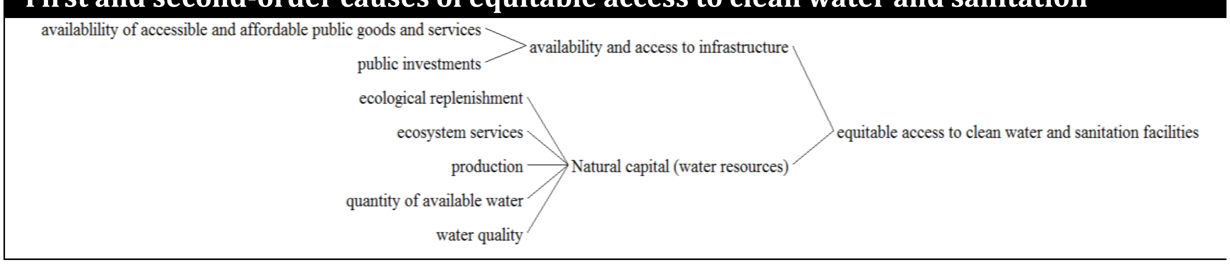


Figure 60. Natural capital and availability and access to infrastructure are needed to provide equitable access to WASH

First and second-order consequences stemming from equitable access to clean drinking water and sanitation

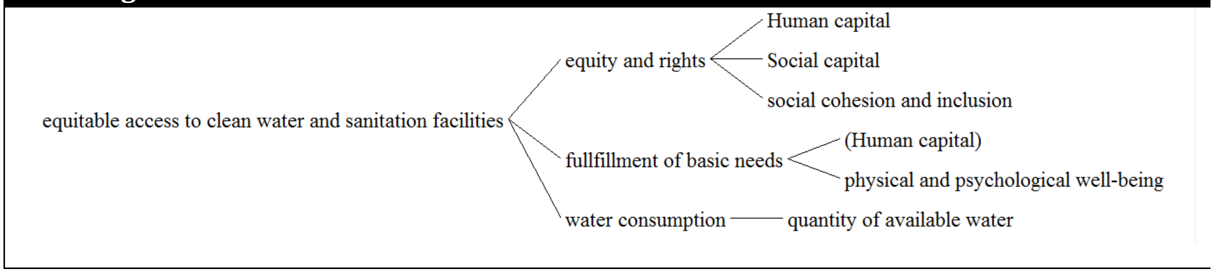


Figure 61. Equitable access to WASH increases builds human capital.

Overall, when the basic needs of students are met, students are healthier and have a higher well-being, which can cause other societal, social, and human capital consequences. For example, increased physical and psychological well-being or health has been consequentially linked to increased education and skill attainment. Increased education and skill attainment stemming from WASH investments were made apparent during site visits in Africa as all of the principal's that were interviewed within Coca-Cola's RAIN Water for Schools program reported decreased absenteeism in schools. Therefore the connection between WASH investments in South Africa's primary schools and increased educational attainment can be inferred as the decreased incidence of diarrheal disease from water-borne illness decreased school absenteeism overtime. Increased attainment of education and skills is further related to other social and economic benefits within the *Water Stewardship CLD,* including increased human capital, increased productivity, and increased income. When all of these factors increase, one can infer that household economic capital and human and social adaptability can also increase over time, which has other economic and social benefits.

While increasing the level of access to WASH and water for productive use creates significant social and economic benefits, one adverse effect associated with these investments is that the quantity of water consumed can also increase. Therefore, when investing in WASH and water for productive use programs in schools, it is important to consider investment simultaneous investments in watershed protection in order to increase the quantity and quality of freshwater available for communities, nature and business. These watershed protection programs could potentially be implemented within the boundaries of schools benefitting from WASH as some of the schools visited during the site visits reported challenges with flooding and sewage overflow. Therefore, investments in watershed protection, specifically the installation of rain gardens or natural detention basins within school yards, can help mitigate challenge with storm water and sewage overflow, while also providing ecological replenishment benefits.

Overall, Coca-Cola's RAIN Water for Schools program has the potential to generate significant social and economic value in South Africa and across the continent. Considering the large number of children enrolled in primary schools, coupled with RAIN's commitment to provide 6 million people with access to improved drinking-water resources by 2020, this program has the potential to touch the lives of millions of people that will shape the future of Africa's emerging economies. Based on the significant potential benefits identified in the value creation section, RAIN's school WASH programming can help to transform the lives of millions of students in Africa. South Africa alone has over 7 million pupils enrolled in primary schools; 48.5% of which are females. Other countries scoring in the top 10 for the highest number of pupils in primary schools are Nigeria with over 21 million and Ethiopia with over 14 million. Furthermore, Tanzania, Uganda, Kenya, Mozambique, and Angola each have over 5 million pupils enrolled in primary schools. Notably, of the 5 million students enrolled in primary school in Angola, only 38.9% are female. Therefore, investments in RAIN Water for Schools could generate additional gender equity-related benefits as young girls are relieved of the challenges associated with using the bathroom at school.

In addition to the large impacts RAIN Water for Schools could have on populations in Africa, Coca-Cola's RAIN Water for Schools program aligns with of UNICEF's larger goal to provide WASH in schools globally. Overall, when corporate social programs are aligned with goals and initiatives that are prioritized by well-known intergovernmental agencies or non-governmental partners, the potential to create shared value is further strengthened.

Appendix A: Introduction – Figures

Figures

BEVERAGE		Raw material production	Suppliers	Direct operations	Product use/ end of life
Value chain segment		Food crop production, such as sugar cane, barley, fruits	Bottle, container and packaging manufacturing; Ingredient suppliers	Bottling; Distribution; Retail and marketing	Beverage consumption; Container recycling and disposal
Withdrawal	*Intensity*	High	Medium	High	Medium
	Description	Freshwater for crop irrigation; Freshwater for rinsing and cleaning crops	Freshwater to manufacture containers and packaging; Freshwater for washing and cooling	Water as a product ingredient; Water use in dispensing products; Water withdrawal for bottled water; Washing, cleaning, pasteurization (steam)	Water use to wash and recycle beverage containers
Discharge	*Intensity*	Medium	Low	Medium	Medium
	Description	Agricultural runoff; wastewater from food processing facilities containing fertilizer, pesticides, and herbicides.	Wastewater discharge containing toxic chemicals	Wastewater discharge from beverage manufacturing processes such as brewing, cooking, and fermentation; Wastewater discharge from retail and commercial facilities (bathroom, kitchen, landscaping)	Wastewater discharge; Impact of discarded bottles and packaging on aquatic ecosystems

Figure 62. Water footprint intensity associated with the beverage industry's value chain.

	Physical Risks	Reputational Risks	Regulatory Risks
BEVERAGE	• Most significant water use is embedded in the raw material production phase. Severe drought or changes in patterns of precipitation can decrease crop yield and quality. • Potable water is principal and non-substitutable ingredient for beverage products. Water scarcity or contamination of water sources may force bottling or manufacturing facilities to shut down or relocate.	• Beverage manufacturing requires potable water, putting water use in direct competition with local populations. • Decline in economic, social and physical wellbeing of consumers due to the lack of access to clean water may affect market growth for beverage products in emerging economies.	• Water scarcity may raise the price of water, cap the amount of withdrawal, or result in the suspension of license to use water resources.

Figure 63. Water-related risks facing the beverage industry.

Table 24. Information collected and included in Coca-Cola's source water protection plans

Information collected and included in Coca-Cola's source water protection plans
A description of the physical water resource system from the water source(s) to the facility's water treatment system, including groundwater, surface water and ocean water
An inventory of water resource management agencies and their policies, regulations, planning priorities, and enforcement activities.
An inventory of relevant stakeholders, including communities, water providers, regulatory agencies, NGOs, labor and trade organizations, learning institutions, political entities and others.
Maps showing the areal extent of the local watershed and surface water system.
Basic descriptions of the local hydrogeology and groundwater resources, and a map of the local groundwater resources and groundwater basin.
A review of available water quality data and known current and historical water quality issues.
A "conceptual hydrologic model" for the watershed and groundwater basin. Models include a water balance calculation and account for inputs such as rain and outputs such as withdrawals and evaporation.
A water scarcity evaluation that identifies current water stress and drought conditions.
An evaluation of the potential for natural disasters and security issues to threaten the facility's source water.
An evaluation of how the facility's water use could limit the availability and quality of water for people in the local community.
An assessment of the facility's wastewater treatment system and its effectiveness in removing known and suspected contaminants, along with an assessment of the potential impact our wastewater discharge could have on the surrounding ecosystem and community.[353]

Appendix B: Business Case—Figures

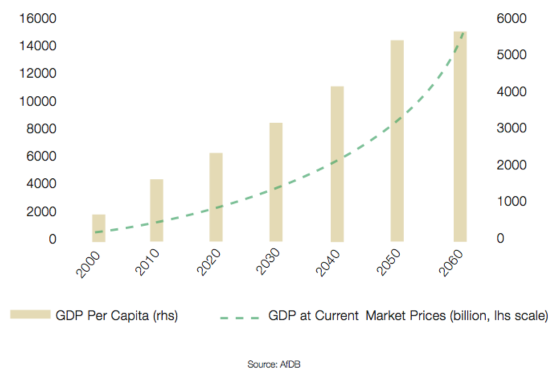


Figure 64: AfDB forecast for GDP across the African continent, 2000-2060

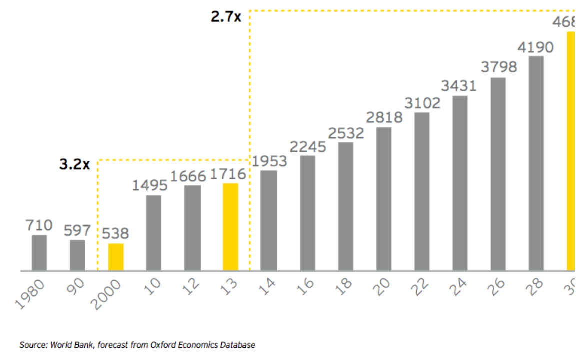


Figure 65: Pan-African GDP per capita (nominal US$), 1980-2030

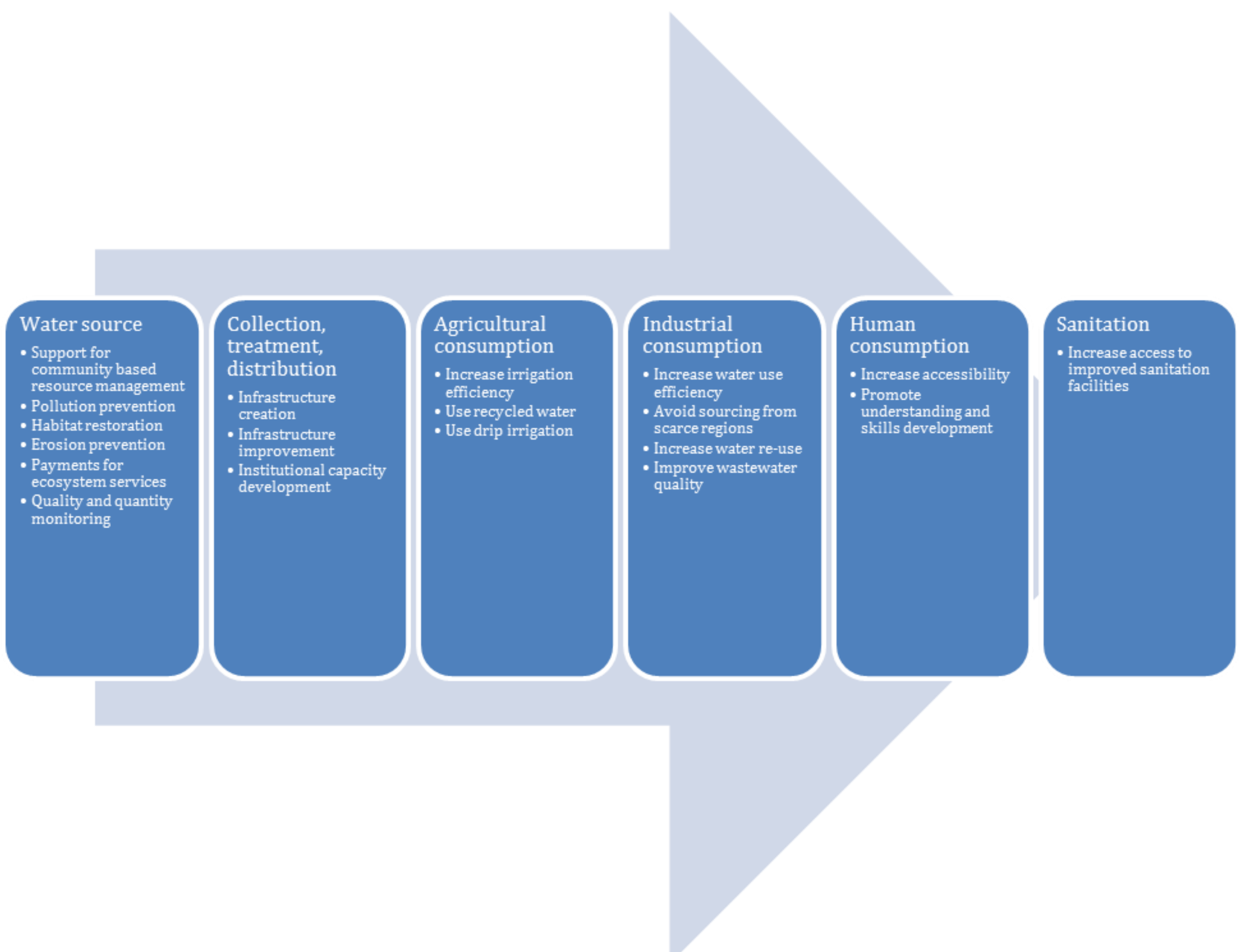


Figure 66: Examples of interventions at major parts of the water lifecycle

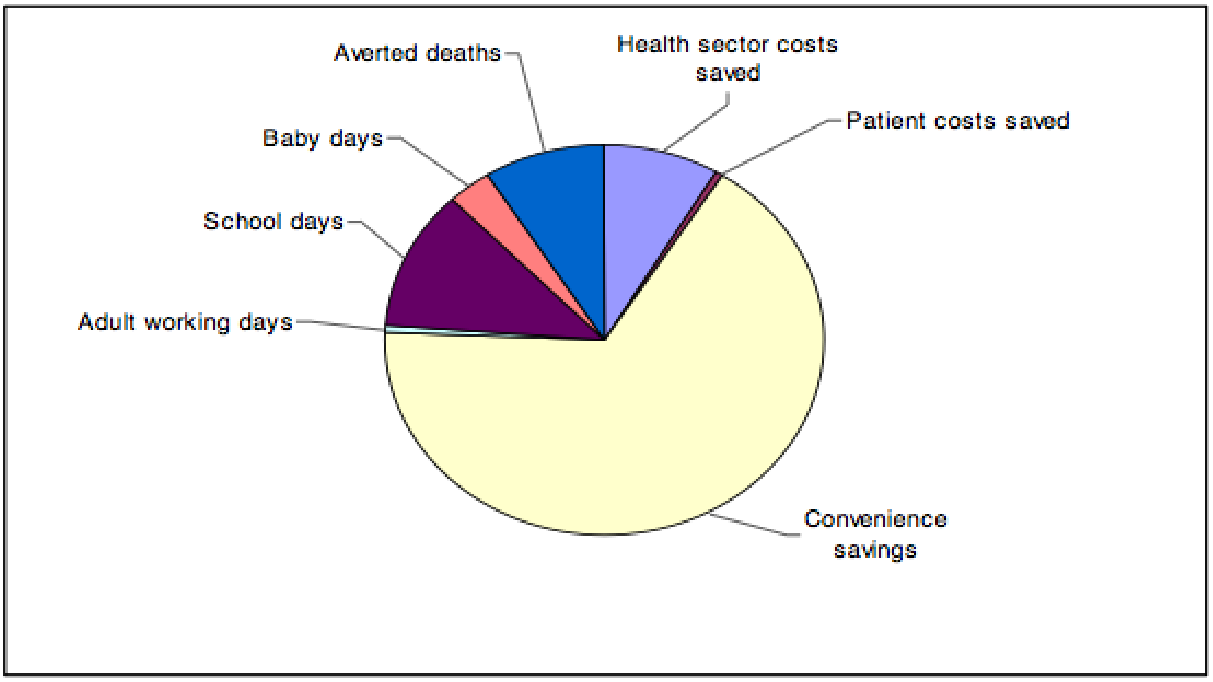


Figure 67: One calculation of the distribution of economic benefits by type of benefit in West- and Central-Africa[354]

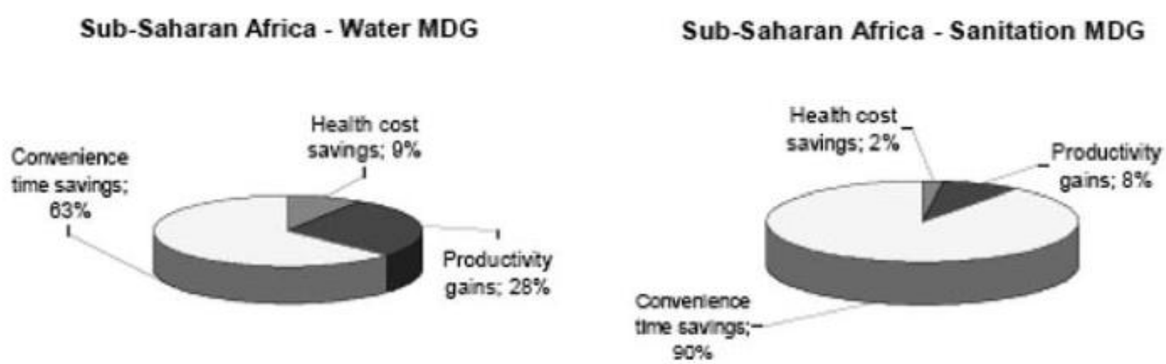


Figure 68: Separate calculations of the economic benefit distributions in Sub-Saharan Africa for meeting the MDG for water and the MDG for sanitation[355]

Table 25: Summary of monetary values for various ecosystem services per biome (values in int.$/ha/year, 2007 price levels)[356]

	Marine	Coral reefs	Coastal systems	Coastal wetlands [a]	Inland wetlands	Fresh water (rivers/ lakes)	Tropical forest	Temperate forest	Woodlands	Grasslands
Provisioning services	102	55,724	2396	2998	1659	1914	1828	671	253	1305
1 Food	93	677	2384	1111	614	106	200	299	52	1192
2 Water				1217	408	1808	27	191		60
3 Raw materials	8	21,528	12	358	425		84	181	170	53
4 Genetic resources		33,048		10			13			
5 Medicinal resources				301	99		1504			1
6 Ornamental resources		472			114				32	
Regulating services	65	171,478	25,847	171,515	17,364	187	2529	491	51	159
7 Air quality regulation							12			
8 Climate regulation	65	1188	479	65	488		2044	152	7	40
9 Disturbance moderation		16,991		5351	2986		66			
10 Regulation of water flows					5606		342			
11 Waste treatment		85		162,125	3015	187	6	7		75
12Erosion prevention		153,214	25,368	3929	2607		15	5	13	44
13 Nutrient cycling				45	1713		3	93		
14 Pollination							30		31	
15 Biological control					948		11	235		
Habitat services	5	16,210	375	17,138	2455	0	39	862	1277	1214
16 Nursery service		0	194	10,648	1287		16		1273	
17 Genetic diversity	5	16,210	180	6490	1168		23	862	3	1214
Cultural services	319	108,837	300	2193	4203	2166	867	990	7	193
18 Esthetic information		11,390			1292					167
19 Recreation	319	96,302	256	2193	2211	2166	867	989	7	26
20 Inspiration		0			700					
21 Spiritual experience			21							
22 Cognitive development		1145	22					1		
Total economic value	**491**	**352,249**	**28,917**	**193,845**	**25,682**	**4267**	**5264**	**3013**	**1588**	**2,871**

Numbers in the cells are averages of the values found for a particular service and biome. Calculations are based on a total of 665 values. For details see Appendix 1.

[a] Coastal systems include estuaries, continental shelf area and sea grass, but exclude wetlands like tidal marsh, mangroves and salt water wetlands.

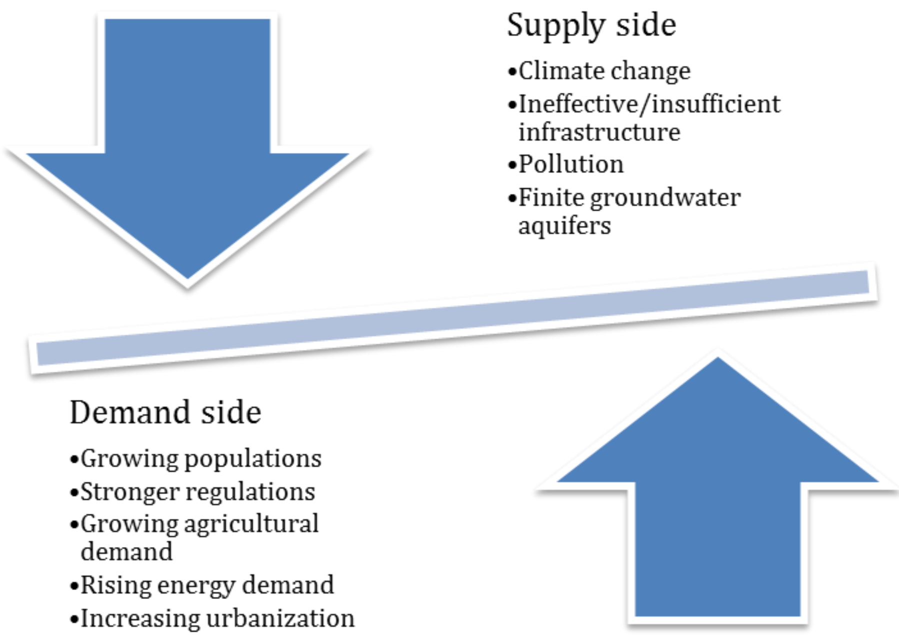


Figure 69: Examples of supply-side and demand-side pressures related to water security

Appendix C: Spatial Assessments – Methods, Tables, and Figures

Creation of the Spatial Layers

African countries.

The 2015 update of the Esri "World Countries" spatial layer package was processed to create shapefiles for African countries with smoothed boundaries and rough boundaries, separately.[357] As the original layer package contained countries from all continents, it was manipulated using the following steps to develop feature classes of African countries:

1. Create new feature class containing only countries from Africa
    a. Input layer: "World Countries" from Esri
    b. Select (Analysis)
        i. SQL syntax: CONTINENT = 'Africa'
    c. Output file: "Africa_countries.shp"
2. Project "African countries" to Albers Equal Area Conic projection
    a. Output file: "Africa_projected.shp"
    b. Input coordinate system: GCS_WGS_1984 (geographic coordinate system, world geodetic system 1984)
    c. Output coordinate system: Albers Equal Area Conic projection (
    d. No geographic transformation needed
3. Because the countries were separated into separate, unique features instead of multipart features…

3a. Dissolve countries by name (South Sudan and Sudan are separated)
    a. Input file: "Africa_projected.shp"
    b. Output file: "Africa_withSouthSudan.shp"
    c. Dissolve field: NAME
    d. Create multipart features: yes

3b. Dissolve countries by name (South Sudan and Sudan are combined)
    e. Edit "Africa_projected.shp" manually, changing NAME field entries of "South Sudan" to "Sudan"
    f. Input file: "Africa_projected.shp"
    g. Output file: "Africa_NOSouthSudan.shp"
    h. Dissolve field: NAME
    i. Create multipart features: yes

4. Convert African country files from vector format to raster format; this adjusts the edges of the polygons to be rough, or pixelated.

4a. Tool: Polygon to Raster – (South Sudan and Sudan are separated)

4b. Tool: Polygon to Raster – (South Sudan and Sudan are combined)

5. Convert African country files from raster format to vector format; this keeps the rough edges but allows for a fill & outline symbology, which is not available for raster symbology.

5a. Tool: Raster to Polygon – (South Sudan and Sudan are separated)

5b. Tool: Raster to Polygon – (South Sudan and Sudan are combined)

Most of the SOFI data contains data collected prior to South Sudan gaining its independence from Sudan, but the SCI and the GCI both contain mostly data collected *after* the separation. Because of this, two separate African country layers were created: one to show Sudan and South Sudan merged as one country and another to show them as separate countries.

Nitrogen and phosphorus pollution levels.

The water pollution levels of nitrogen and phosphorus in African river basins were originally available and downloaded as raw raster files. Processing steps were performed on this data to prepare it for inclusion in the SOFI. First, the raster data was projected from the GWS_WGS_1984 (global coordinate system, world geodetic system 1984) into the Africa Albers Equal Area Conic projection. This projection was chosen because the next processing step relied on accurate area measurements and because the data contained the entire African continent. After this, the data was clipped to the approximate extent of the African countries shapefile derived from the Esri world countries layer in order to reduce processing times. After changing the format of the NAN data entries, and creating new rasters with them, mean pollution levels for nitrogen and phosphorus were calculated by country with Zonal Statistics tools using ArcGIS software[358] and exported to tables.

State of Freshwater Resources Index (SOFI).

The five components of the SCI were individually mapped to better understand the impact that each factor had on the composite index. All of the components are illustrated with colors from red to yellow to green. These colors can be interpreted as understanding dark red as bad, yellow as moderate (not bad but not very good), and dark green as good. Each of the components was classified in the manner that best showed the variation across the African continent.

Groundwater resources per capita data, measured in billion liters, were classified using Jenkins natural breaks (5 classes) (Figure 70a). Green indicates more groundwater resources per capita, and red indicates less groundwater resources per capita.

Water pollution levels, with no units of measure, were classified using Jenkins natural breaks (6 classes) (Figure 70b). In respects to nitrogen and phosphorus, green indicates lower levels of water pollution, and red indicates higher levels of water pollution.

Import dependence ratios were classified using Jenkins natural breaks (6 classes) (Figure 70c). Green can be understood as countries that are less reliant (in terms of the proportion of their total water usage, including water inherent in products and food) on water resources in other countries, and red can be understood as countries that are more reliant (in terms of the proportion of total national water usage, including water that is inherent in food and other products) on water resources in other countries.

Use-to-resources ratios (UtRRs) were manually classified into five classes (Figure 70d). Using ArcGIS software,[359] the class breaks were first determined using Jenkins natural breaks (5 classes), and then the first three break points were changed from 2.49 to 0.20, 18.77 to 0.40, and 57.55 to 1.00; the fourth break point, separating the fourth and fifth class, was left as defined by the original Jenkins classification. The first three break points were manually edited to reflect the specific ratio cutoffs for defining water scarcity, as described by Raskin et al. (1997).[360]

Areas where annual water withdrawals do not exceed 20% of annual renewable freshwater supply are not considered "water scarce," and those areas are indicated in dark green on the map (Figure 70d).[361] If more annual withdrawals are more than 20% but less than 40% of the annual renewable freshwater resources, then the area is described as "water scarce," and countries in this category are shown as light green.[362] If annual withdrawals exceed 40% of annual renewable freshwater resources, then the area is described as "severely water scarce."[363] African countries in this category are shown in three separate classes in the map (Figure 70d): countries with yearly withdrawals of 40 – 100% of the annual renewable freshwater supply are illustrated in yellow, countries with yearly freshwater withdrawals of 100 – 485% of annual renewable supply are illustrated in orange, and countries with yearly freshwater withdrawals of over 485% of annual renewable supply are shown in red. The higher cut-off of 100% for the category 40 – 100% was chosen because once annual withdrawal equals annual renewal, there is no longer any annual surplus in renewable water—all the renewable water that enters the country is being consumed by one sector or another.

The Falkenmark indicator values, representing annual renewable freshwater resources per capita (cubic meters), were classified manually into six classes. According to Falkenmark, areas that receive an average of less than 1,000 cubic meters of renewable freshwater resources per person annually are considered water scarce, and areas that receive an average of between 1,000 and 1,700 cubic meters of renewable freshwater resources per person annually are categorized as water stressed. These two thresholds were used to separate the first and second classes and the second and third classes, respectfully. The worst "water scarce" category of this indicator (0 – 1,000 m^3/capita/year) is colored red on the map, and the "water stressed" category (1,000 – 1,700 m^3/capita/year) is colored orange on the map (Figure 70e). The other class breaks were decided through visual estimation of natural breakpoints within the remaining data for this indicator. The next category of 1,701 – 9,326 m^3/capita/year is colored yellow, the category of 9,327 – 45,400 m^3/capita/year is colored light green, the category of 45,401 – 107,612 m^3/capita/year is colored medium green, and the category with the most water (107,613 – 189,951 m^3/capita/year) is colored dark green (Figure 70e).

Tables.

Table 26. The Africa Infrastructure Development Index's Components and Indicators[364]

<table>
<tr><td rowspan="2">1. Transport Composite Index</td><td colspan="2">1a. Total Paved Roads
"The country's total surface with crushed stone (macadam) and hydrocarbon binder or bituminized agents, with concrete, or with cobblestones. The indicator is measured in km per 10,000 inhabitants as a proxy of access to the road paved network."</td></tr>
<tr><td colspan="2">1b. Total Road Network
- "The total road surface (both paved and non-paved roads) of a given country. The indicator is measured in km (per km² of exploitable land area)."
- "Exploitable land area is the total surface area of a country minus the surface area of deserts, forest, mountains and other inaccessible areas."</td></tr>
<tr><td>2. Electricity Index: Net Generation (kWh per inhabitant)</td><td colspan="2">"The total electricity production of a given country, including the energy imported from abroad. This includes both private and public energy generated. The indicator is measured in millions of kilowatt-hours produced per hour and per inhabitant."</td></tr>
<tr><td rowspan="5">3. ICT Composite Index (ICT)</td><td rowspan="2">3a. Total Phone Subscriptions
"The total number of phone subscriptions in a country, both fixed telephone lines and mobile cellular telephone subscriptions, in a given year. For the purpose of the AIDI, the indicator is per 100 inhabitants."</td><td>3ai. Fixed-line Telephone Subscriptions (% population)
"Active line connecting the subscriber's terminal equipment to the Public Switched Telephone Network (PSTN) and which has a dedicated port in the telephone exchange equipment."</td></tr>
<tr><td>3a ii. Mobile-cellular Subscriptions (% population)
"Refers to the subscriptions to a public mobile telephone service, which provide access to the Public Switched Telephone Network (PSTN) using cellular technology. This indicator includes the number of pre-paid SIM cards active during the past three months. This indicator includes both analogue and digital cellular systems IMT-2000 (Third Generation. 3G) and 4G subscriptions."</td></tr>
<tr><td colspan="2">3b. Number of Internet Users
"The estimated number of Internet users in the total population. This includes those using the Internet from any device (including mobile phones) in the last 12 months. For the purpose of the AIDI, the indicator is per 100 inhabitants."</td></tr>
<tr><td colspan="2">3c. Fixed (wire) Broadband Internet Subscribers (per 100 inhabitants)
"Total Internet subscriptions using fixed (wired) broadband technologies to access the Internet. Subscriptions that have access to data communications (including the Internet) via mobile cellular networks are excluded. For the purpose of the AIDI, the indicator is reported per 100 inhabitants."</td></tr>
<tr><td colspan="2">3d. International Internet Bandwidth (Mbps)
"Total capacity of international Internet bandwidth in megabits per second (Mbps). If capacity is asymmetric (i.e. more incoming than outgoing), the incoming capacity should be provided. This is measured as the sum of capacity of all Internet exchanges offering international bandwidth."</td></tr>
<tr><td rowspan="2">4. Water & Sanitation Composite Index (WSS)</td><td colspan="2">4a. Improved Water Source (% of population with access)
"Access to an improved water source refers to the percentage of the population with reasonable access to an adequate amount of water from an improved source, such as a household connection, public standpipe, borehole, protected well or spring, and rainwater collection. Unimproved sources include vendors, tanker trucks, and unprotected wells and springs. Reasonable access is defined as the availability of at least 20 liters a person per day from a source within 1 km of the dwelling."</td></tr>
<tr><td colspan="2">4b. Improved Sanitation Facilities (% of population with access)
"Access to improved sanitation facilities refers to the percentage of the population with at least adequate access to excreta disposal facilities that can effectively prevent human, animal, and insect contact with excreta. Improved facilities range from simple but protected pit latrines to flush toilets with a sewerage connection. To be effective, facilities must be correctly constructed and properly maintained."</td></tr>
</table>

Table 27. The twelve main indicators of the *Fragile States Index* and their definitions.[365]

Social and Economic Indicators	**Demographic Pressures**	**Refugees and IDPs**	**Uneven Economic Development**
	"Pressures on the population such as disease and natural disasters make it difficult for the government to protect its citizens or demonstrate a lack of capacity or will"	*"Pressures associated with population displacement. This strains public services and as the potential to pose a security threat."*	*"When there are ethnic, religious, or regional disparities, governments tend to be uneven in their commitment to the social contract."*
	Group Grievance	**Human Flight and Brain Drain**	**Poverty and Economic Decline**
	"When tension and violence exists between groups, the state's ability to provide security is undermined and fear and further violence may ensue."	*"When there is little opportunity, people migrate, leaving a vacuum of human capital. Those with resources also often leave before, or just as, conflict erupts."*	*Poverty and economic decline strain the ability of the state to provide for its citizens if they cannot provide for themselves and can create friction between the "haves" and "have nots".*
Political and Military Indicators	**State Legitimacy**	**Public Services**	**Human Rights and Rule of Law**
	"Corruption and lack of representativeness in the government directly undermine social contract."	*"The provision of health, education, and sanitation services, among others, are key roles of the state."*	*"When human rights are violated or unevenly protected, the state is failing in its ultimate responsibility."*
	Security Apparatus	**Factionalized Elites**	**External Intervention**
	"The security apparatus should have a monopoly on use of legitimate force. The social contract is weakened where this is affected by competing groups."	*"When local and national leaders engage in deadlock and brinksmanship for political gain, this undermines the social contract."*	*"When the state fails to meet its international or domestic obligations, external actors may intervene to provide services or to manipulate internal affairs."*

Table 28. Countries with the "Top 20" scores in the SOFI, SCI, and GCI.

Rank	SOFI	SCI	GCI
1	Gabon	Seychelles	Mauritius
2	Sao Tome and Principe	Mauritius	South Africa
3	Liberia	Tunisia	Rwanda
4	Central African Republic	Libya	Botswana
5	Comoros	Cabo Verde	Morocco
6	Republic of the Congo	Algeria	Algeria
7	Chad	South Africa	Namibia
8	Democratic Republic of the Congo	Morocco	Tunisia
9	Guinea	Egypt	Kenya
10	Madagascar	Namibia	Seychelles
11	Mali	Botswana	Zambia
12	Niger	Ghana	Gabon
13	Botswana	Sao Tome and Principe	Lesotho
14	Cameroon	Gabon	Ghana
15	Libya	Rwanda	Senegal
16	Guinea-Bissau	Senegal	Cameroon
17	Sierra Leone	Kenya	Cabo Verde
18	Equatorial Guinea	Zambia	Ivory Coast
19	Burundi	Swaziland	Egypt
20	Ethiopia	Madagascar	Ethiopia

Table 29. Countries with the "Bottom 10" scores in the SOFI, SCI, and GCI.

Rank	SOFI	SCI	GCI
10	South Africa	Guinea	Nigeria
9	Morocco	Sudan	Burkina Faso
8	Algeria	Sierra Leone	Malawi
7	Eritrea	Guinea-Bissau	Mozambique
6	Swaziland	Niger	Burundi
5	Mauritius	Eritrea	Sierra Leone
4	Cabo Verde	Democratic Republic of the Congo	Angola
3	Egypt	Central Africa	Mauritania
2	Djibouti	Chad	Chad
LAST	Seychelles	Somalia	Guinea

Figures.

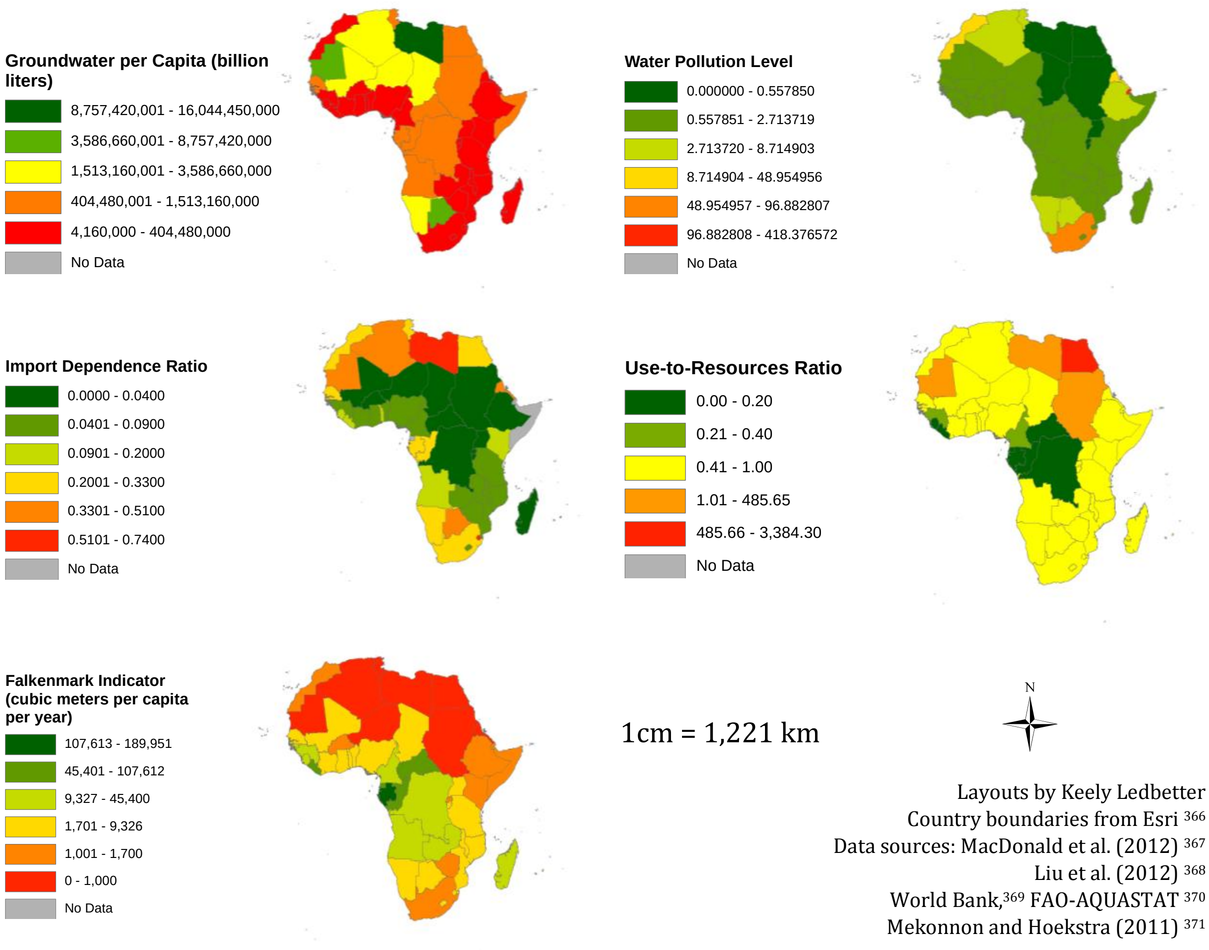


Figure 70. Components of the *State of Freshwater Resources Index* (SOFI). This includes groundwater per capita (1a), water pollution (1b), import dependence ratio (1c), use-to-resources ratios (1d), and the Falkenmark indicator (1e). Generally, red indicates bad scores, yellow indicates moderate scores, and green indicates good scores. Layouts created by Keely Ledbetter in 2015.

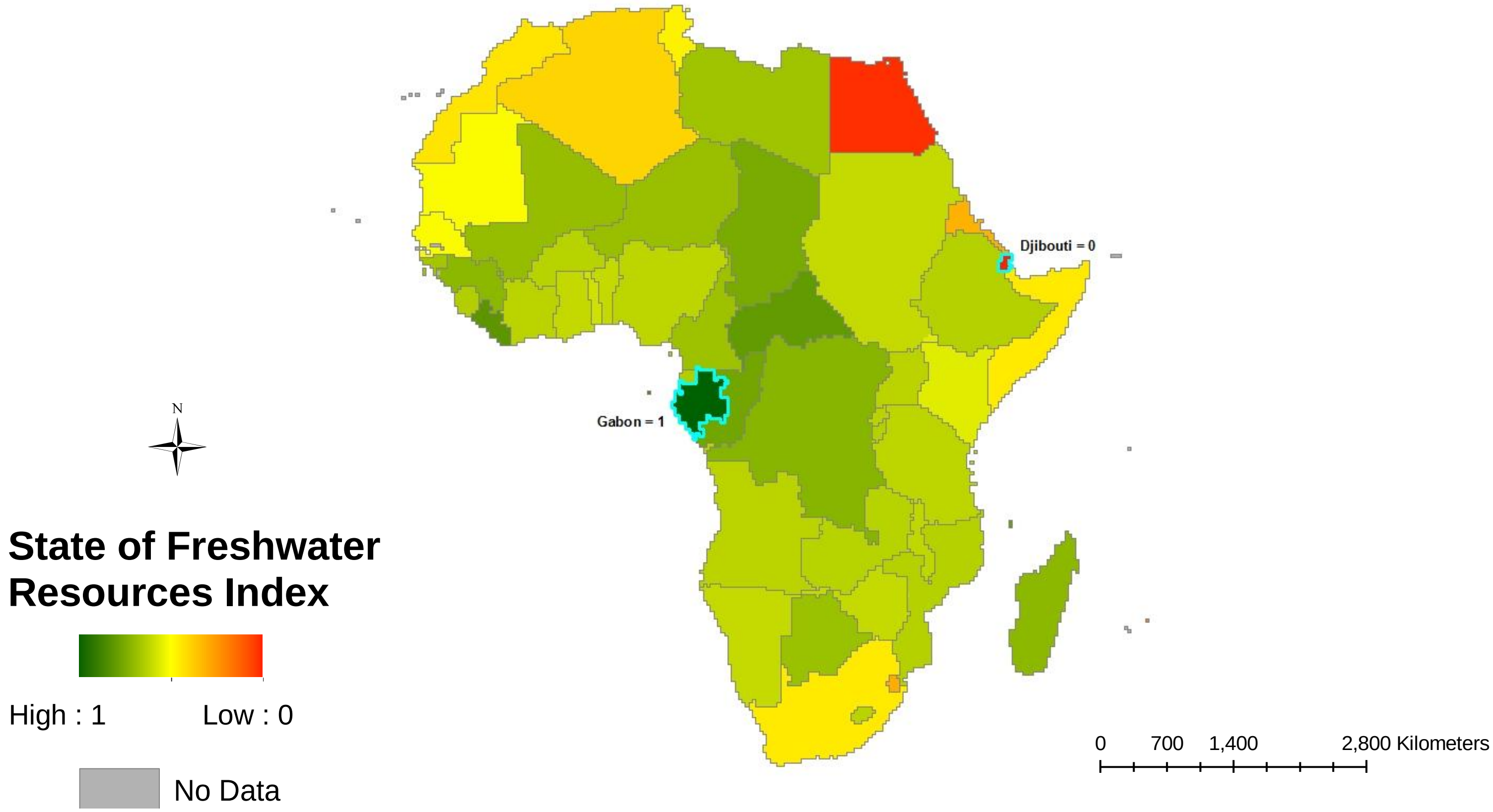


Figure 71. The *State of Freshwater Resources Index* (SOFI). Standardized for Africa on a scale between 0 (low) and 1 (high). The lowest ranking country (Djibouti) and the highest-ranking country (Gabon) are shown outlined in cyan. Areas of dark grey indicate insufficient data for those countries. [372] [373] [374] [375] [376] [377]

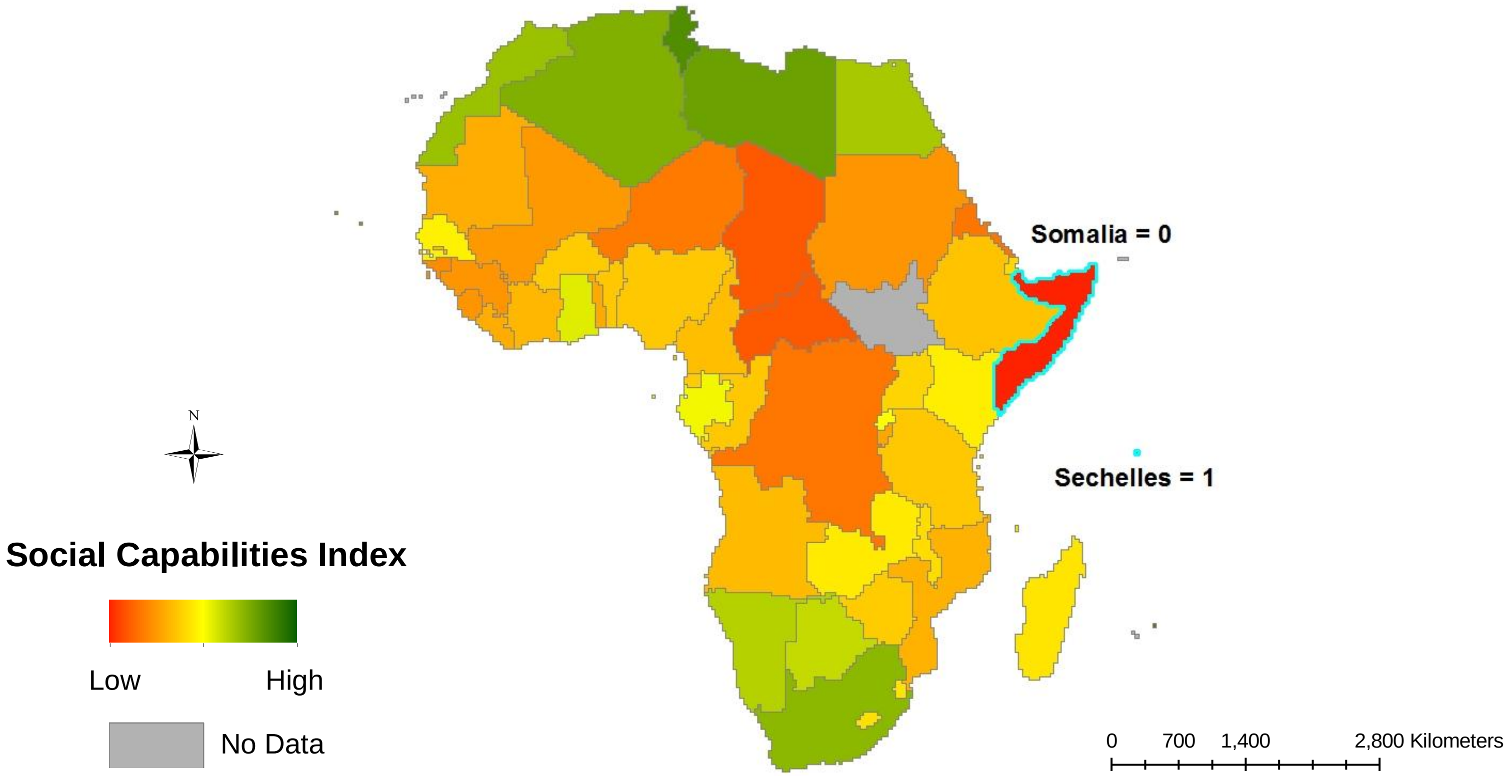


Figure 72. The *Social Capabilities Index* (SCI). Standardized for Africa on a scale between 0 (low) and 1 (high). The lowest ranking country (Somalia) and the highest-ranking country (Seychelles) are shown outlined in cyan.

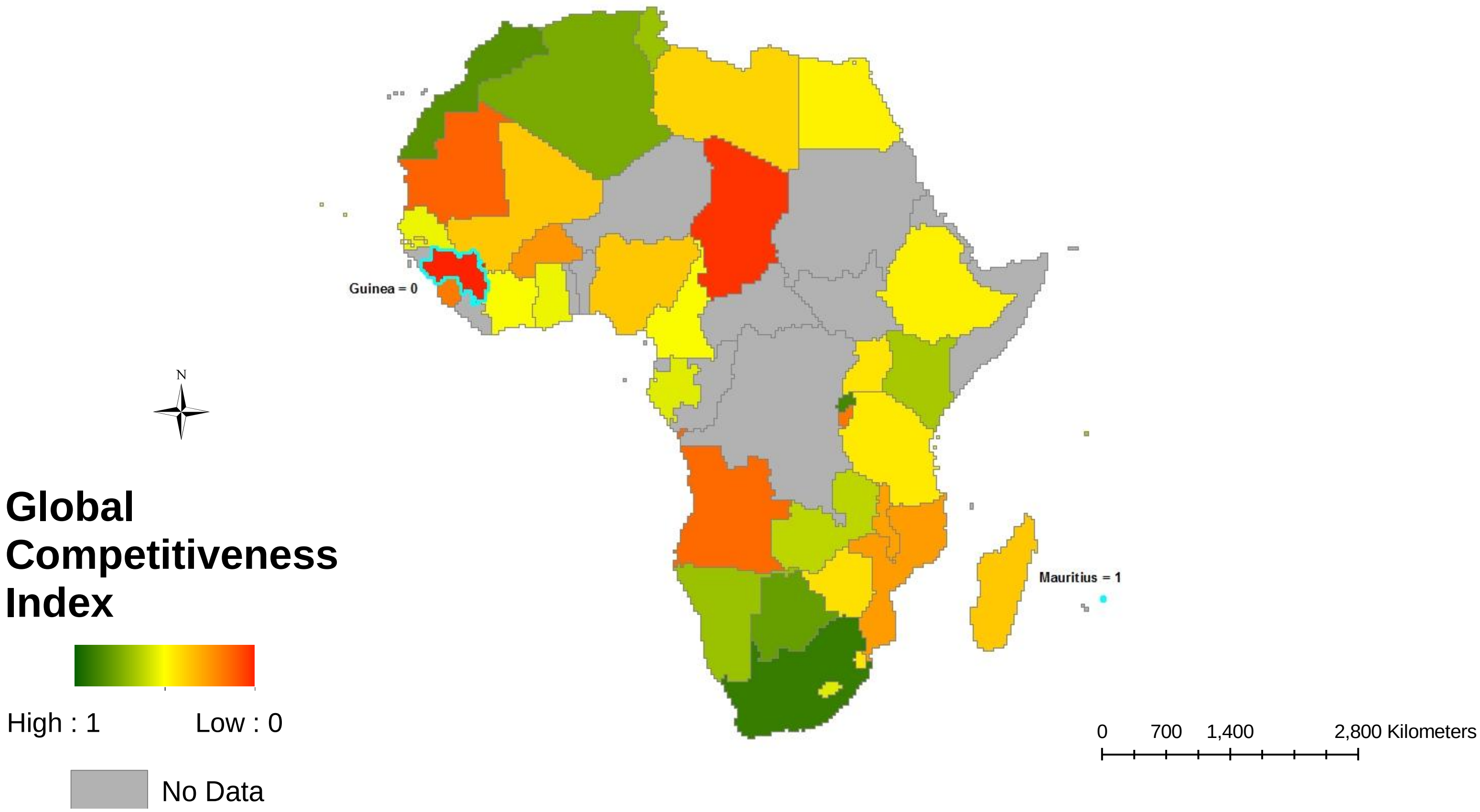


Figure 73. The *Global Competitiveness Index* (GCI). Standardized for Africa on a scale between 0 (low) and 1 (high). The lowest ranking country (Guinea) and the highest-ranking country (Mauritius) are shown outlined in cyan. Areas of dark grey indicate insufficient data.

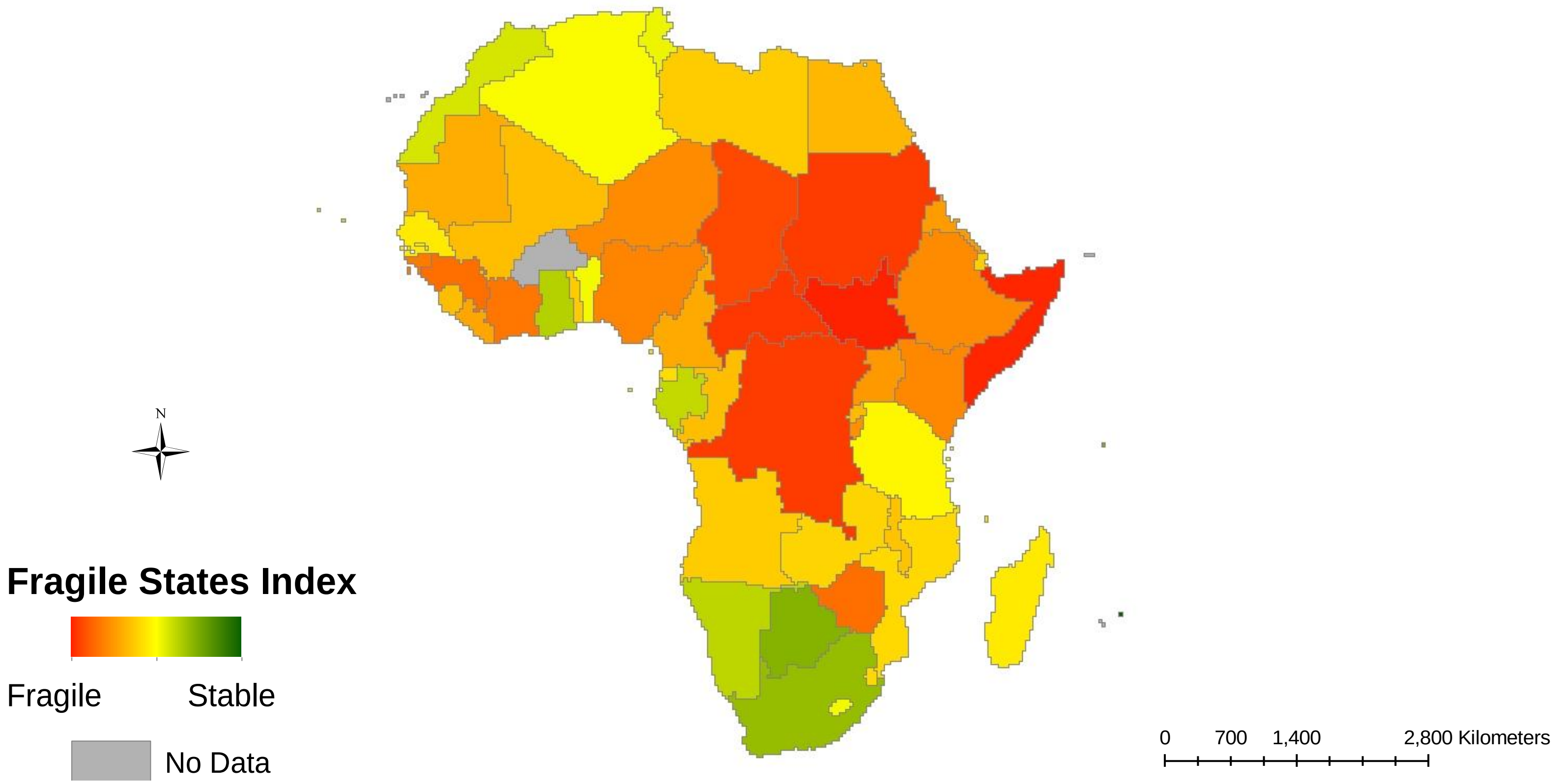


Figure 74. ***Fragile states index.*** A higher score (redder) indicates that a country is more fragile, while a lower score (greener) indicates that a country is less fragile.[378] Map layout by Keely Ledbetter.

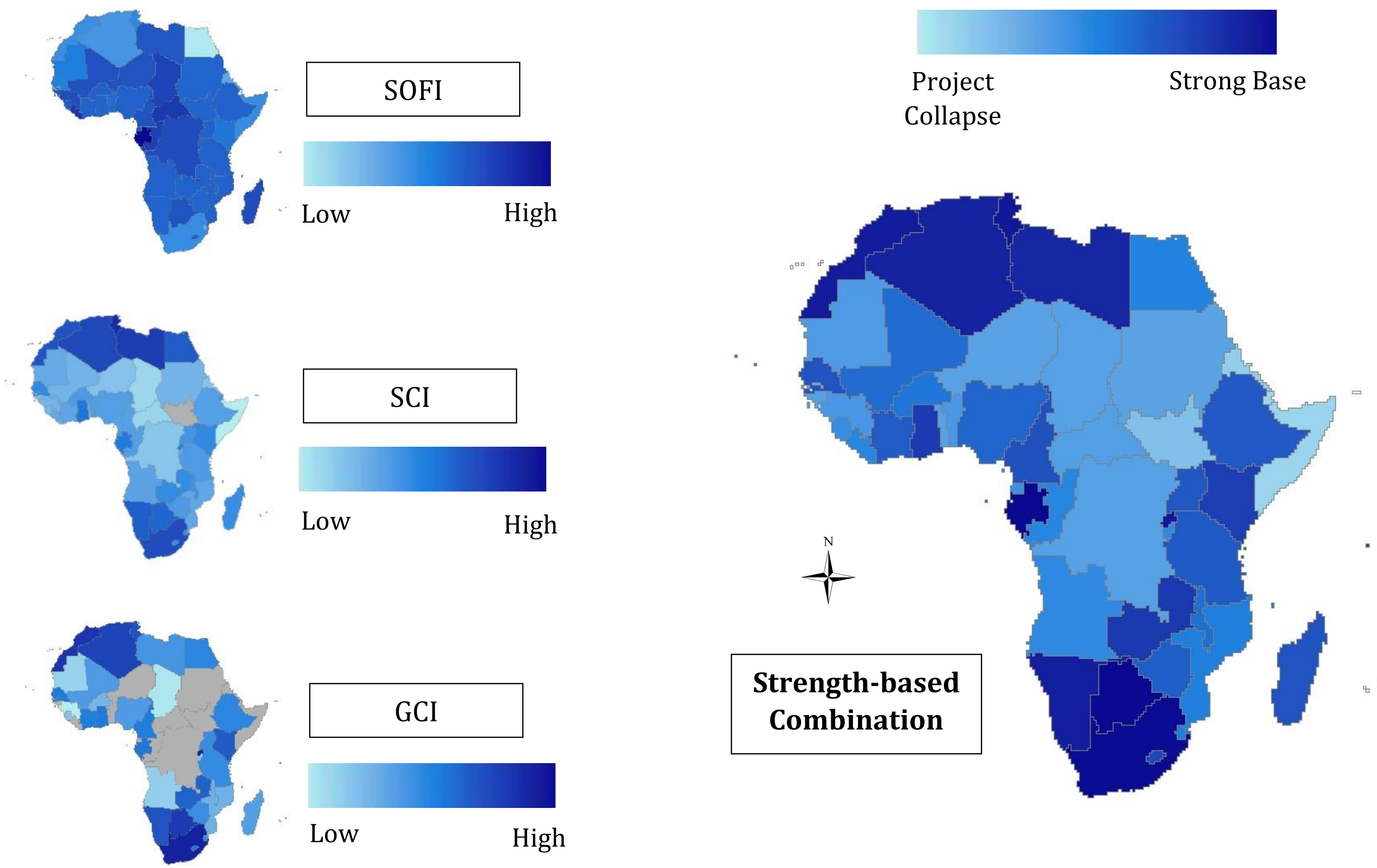
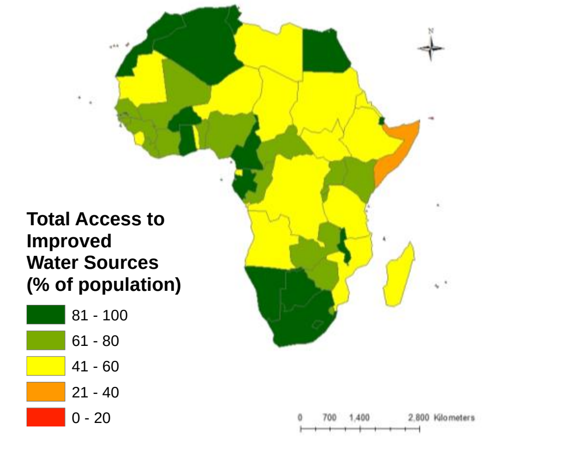
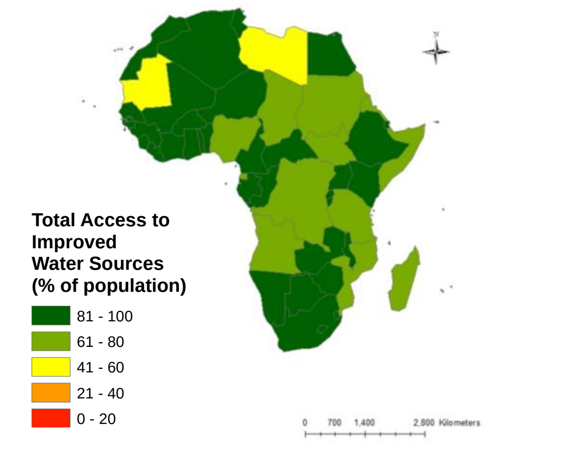


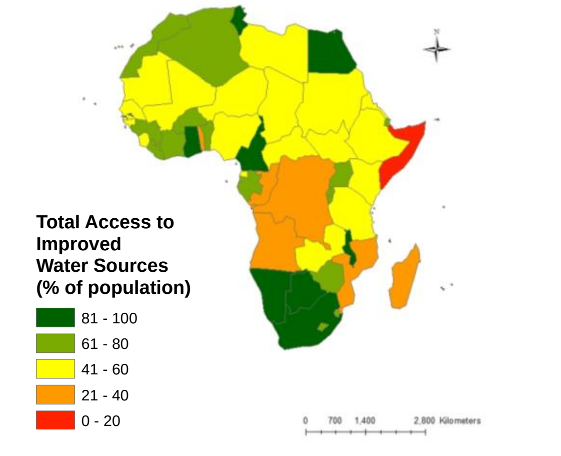
Figure 75. Strength-based combination, composed of emphasized high State of Freshwater Resources Index (SOFI), high Social Capabilities Index (SCI), and high Global Competitiveness Index (GCI). The map on the right was created from averaging the scores of the maps on the left. For the right-hand map, lighter colors indicate areas where there is a strong need for social water programming, and darker areas indicate areas where such programming would be redundant due to lack of need. Areas of grey indicate countries where no composing indices had data (for the SCI) or no score was given (for the GCI).



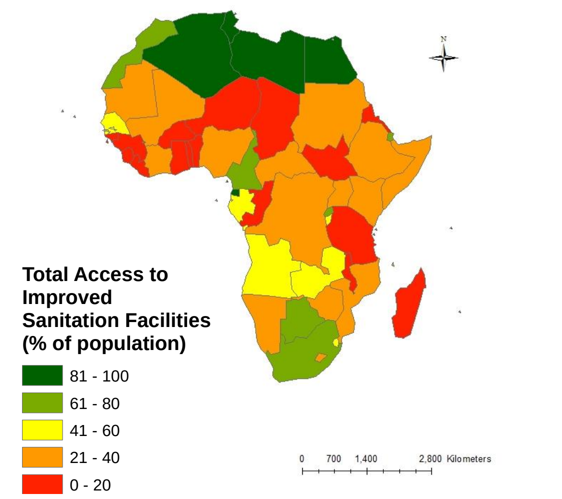
a. Total access to improved water sources.



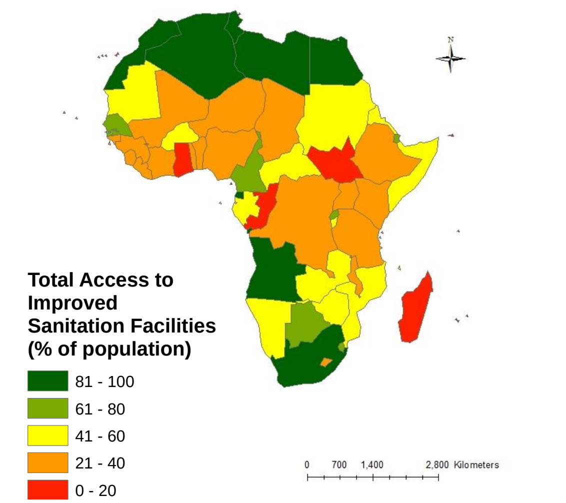
b. Urban access to improved water sources.



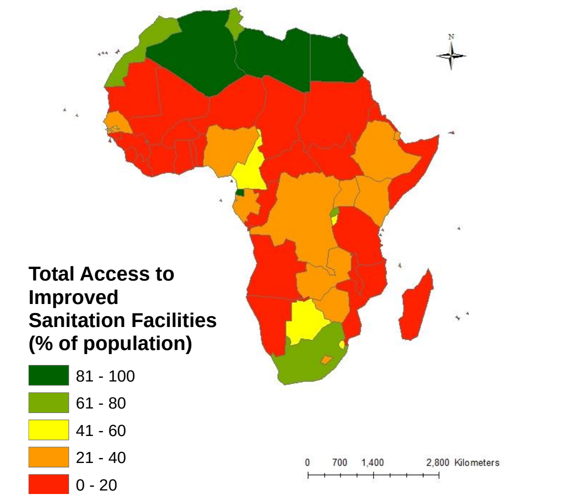
c. Rural access to improved water sources.



d. Total access to improved sanitation facilities.



e. Urban access to improved sanitation facilities.



f. Rural access to improved sanitation facilities.

Figure 76. Access to improved water sources by population—total (a), urban (b), rural (c)—and improved sanitation facilities by population—total (d), urban (e), rural(f)—by country in Africa. Values are in percentages of the specified population.

Appendix D: Value Creation Model – Tables and Figures

Tables.

Table 30: Summary of themes that inform value creation

Value creation takes place within a context

"Value is created by organizations from a wide range of interactions, activities, relationships, causes and effects. Those interactions take place in the market, regulatory, societal and natural/environmental context within which the organization operates and on which it depends. The interactions occur between the organization and its consumers, employees, stakeholders, regulators, suppliers and others operating in the context within which an organization conducts business activities. The context is also affected by natural, environmental and planetary limits."

Financial value is relevant, but not sufficient for assessing value creation

"Financial value may be manifested in various ways, including in an organization's stock price, profits, balance sheet and organizational growth, and it may change over different timeframes. According to McKinsey, companies create value by investing capital from investors to generate future cash flows at rates of return exceeding the cost of that capital…However, recent analyses challenge the narrow focus of value creation on financial value and contend that value creation extends beyond benefits directly associated with financial value or financial capital accretion. Although relevant, it is not sufficient to assess value creation only through the process of exchange in markets which sets prices and expresses the quantified worth of goods and services or through accounting concepts of value expressed in profit and loss statements, balance sheets and organizational growth."

Value is created from tangible and intangible assets

"Tangible assets have a physical form and existence. By contrast, intangible assets do not have a physical presence. In International Accounting Standard (IAS) 38, the International Accounting Standards Board (IASB) defines them as non-monetary assets, which are without physical substance. Intangible assets include brands, patents, goodwill, know-how, reputation, the knowledge held by employees and the corporate strategy…Although intangible assets are recognized for the purposes of valuing organizations, there is no standard method of accounting for them, as there is for physical assets."

Value is created from private and public/common resources

"In some cases an organization does not own or bear a direct charge for their use of, or effect on, sources of capital that are input to the business model to transform into outputs and outcomes that create value. Such sources of inputs are often known as the 'global commons' or 'common pool resources' – terms that refer to resources that are unowned, unprivatized, unregulated, free and shared by all. These include the oceans and the atmosphere and the environmental goods and services that they provide, as well as societal assets such as public road networks."

Value is created for an organization and for others

See earlier sections for discussion of shareholder and stakeholder theories of value. Additional discussion of Michael Jensen's 'value maximization' and Porter and Kramer's 'shared value' can be found below.[e]

Value is created from the connectivity between a wide range of factors

"The assessment of value creation is based on a 'compound vector of qualitative, ethical, social, aesthetic and practical' factors, the way in which they interact and the outcomes of those interactions for multiple stakeholders…Therefore, communicating value creation is not simply a question of merging financial and non-financial information. As Ernst & Young observes, a comprehensive picture of value creation is communicated through alignment between many factors including business practices, tangible and intangible assets, material financial and non-financial capital risks, the company's strategy, its engagement with multiple stakeholders, sustainability agenda, governance practices and future goals over the short, medium and long term. Communicating value creation also involves describing the trade-offs between the various interdependencies on which the value creation process depends, such as between equity and advantage and quality over quantity."

Value creation manifests itself in outcomes

"The connections and interdependencies between the different factors that contribute to the creation of value result in different outcomes for different stakeholders. Outcomes are defined…as 'the internal and external consequences (positive and negative) for the capitals as a result of an organization's business activities and outputs.' Those outcomes inform the assessment of value depending on the perspective of the stakeholders and their dependence upon the stores of capital affected by the value creation process."

Innovation is central to value creation

"Changes to the context in which organizations operate, including globalization, resource

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[e] "In Michael Jensen's report 'Value Maximization, Stakeholder Theory and the Corporate Objective Function", Jensen states that business should get the most out of society's limited resources, while returning greater value to society so that the pursuit of stakeholder value and a healthy environment helps a business to maximize its financial value. The implication of Jensen's work is that the interests of shareholders and stakeholders are not at odds. Jensen states that any potential conflicts between them should be resolved through a focus on long-term value creation, as the long term value of a company 'cannot be maximized if any important constituency is ignored or mistreated. We cannot create value without good relations with customers, employees, financial backers, suppliers, regulators, communities and so on.'

Increasingly, value creation is understood in terms of the value that is appropriated to the organization from its business activities and the value that is created for and captured by others. In 'Creating Shared Value' Michael E. Porter and Mark R. Kramer define shared value as 'creating economic value in a way that also creates value for society by addressing its needs and challenges'. They describe shared value as 'a concept that focuses on the connections between societal and economic progress… and that expands the total pool of economic and social value'. Shared value is based on the premise that having environmental or social issues that are not addressed creates internal costs for companies (e.g., wasted energy, remedial training to compensate for inadequate education systems), which constrain the extent of value creation, destroy value or, over the longer term, make the business model unsustainable."

scarcity, demographical changes and competition require strategies that secure a competitive advantage for organizations. Such strategies are aimed at generating and innovating new outcomes that distinguish the organization from others in an increasingly complex and competitive environment and that make the organization resilient and capable of adapting to new circumstances."

Values play a role in how and what type of value is created

"Whilst they are distinct from value creation, there is a relationship between value creation and values such as the beliefs, behaviors, cultural choices and philosophies embraced by an organization. Values or the absence of values, sometimes expressed in codes of business conduct, can play a role in determining the way and extent to which an organization creates and protects value."

Measures of value creation are evolving

"…measures of value such as Economic Value Added, Balanced Scorecard, Enterprise Value, Total Contribution, Total Economic Value and Total Value are emerging as means of expressing value creation. These new measures go beyond the expression of value creation in terms of market valuation and pricing. They seek to reflect the full costs and benefits of the outputs and outcomes created by an organization."

Table 31. Capitals and their descriptions

Capital	Description
Financial	Funds available for use by an organization, as obtained from financing, debt, equity, grants, or as generated through operations or investments.
Manufactured	Physical objects that were manufactured (not created naturally) and which are available for use by an organization, such as buildings, equipment, and infrastructure.
Intellectual	Knowledge-based intangibles, such as intellectual property, knowledge, and organizational procedures.
Human	People's competencies, capabilities, and experience, along with their motivations.
Social and relationship	"Institutions and the relationships within and between communities, groups of stakeholders and other networks, and the ability to share information to enhance individual and collective well-being."
Natural	Resources occurring in nature (either renewable or non-renewable) as well as ecosystem services.

Table 32. Terminology related to complex systems and causal loop diagrams

Terminology
• **Causal loop diagrams** contain two primary components: the individual variables in the system and arrows indicating the causal relationships between these variables
• **Polarity** is assigned to each arrow/causal relationship to indicate if there is a positive or negative relationship between the variables. A causal link from element A to element B is positive (+) when either A adds to B or when a change in A leads to a change in B in the *same* direction. A causal link from element A to element B is negative (-) when either A subtracts from B or when a change in A leads to a change in B in the *opposite* direction.[379]
• **Causes** refer to the variables that are *influencing* the variable that is being discussed. For example when examining variable B, the causal link from variable A to variable B is positive (+), therefore variable A is positively influencing, or causing the same behavior in variable B. Similarly, if the causal link from variable A to variable B is negative (-), variable A is negatively influencing, or causing the opposite behavior in variable B.
• **Consequence**s are the variables that are *influenced by* the variable that is being discussed. For example when examining variable A, the causal link from variable A to variable B can be positive or negative (+/-), therefore the behavior of variable B is a consequence of the behavior of variable A.
• **Stocks** refer to natural capital, societal economic capital, social capital & human capital, and firm value.
• **Intra-module** causes and consequences refer to the causes and consequences within each respective module.
• **Module interconnectedness** refers to the causal relationships between two or more modules.
• **Cause-trees** are a tool that can be used to visually evaluate causal connections in a linear manner. Furthermore, cause-trees can be used to trace pathways to value. Cause-trees also enable first-order and second-order causality to be deduced.
• **First-order connections** are variables that are directly linked to the variable that is being discussed. For example, if variable B causes variable C, which causes variable D, then when examining variable C, variable B is a first-order cause and variable D is a first-order consequence.
• **Second-order connections** are variables that are influencing or influenced by the first-order variables. For example, if variable A causes variable B, which causes variable C, which in turn causes variable D, which then causes variable E, then when examining variable C, variable A is a second-order cause. Similarly, variable E, is a second order consequence.
• **Feedback loops** are created when changes in a stock influence the flow in or out of that same stock. There are two types of feedback loops: positive (reinforcing) and negative (balancing).
• **Leverage points** are variables within a system where a change or intervention can produce significant, systemic change. When discussing leverage points, there can be high leverage points, which can be leveraged to generate significant systemic change, or low leverage points, which cause smaller, more superficial changes in the system.
• **Interventions** are actions, policies, programs or investments that are strategically leveraged to exogenously influence the behavior of a feedback loop or complex system at a leverage point.
• **Pathways to value** showcase how strategic interventions can be utilized at key leverage

points in a complex system to change the behavior of a feedback loop or complex system. Pathways to value are illustrated through cause-tree diagrams and feedback loops and ultimately serve as a tool to identify investments that can be leveraged to drive shared value in a system.

Table 33. Natural Capital Module variables

Variable	Description
Ecological replenishment	The ability of natural ecosystems to replace extracted resources. In the context of water, this can refer to groundwater recharge
Ecosystem services	The many ways in which ecosystems provide benefits to human societies and economies, including provisioning services, supporting services, regulating services, and cultural services
Habitat quality	The quality of both terrestrial and aquatic habitats, including both undeveloped and developed areas
(Box) Natural capital (water resources)	The 'stock' referring to both the quantity and quality of natural resources (both goods and services). In this model, it is focused around the quantity and quality of freshwater resources.
Pollution	Contamination by substances that are harmful to living organisms
Quantity of available water	The volume of freshwater in an area that is accessible to humans via currently existing means
Water consumption	The quantity of freshwater consumed by any actor, group, or process
Water quality	The condition of available freshwater resources (including chemical, physical, biological, and radiological characteristics) relative to the requirements of biota, including societal and economic needs

Table 34. Societal Economic Capital Module variables

Variable	Description
Availability and access to capital, capital markets, and credit	The extent to which global or local financial markets and credit providers are available and accessible to governments, firms, and individuals
Debt	Money, goods, or services owed to another individual, firm, or government
Demand	A consumer's desire for and willingness to pay for a good or service
Household economic capital	The stock of economic assets for an individual household or group of households (may also be thought of as household financial wealth)
Price	The amount of money required to purchase a quantity of a good or service
Private economic capital	The stock of economic assets held within the private sector
Production	The process of making or growing something for use or for sale
Public investments	Investments or purchases made by public institutions
Public economic capital	The stock of economic assets held by all individual people in a specific area, exclusive of public institutions or private firms
(Box) Societal economic capital	The stock of all economic assets held by all members of a society, including public and private institutions, governments, and firms
Supply	The total quantity of a particular good or service available
Tax and tariff revenue	Revenues collected by public institutions from general or specific taxes or tariffs from households, firms, or other sources

Table 35. Social and Human Capabilities Module variables

Variable	Description
Availability and access to infrastructure	The extent to which all types of infrastructure (including water, sanitation, transportation, communication, etc.) exist in an area, the quality of such infrastructure, and how easily accessible they are by any and all individuals or groups
Availability and access to local employment opportunities	The quantity and quality of employment opportunities in a given area, along with how easily discoverable and accessible such opportunities are
Availability of accessible and affordable public goods and services	The extent to which all manner of goods and services are provided for by public institutions, and how accessible they are to all members within a society
Availability of and equitable access to knowledge and information	The extent to which general and specific knowledge as well as all manner of information are easily accessible by all members within a society
Education and skills	Reflects educational attainment, educational opportunity, educational quality, and skills development
Engaged governance	Includes elements of participatory democracy, citizen participation, community engagement – both opportunities for and the realization of these factors
Equitable access to clean water and sanitation facilities	The extent to which both clean, safe drinking water and improved sanitation facilities and infrastructure are available and easily accessible by all members of a society
Equity and rights	Fairness and justice within a society, particularly around economic, political, and gender considerations, as well as the presence of recognized and accepted rights ensuring such equity
Fulfillment of basic needs	The extent to which basic human needs, such as food, water, clothing, shelter, and security are fulfilled for all members within a society or region
(Box) Human capital	The skills, knowledge, or other intangible assets of individuals that can be used in the creation of economic value
Human and social adaptability	The capacity of individuals and communities to effectively adjust their behavior and livelihoods in the face of endogenous or exogenous stressors or events
Income	Financial assets received in exchange for labor, services, the sale of goods, or from other investments

Physical and psychological well-being	The quality of being completely healthy and resilient both physically and mentally, in a way that is not merely the absence of disease or infirmity
(Box) Social capital	The norms and networks that enable collective action. It encompasses institutions, relationships, and customs that shape the quality and quantity of a society's social interactions[380]
Social cohesion and inclusion	A cohesive society works towards the well-being of all its members, fights exclusion and marginalization, creates a sense of belonging, promotes trust, and offers its members the opportunity of upward mobility[381]

Table 36. Firm Value Module variables

Variable	Description
Ability to charge price premium	The ability to sell a good or service at a price above that of the competition or market value
Access to new markets	The extent to which a firm is able to enter both new product markets and new geographic markets
Competitive advantage	An advantage a firm has over its competitors, allowing it to perform better by some measure than its competitors
Compliance costs	All costs associated with regulatory compliance
Corporate adaptability	The ability of a firm to easily adapt to all manner of changes, such as those from anywhere in its value chain, regulatory changes, environmental changes, changes in supply or demand, etc.
Cost of labor inputs	All costs associated with staffing and labor
Cost of non-labor inputs, logistics, and assets	All costs not associated with staffing and labor
Costs	All costs
Current and potential customer base	Includes characteristics such as the size, preferences, and demands of a firm’s current customers, as well as those of potential future customers
Customer loyalty	The likelihood of previous customers continuing to purchase from the same firm
(Box) Firm value	The total value of a firm, as measured by various methods or metrics
Innovation	The extent to which new ideas are translated into new goods, services, structures, or processes, or improvements to existing goods, services, structures, or processes that creates value
Insurance	All costs associated with obtaining and maintaining insurance coverage of any sort
Physical water risk	The probability of a firm experiencing a harmful or costly water-related event[382]
Private investment (incl. R&D)	Any investment from a private firm or institution
Regulatory risk	The risk that changes in laws or regulations will negatively impact or impose costs on a firm
Reputation and brand value (ESG related)	The premium that accrues to a particular brand from customers willing to pay extra for it because of its ESG-related performance or other ESG factors

Reputational water risk	The risk faced by a firm resulting from any factor related to water, particularly the firm's negative impacts to an area's water quality or quantity
Revenue	The inflow of money to a firm
Risk	The probability of damage, liability, loss, or other negative or cost creating occurrence caused as a result of external or internal factors
Sales	The quantity of market transactions in which the firm is the seller
Social license to operate	The usually implicit or tacit approval within a community or among other stakeholders for the ongoing presence and/or operations of a firm
Staff and labor productivity	The amount of goods or services produced within a given measure of time
Supply chain security	The extent to which all manner of risks upstream of a firm in their value chain have been minimized
Talent attraction and retention costs	All costs associated with recruiting highly qualified employees and retaining them as employees
Training/skills development	All costs associated with providing opportunities for employees to develop and refine skills and knowledge

Table 37. Other variables

Variable	Description
Population	Human population size

Table 38. First-order causes and consequences of each variable in the natural capital module.[f]

Natural Capital Module [A]	Intra-module cause	Intra-module consequence
Pollution	N/A	(-) Water Quality
Quantity of available water	+Ecological Replenishment (-) Water Consumption	+ Natural Capital
Water consumption	N/A	(-) Quantity of Available Water
Water quality	+ Ecosystem Services (-) Pollution	+ Habitat Quality + Natural Capital
Ecological replenishment	+Habitat Quality +Natural Capital (water resources)	+Ecosystem Services +Natural Capital (water resources +Quantity of Available water
Ecosystem services	+Habitat Quality +Natural Capital +Ecological Replenishment	+Habitat Quality +Natural Capital (water resources) +Water Quality
Habitat quality	+Ecosystem Services +Water Quality	+Ecosystem Services +Ecological Replenishment
Natural capital (water resources)	+Ecological Replenishment +Ecosystem Services +Quantity of Available Water +Water Quality	+Ecological Replenishment +Ecosystem Services

[f] ***Note:*** *(+) and (-) labels are consistent with polarity assignments in module.*

- *A causal link from variable A to variable B is positive (+) when either A adds to B or when a change in A leads to a change in B in the same direction.*
- *A causal link from element A to element B is negative (-) when either A subtracts from B or when a change in A leads to a change in B in the opposite direction.*[f]

Table 39.First-order causes and consequences of each variable in the societal economic capital module.[g]

Societal Economic Capital Module [B]	Intra-module cause	Intra-module consequence
Availability and access to capital, capital markets, and credit	+Private economic capital +Public Economic Capital +Societal Economic Capital	+Debt +Household economic capital +Private economic Capital +Public Economic capital +Societal Economic Capital
Debt	+Availability and access to capital, capital markets and credit	(-) Societal Economic Capital
Demand	+Household economic capital (-) Price	+ Price
Household economic capital	+Availability and access to capital, capital markets and credit (-) Tax and Tariff Revenue	+ Demand +Societal Economic capital +Tax and Tariff Revenue
Price	+Demand (-) Supply	+ Production (-) Demand
Private economic capital	+Availability and access to capital, capital markets and credit (-) Tax and Tariff Revenue	+Availability and access to capital, capital markets and credit +Production +Societal Economic Capital +Tax and Tariff Revenue
Production	+ Private Economic Capital +Price	+Supply
Public investments	+Public Economic Capital	(-) Public Economic Capital
Public economic capital	+Availability and access to capital, capital markets and credit +Tax and Tariff Revenue (-) Public Investment	+Availability and access to capital, capital markets and credit +Public Investments +Societal economic capital
Supply	+ Production	(-) Price
Tax and tariff revenue	+Household Economic Capital +Private economic Capital	(-) Household economic capital (-) Private economic capital

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[g] ***Note:*** *(+) and (-) labels are consistent with polarity assignments in module*

- *A causal link from variable A to variable B is positive (+) when either A adds to B or when a change in A leads to a change in B in the same direction.*
- *A causal link from element A to element B is negative (-) when either A subtracts from B or when a change in A leads to a change in B in the opposite direction.*[g]

		(-) Public Economic Capital
Societal economic capital	+Availability and access to capital, capital markets and credit (-) Debt + Household Economic Capital + Private Economic capital + Public Economic Capital	+Availability and access to capital, capital markets and credit

Table 40. Description of variables in the social and human capabilities module.

Variable	Description
Availability and access to infrastructure	The extent to which all types of infrastructure (including water, sanitation, transportation, communication, etc.) exist in an area, the quality of such infrastructure, and how easily accessible they are by any and all individuals or groups
Availability and access to local employment opportunities	The quantity and quality of employment opportunities in a given area, along with how easily discoverable and accessible such opportunities are
Availability of accessible and affordable public goods and services	The extent to which all manner of goods and services are provided for by public institutions, and how accessible they are to all members within a society
Availability of and equitable access to knowledge and information	The extent to which general and specific knowledge as well as all manner of information are easily accessible by all members within a society
Education and skills	Reflects educational attainment, educational opportunity, educational quality, and skills development
Engaged governance	Includes elements of participatory democracy, citizen participation, community engagement – both opportunities for and the realization of these factors
Equitable access to clean water and sanitation facilities	The extent to which both clean, safe drinking water and improved sanitation facilities and infrastructure are available and easily accessible by all members of a society
Equity and rights	Fairness and justice within a society, particularly around economic, political, and gender considerations, as well as the presence of recognized and accepted rights ensuring such equity
Fulfillment of basic needs	The extent to which basic human needs, such as food, water, clothing, shelter, and security are fulfilled for all members within a society or region
(Box) Human capital	The skills, knowledge, or other intangible assets of

	individuals that can be used in the creation of economic value
Human and social adaptability	The capacity of individuals and communities to effectively adjust their behavior and livelihoods in the face of endogenous or exogenous stressors or events
Income	Financial assets received in exchange for labor, services, the sale of goods, or from other investments
Physical and psychological well-being	The quality of being completely healthy and resilient both physically and mentally, in a way that is not merely the absence of disease or infirmity
(Box) Social capital	The norms and networks that enable collective action. It encompasses institutions, relationships, and customs that shape the quality and quantity of a society's social interactions [383]
Social cohesion and inclusion	A cohesive society works towards the well-being of all its members, fights exclusion and marginalization, creates a sense of belonging, promotes trust, and offers its members the opportunity of upward mobility[384]

Table 41. First-order causes and consequences of each variable in the social and human capabilities module.[h]

Social and Human Capabilities Module [C]	Intra-module cause	Intra-module consequence
Availability and access to infrastructure	+Availability of accessible and affordable public goods and services	+Availability and access to local employment opportunities +Equitable access to clean water and sanitation facilities +Social capital
Availability and access to local employment opportunities	+Availability and access to infrastructure	+Education and skills +Human and social adaptability +Income +Social Capital
Availability of accessible and affordable public goods and services	+Engaged Governance	+Availability and access to infrastructure +Availability of and equitable access to knowledge and information +Fulfillment of basic needs
Availability of and equitable access to knowledge and information	+Availability of accessible and affordable public goods and services	+Education and skills +Human and Social adaptability
Education and skills	+Availability and access to local employment opportunities +Availability of and equitable access to knowledge and information +Physical and psychological well-being	+Human and social adaptability +Human Capital +Income
Engaged governance	N/A	+Availability of accessible and affordable public goods and services +Equity and rights +Human and social adaptability +Social Capital +Social Cohesion and Inclusion

[h] ***Note:*** *(+) and (-) labels are consistent with polarity assignments in module*

- *A causal link from variable A to variable B is positive (+) when either A adds to B or when a change in A leads to a change in B in the same direction.*
- *A causal link from element A to element B is negative (-) when either A subtracts from B or when a change in A leads to a change in B in the opposite direction.*[h]

Equitable access to clean water and sanitation facilities	+Availability and access to infrastructure	+Equity and rights +Fulfillment of basic needs
Equity and rights	+Engaged governance +Equitable access to clean water and sanitation facilities	+Human capital +Social Capital +Social Cohesion and Inclusion
Fulfillment of basic needs	+Equitable access to clean water and sanitation facilities +Income +Availability of accessible and affordable public goods and services	+Human Capital +Physical and psychological well-being
Human and social adaptability	+Availability and access to local employment opportunities +Availability of and equitable access to knowledge and information +Education and skills +Engaged Governance +Human Capital +Income +Physical and psychological well-being +Social Capital	+Human Capital
Income	+Availability and access to local employment opportunities +Education and skills	+Fulfillment of basic needs +Human and social adaptability
Physical and psychological well-being	+Fulfillment of basic needs	+Education and skills +Human and Social Adaptability +Human Capital
Social cohesion and inclusion	+Engaged Governance +Equity and rights	+Human Capital +Social Capital
Human capital	+Education and skills +Equity and rights +Fulfillment of basic needs +Human and Social Adaptability +Physical and psychological well-being +Social Capital +Social Cohesion and Inclusion	+Human and Social Adaptability +Social Capital
Social capital	+Availability and access to infrastructure +Availability and access to local employment opportunities +Engaged Governance +Equity and rights +Human Capital	+Human and social adaptability +Human capital

+Social cohesion and inclusion

Table 42. Description of variables in the social and human capabilities module.

Variable	Description
Ability to charge price premium	The ability to sell a good or service at a price above that of the competition or market value
Access to new markets	The extent to which a firm is able to enter both new product markets and new geographic markets
Competitive advantage	An advantage a firm has over its competitors, allowing it to perform better by some measure than its competitors
Compliance costs	All costs associated with regulatory compliance
Corporate adaptability	The ability of a firm to easily adapt to all manner of changes, such as those from anywhere in its value chain, regulatory changes, environmental changes, changes in supply or demand, etc.
Cost of labor inputs	All costs associated with staffing and labor
Cost of non-labor inputs, logistics, and assets	All costs not associated with staffing and labor
Costs	All costs
Current and potential customer base	Includes characteristics such as the size, preferences, and demands of a firm's current customers, as well as those of potential future customers
Customer loyalty	The likelihood of previous customers continuing to purchase from the same firm
(Box) Firm value	The total value of a firm, as measured by various methods or metrics
Innovation	The extent to which new ideas are translated into new goods, services, structures, or processes, or improvements to existing goods, services, structures, or processes that creates value
Insurance	All costs associated with obtaining and maintaining insurance coverage of any sort
Physical water risk	The probability of a firm experiencing a harmful or costly water-related event[385]
Private investment (incl. R&D)	Any investment from a private firm or institution
Regulatory risk	The risk that changes in laws or regulations will negatively impact or impose costs on a firm
Reputation and brand value (ESG related)	The premium that accrues to a particular brand from customers willing to pay extra for it because of its ESG-related performance or other ESG factors

Reputational water risk	The risk faced by a firm resulting from any factor related to water, particularly the firm's negative impacts to an area's water quality or quantity
Revenue	The inflow of money to a firm
Risk	The probability of damage, liability, loss, or other negative or cost creating occurrence caused as a result of external or internal factors
Sales	The quantity of market transactions in which the firm is the seller
Social license to operate	The usually implicit or tacit approval within a community or among other stakeholders for the ongoing presence and/or operations of a firm
Staff and labor productivity	The amount of goods or services produced within a given measure of time
Supply chain security	The extent to which all manner of risks upstream of a firm in their value chain have been minimized
Talent attraction and retention costs	All costs associated with recruiting highly qualified employees and retaining them as employees
Training/skills development	All costs associated with providing opportunities for employees to develop and refine skills and knowledge

Table 43. First-order causes and consequences of each variable in the social and human capabilities module.[i]

Firm Value Module [D]	Intra-module cause	Intra-module consequence
Ability to charge price premium	+Competitive advantage +Reputation and brand value (ESG related)	+Revenue
Access to new markets	+Innovation	+Corporate Adaptability +Current and Potential customer base
Competitive advantage	+Corporate Adaptability +Customer Loyalty +Innovation +Reputation and Brand Value (ESG related)	+Ability to Charge Price Premium +Firm Value (-) Risk

[i]***Note:*** *(+) and (-) labels are consistent with polarity assignments in module*

- *A causal link from variable A to variable B is positive (+) when either A adds to B or when a change in A leads to a change in B in the same direction.*
  A causal link from element A to element B is negative (-) when either A subtracts from B or when a change in A leads to a change in B in the opposite direction.[i]

	+Social License to operate +Supply Chain Security (-) Risk	
Compliance costs	+Regulatory Risk	+Costs
Corporate adaptability	+Access to new markets +Innovation +Training/skills development	+Competitive Advantage (-) Risk
Cost of labor inputs	+Talent attraction and retention costs (-) Staff and labor productivity	+Costs
Cost of non-labor inputs, logistics, and assets	(-) Supply Chain Security	+Costs
Costs	+Compliance Costs +Cost of labor inputs +Cost of non-labor inputs , logistics and assets +Innovation +Insurance +Private Investment (incl. R&D)	(-) Firm Value
Current and potential customer base	+Access to new markets +Reputation and brand value (ESG related) +Training/skills development	+Sales
Customer loyalty	+Reputation and brand value (ESG related)	+Competitive Advantage
Innovation	+Private Investment (incl. R&D) +Training/skills Development	+Access to new markets +Competitive Advantage +Corporate Adaptability +Costs
Insurance	+Risk	+Costs
Physical water risk	N/A	+Regulatory Risk +Reputational water risk +Risk (-) social license to operate (-) Supply Chain Security
Private investment (incl. R&D)	N/A	+Costs +Innovation +Revenue
Regulatory risk	+Physical water risk +Reputational Water Risk (-) Social License to operate	+Compliance Costs +Risk
Reputation and brand value (ESG related)	+Supply Chain Security +Training/skill development	+Ability to charge price premium

		+Competitive advantage Current and potential customer base Customer loyalty +Social license to operate (-) Reputational Water risk (-) Talent attraction and retention costs
Reputational water risk	+Physical water risk (-) Social License to operate (-) Reputation and brand value (ESG related)	+Regulatory Risk +Risk (-) Social License to operate
Revenue	+Ability to charge price premium +Private investment (incl. R&D) +Sales	+Firm Value
Risk	+Physical Water risk +Regulatory Risk +Reputational water risk (-) Social License to operate (-) Supply Chain security (-) Competitive advantage	+ Insurance (-) Firm Value (-) Competitive Advantage
Sales	+Current and potential customer base	+Revenue
Social license to operate	+Reputation and brand value (ESG related) (-) Reputational Water risk (-) Physical water risk	(+) Competitive advantage (-) Regulatory Risk (-) Reputational water risk (-) Risk
Staff and labor productivity	+ Training/skills development	(-) Cost of labor inputs
Supply chain security	(-) Physical Water risk	+ Competitive Advantage +Reputation and brand value (ESG related) (-) Risk (-) Cost of non-labor inputs, logistics and assets
Talent attraction and retention costs	(-) Reputation and brand value (ESG related)	+ Cost of labor inputs
Training/skills development	+Staff and labor productivity	+Cost of labor inputs
Firm value	+Competitive advantage +Revenue (-) Risk (-) costs	N/A

Table 44. Variables interacting in the Natural Capital and Societal economic Capital Modules.

Natural Capital Module [A]	Societal Economic Capital Module [B]
Pollution	Availability and access to capital, capital markets, and credit
Quantity of available water	Debt
Water consumption	Demand
Water quality	Household economic capital
Ecological replenishment	Price
Ecosystem services	Private economic capital
Habitat quality	Production
Natural capital (water resources)	Public investments
	Public economic capital
	Supply
	Tax and tariff revenue
	Societal economic capital

Table 45. Variable interacting in the Natural Capital and Social and Human Capabilities Modules.

Natural Capital Module [A]	Social and Human Capabilities Module [C]
Pollution	Availability and access to infrastructure
Quantity of available water	Availability and access to local employment opportunities
Water consumption	Availability of accessible and affordable public goods and services
Water quality	Availability of and equitable access to knowledge and information
Ecological replenishment	Education and skills
Ecosystem services	Engaged governance
Habitat quality	Equitable access to clean water and sanitation facilities
Natural capital (water resources)	Equity and rights
	Fulfillment of basic needs
	Human and social adaptability
	Income
	Physical and psychological well-being
	Social cohesion and inclusion
	Human capital
	Social capital

Table 46. Variables interacting in the Societal Economic Capital and Social and Human Capabilities Modules.

Societal Economic Capital Module [B]	Social and Human Capabilities Module [C]
Availability and access to capital, capital markets, and credit	Availability and access to infrastructure
Debt	Availability and access to local employment opportunities
Demand	Availability of accessible and affordable public goods and services
Household economic capital	Availability of and equitable access to knowledge and information
Price	Education and skills
Private economic capital	Engaged governance
Production	Equitable access to clean water and sanitation facilities
Public investments	Equity and rights
Public economic capital	Fulfillment of basic needs
Supply	Human and social adaptability
Tax and tariff revenue	Income
Societal economic capital	Physical and psychological well-being
	Social cohesion and inclusion
	Human capital
	Social capital

Table 47. Variables interacting in the Natural Capital and Firm Value Modules

Natural Capital Module [A]	Firm Value Module [D]
Pollution	Ability to charge price premium
Quantity of available water	Access to new markets
Water consumption	Competitive advantage
Water quality	Compliance costs
Ecological replenishment	Corporate adaptability
Ecosystem services	Cost of labor inputs
Habitat quality	Cost of non-labor inputs, logistics, and assets
Natural capital (water resources)	Costs
	Current and potential customer base
	Customer loyalty
	Innovation
	Insurance
	Physical water risk
	Private investment (incl. R&D)
	Regulatory risk
	Reputation and brand value (ESG related)
	Reputational water risk
	Revenue
	Risk
	Sales
	Social license to operate
	Staff and labor productivity
	Supply chain security
	Talent attraction and retention costs
	Training/skills development
	Firm value

Table 48. Variable interacting in the Societal Economic Capital and Firm Value Module.

Societal Economic Capital Module [B]	Firm Value Module [D]
Availability and access to capital, capital markets, and credit	Ability to charge price premium
Debt	Access to new markets
Demand	Competitive advantage
Household economic capital	Compliance costs
Price	Corporate adaptability
Private economic capital	Cost of labor inputs
Production	Cost of non-labor inputs, logistics, and assets
Public investments	Costs
Public economic capital	Current and potential customer base
Supply	Customer loyalty
Tax and tariff revenue	Innovation
Societal economic capital	Insurance
	Physical water risk
	Private investment (incl. R&D)
	Regulatory risk
	Reputation and brand value (ESG related)
	Reputational water risk
	Revenue
	Risk
	Sales
	Social license to operate
	Staff and labor productivity
	Supply chain security
	Talent attraction and retention costs
	Training/skills development
	Firm value

Table 49. Variables interacting in the Social and Human Capabilities Module and Firm Value Module.

Social and Human Capabilities Module [C]	Firm Value Module [D]
Availability and access to infrastructure	Ability to charge price premium
Availability and access to local employment opportunities	Access to new markets
Availability of accessible and affordable public goods and services	Competitive advantage
Availability of and equitable access to knowledge and information	Compliance costs
Education and skills	Corporate adaptability
Engaged governance	Cost of labor inputs
Equitable access to clean water and sanitation facilities	Cost of non-labor inputs, logistics, and assets
Equity and rights	Costs
Fulfillment of basic needs	Current and potential customer base
Human and social adaptability	Customer loyalty
Income	Innovation
Physical and psychological well-being	Insurance
Social cohesion and inclusion	Physical water risk
Social capital	Private investment (incl. R&D)
Human Capital	Regulatory risk
	Reputation and brand value (ESG related)
	Reputational water risk
	Revenue
	Risk
	Sales
	Social license to operate
	Staff and labor productivity
	Supply chain security
	Talent attraction and retention costs
	Training/skills development
	Firm value

Table 50. Variables interacting in the full Water Stewardship CLD.

Natural Capital Module [A]	Societal Economic Capital Module [B]	Social and Human Capabilities Module [C]	Firm Value Module [D]
Pollution	Availability and access to capital, capital markets, and credit	Availability and access to infrastructure	Ability to charge price premium
Quantity of available water	Debt	Availability and access to local employment opportunities	Access to new markets
Water consumption	Demand	Availability of accessible and affordable public goods and services	Competitive advantage
Water quality	Household economic capital	Availability of and equitable access to knowledge and information	Compliance costs
Ecological replenishment	Price	Education and skills	Corporate adaptability
Ecosystem services	Private economic capital	Engaged governance	Cost of labor inputs
Habitat quality	Production	Equitable access to clean water and sanitation facilities	Cost of non-labor inputs, logistics, and assets
Natural capital (water resources)	Public investments	Equity and rights	Costs
	Public economic capital	Fulfillment of basic needs	Current and potential customer base
	Supply	Human and social adaptability	Customer loyalty
	Tax and tariff revenue	Income	Innovation
	Societal economic capital	Physical and psychological well-being	Insurance
		Social cohesion and inclusion	Physical water risk
		Human capital	Private investment (incl. R&D)
		Social capital	Regulatory risk
			Reputation and brand value (ESG related)
			Reputational water risk
			Revenue
			Risk
			Sales

	Social license to operate
	Staff and labor productivity

Table 51. First-order causes and consequences of habitat quality.[j]

Natural Capital Module [A]	First-order cause	First-order consequence
Habitat quality	+Ecosystem Services +Water Quality	+Ecosystem Services +Ecological Replenishment

Table 52. First-order causes and consequences of fulfillment of basic needs.[k]

Social and Human Capabilities Module [C]	First-order cause	First-order consequence
Fulfillment of basic needs	+Equitable access to clean water and sanitation facilities +Income +Availability of accessible and affordable public goods and services	+Human Capital +Physical and psychological well-being

[j] ***Note:*** *(+) and (-) labels are consistent with polarity assignments in module.*

- *A causal link from variable A to variable B is positive (+) when either A adds to B or when a change in A leads to a change in B in the same direction.*

[k] ***Note:*** *(+) and (-) labels are consistent with polarity assignments in module.*

- *A causal link from variable A to variable B is positive (+) when either A adds to B or when a change in A leads to a change in B in the same direction.*

Table 53: Analyzing potential to create value from investments in *water for productive use/sustainable agriculture* **in top 10 most 'globally competitive' nations in Africa**

Global Competitiveness Index RANK *Data on 38 countries (#1= highest)	Country	Agricultural Land (sq. km) *Data on 53 countries (#1 = highest)	Agricultural Land (% of Land Area) * Data on 52 countries (#1=highest)	Annual Freshwater Withdrawals for Agriculture (% of total withdrawal) *Data on 52 countries (#1= highest)
1	Mauritius**	#51 (870)	#33 (42.85%)	#26 (67.72%)
2	South Africa**	#2 (963410)	#2 (79.41%)	#29 (62.69%)
3	Rwanda*	#44 (18567.7)	#6 (75.26%)	#25 (68%)
4	Morocco	#16 (304030)	#15 (68.12%)	#11 (87.31%)
5	Botswana**	#20 (258879)	#31 (45.677%)	#38 (41.24%)
6	Algeria	#10 (414320)	#46 (17.39%)	#30 (61.69%)
7	Tunisia	#30 (100790)	#16 (64.87%)	#22 (75.96%)
8	Namibia*	#14 (3888090)	#28 (47.13%)	#24 (69.76%)
9	Kenya**	#18 (274300)	#25 (48.19%)	#16 (79.16%)
10	Seychelles*	#52 (30)	#51 (6.52%)	#50 (6.56%)

* Listed on KPMG's Top 10 Ease of Doing Business list for Africa

** Listed on KPMG's Top 10 Ease of Doing Business list for Africa & KPMG's Africa's top 10 for investment list

Table 54. Analyzing potential to create value from investments in water for productive use/sustainable agriculture in Africa's top 10 for investment (KPMG) and Africa's top 10 for Ease of Doing Business (KPMG)

Global Competitiveness Index RANK *Data on 38 countries (#1 =highest)	Country	Reason for Inclusion (KPMG)	Agricultural Land (sq. km) *Data on 53 countries (#1 = highest)	Agricultural Land (% of Land Area) * Data on 52 countries (#1=highest)	Annual Freshwater Withdrawals for Agriculture (% of total withdrawal) *Data on 52 countries (#1= highest)
#11	Zambia	Top 10 Ease of Doing Business (KPMG)	#21 (238360)	#41 (32.06%)	#23 (73.28%)
#14	Ghana	Top 10 Ease of Doing Business & Africa's top 10 for investment (KPMG)	#24 (157000)	#14 (68.99%)	#28 (66.4%)
#19	Ethiopia	Africa's top 10 for investment (KPMG)	#15 (364880)	#37 (36.48%)	#7 (93.63%)
#21	Tanzania	Africa's top 10 for investment (KPMG)	#12 (406500)	#30 (45.89%)	#10 (89.35%)
#22	Uganda	Top 10 Ease of Doing Business (KPMG)	#27 (142620)	#9 (71.37%)	#40 (37.81%)
#27	Nigeria	Africa's top 10 for investment (KPMG)	#3 (720000)	#3 (79.05%)	#31 (53.75%)
#31	Mozambique	Africa's top 10 for investment (KPMG)	#5 (499500)	#18 (63.51%)	#18 (78.04%)
#35	Angola	Africa's top 10 for investment (KPMG)	#4 (591900)	#26 (47.44%)	#44 (20.78%)

Table 55 Analyzing potential to create value from investments in *water, sanitation and hygiene (drinking water supply)* **in the top 10 most 'globally competitive' nations in Africa**

Global Competitiveness Index RANK *Data on 38 countries (#1=highest)	Country	Annual freshwater withdrawal dedicated to domestic uses (%of total) * Data on 52 countries (#1=highest)	% of total population with access to improved sources of water *Data on 55 countries (#1=lowest)	% of rural population with access to improved sources of water *Data on 55 countries (#1=lowest)	% of urban population with access to improved sources of water *Data on 55 countries (#1=lowest)	Benefit to Cost Ratio for Investments in Drinking-Water Supply
1	Mauritius**	#24 (29.52%)	#52 (100%)	#54 (100%)	#51 (100%)	4.2
2	South Africa**	#22 (31.23%)	#45 (95%)	#47 (88%)	#46 (99%)	4.7
3	Rwanda*	#28 (24%)	#21 (71%)	#31 (68%)	#15 (81%)	1.5
4	Morocco	#42 (9.81%)	#35 (84%)	#28 (64%)	#44 (98%)	1.6
5	Botswana**	#17 (40.72%)	#48 (97%)	#49 (93%)	#46 (99%)	3.2
6	Algeria	#27 (24.24%)	#44 (94%)	#40 (79%)	#17 (85%)	2.4
7	Tunisia	#38 (12.81%)	#48 (97%)	#48 (90%)	#51 (100%)	2.1
8	Namibia*	#26 (25.35%)	#41 (92%)	#46 (90%)	#44 (98%)	2.8
9	Kenya**	#38 (17.18%)	#16 (62%)	#20 (55%)	#16 (82%)	2.8
10	Seychelles*	#6 (65.69%)	347 (96%)	No Data	No Data	No Data

* Listed on KPMG's Top 10 Ease of Doing Business list for Africa
** Listed on KPMG's Top 10 Ease of Doing Business list for Africa & KPMG's Africa's top 10 for investment list

Table 56 Analyzing potential to create value from investments in ***water, sanitation and hygiene (drinking water supply)*** **in Africa's top 10 for investment (KPMG) and Africa's top 10 for Ease of Doing Business (KPMG)**

Global Competitiveness Index RANK *Data on 38 countries (#1 =highest)	Country	Reason for Inclusion (KPMG)	Annual freshwater withdrawal dedicated to domestic uses (%of total) * Data on 52 countries (#1=highest)	% of total population with access to improved sources of water *Data on 55 countries (#1=lowest)	% of rural population with access to improved sources of water *Data on 55 countries (#1=lowest)	% of urban population with access to improved sources of water *Data on 55 countries (#1=lowest)	Benefit to Cost Ratio for Investments in Drinking-Water Supply
#11	Zambia	Top 10 Ease of Doing Business	#31 (18.45%)	#17 (63%)	#15 (49%)	#17 (85%)	1.9
#14	Ghana	Top 10 Ease of Doing Business & Africa's top 10 for investment	#29 (23.93%)	#37 (87%)	#41 (81%)	#32 (93%)	5.8
#19	Ethiopia	Africa's top 10 for investment	#45 (5.991%)	#8 (52%)	#8 (42%)	#40 (97%)	0.8
#21	Tanzania	Africa's top 10 for investment	#41 (10.17%)	#9 (53%)	#12 (44%)	#10 (78%)	1.4
#22	Uganda	Top 10 Ease of Doing Business	#12 (47.7%)	#25 (75%)	#36 (71%)	#36 (95%)	1.7
#27	Nigeria	Africa's top 10 for investment	#21 (31.27%)	#18 (64%)	#15 (49%)	#12 (79%)	4.4
#31	Mozambique	Africa's top 10 for investment	#30 (19.22%)	#3 (49%)	#4 (35%)	#14 (80%)	3.3
#35	Angola	Africa's top 10 for investment	#15 (41.05%)	#10 (54%)	#3 (34%)	#6 (68%)	3.9

Table 57 Analyzing potential to create value from investments in *water, sanitation and hygiene (sanitation)* **in the top 10 most 'globally competitive' nations in Africa**

Global Competitiveness Index RANK *Data on 38 countries (#1=highest)	Country	% of total population with access to improved sanitation *Data on 55 countries (#1=lowest)	% of rural population with access to improved sanitation *Data on 55 countries (#1=lowest)	% of urban population with access to improved sanitation *Data on 55 countries (#1=lowest)	Benefit to Cost Ratio for Investments in Sanitation
1	Mauritius**	#50 (91%)	#51 (90%)	#48 (92%)	17.75
2	South Africa**	#46 (74%)	#45 (62%)	#45 (82%)	7.49
3	Rwanda*	#42 (64%)	#47 (64%)	#37 (61%)	2.09
4	Morocco	#47 (75%)	#46 (63%)	#46 (85%)	4.51
5	Botswana**	#42 (64%)	#39 (42%)	#44 (78%)	16.31
6	Algeria	#51 (95%)	#50 (88%)	#52 (98%)	4.84
7	Tunisia	#49 (90%)	#48 (77%)	#50 (97%)	5.98
8	Namibia*	#29 (32%)	#24 (17%)	#35 (56%)	11.33
9	Kenya**	#26 (30%)	#31 (29%)	#13 (31%)	2.11
10	Seychelles*	#53 (97%)	No Data	No Data	No Data

* Listed on KPMG's Top 10 Ease of Doing Business list for Africa
** Listed on KPMG's Top 10 Ease of Doing Business list for Africa & KPMG's Africa's top 10 for investment list

Table 58 Analyzing potential to create value from investments in *water, sanitation and hygiene (sanitation)* **in Africa's top 10 for investment (KPMG) and Africa's top 10 for Ease of Doing Business (KPMG)**

Global Competitiveness Index RANK *Data on 38 countries (#1 =highest)	Country	Reason for Inclusion (KPMG)	% of total population with access to improved sanitation *Data on 55 countries (#1=lowest)	% of rural population with access to improved sanitation *Data on 55 countries (#1=lowest)	% of urban population with access to improved sanitation *Data on 55 countries (#1=lowest)	Benefit to Cost Ratio for Investments in Sanitation
#11	Zambia	Top 10 Ease of Doing Business	#35 (43%)	#36 (34%)	#35 (56%)	3.54
#14	Ghana	Top 10 Ease of Doing Business & Africa's top 10 for investment	#9 (14%)	#14 (8%)	#3 (20%)	2.25
#19	Ethiopia	Africa's top 10 for investment	#22 (24%)	#27 (23%)	#10 (27%)	2.89
#21	Tanzania	Africa's top 10 for investment	#5 (12%)	#9 (7%)	#7 (25%)	1.32
#22	Uganda	Top 10 Ease of Doing Business	#30 (34%)	#36 (34%)	#16 (33%)	1.55
#27	Nigeria	Africa's top 10 for investment	#25 (28%)	#29 (25%)	#13 (31%)	2.41
#31	Mozambique	Africa's top 10 for investment	#17 (21%)	#19 (11%)	#26 (44%)	1.71
#35	Angola	Africa's top 10 for investment	#39 (60%)	#25 (20%)	#47 (87%)	20.34

Table 59 Analyzing potential to create value from investments in *watershed protection* in the top 10 most 'globally competitive' nations in Africa

Global Competitiveness Index RANK *Data on 38 countries (#1=highest)	Country	State of Freshwater Resources Index *Data on 53 countries (#1 = best)	Total annual freshwater withdrawal (Billion Cubic Meters) *Data on 53 countries (#1= highest)	Annual freshwater withdrawal dedicated to industry (% of total) * Data on 52 countries (#1=highest)	Average Precipitation in depth (mm per year) * Data on 53 countries (#1=highest)
1	Mauritius**	#49	#28 (0.725)	#38 (2.759%)	#6 (2041)
2	South Africa**	#44	#6 (12.5)	#26 (6.048%)	#38 (495)
3	Rwanda*	#26	#41 (0.15)	#23 (8%)	#17 (1212)
4	Morocco	#45	#5 (12.61)	#37 (2.855%)	#41 (346)
5	Botswana**	#13	#38 (0.194)	#12 (18.04%)	#39 (416)
6	Algeria	#46	#7 (5.723)	#15 (14.58%)	#51 (89)
7	Tunisia	#41	#14 (2.85)	#32 (3.86%)	#48 (207)
8	Namibia*	#33	#36 (0.2122)	#30 (4.861%)	#43 (285)
9	Kenya**	#38	#15 (2.735)	#33 (3.656%)	#37 (630)
10	Seychelles*	#53	#51 (0.0137)	#5 (27.74%)	#4 (2330)

* Listed on KPMG's Top 10 Ease of Doing Business list for Africa
** Listed on KPMG's Top 10 Ease of Doing Business list for Africa & KPMG's Africa's top 10 for investment list

Table 60. Analyzing potential to create value from investments in *watershed protection* in Africa's top 10 for investment (KPMG) and Africa's top 10 for Ease of Doing Business (KPMG)

Global Competitiveness Index RANK *Data on 38 countries (#1 =highest)	Country	Reason for Inclusion (KPMG)	State of Freshwater Resources Index *Data on 53 countries (#1 = best)	Total annual freshwater withdrawal (Billion Cubic Meters) *Data on 53 countries (#1= highest)	% of total withdrawal dedicated to industry * Data on 52 countries (#1=highest)	Average Precipitation in depth (mm per year) * Data on 53 countries (#1=highest)
#11	Zambia	Top 10 Ease of Doing Business (KPMG)	#23	#17 (1.572)	#22 (8.27%)	#26 (1020)
#14	Ghana	Top 10 Ease of Doing Business & Africa's top 10 for investment (KPMG)	#32	#23 (0.982)	#20 (9.674%)	#18 (1187)
#19	Ethiopia	Africa's top 10 for investment (KPMG)	#20	#8 (5.558)	#47 (0.3778%)	#30 (848)
#21	Tanzania	Africa's top 10 for investment (KPMG)	#30	#10 (5.184)	#36 (0.4823%)	#23 (1071)
#22	Uganda	Top 10 Ease of Doing Business (KPMG)	#24	#34 (0.3174)	#17 (14.49%)	#20 (1180)
#27	Nigeria	Africa's top 10 for investment (KPMG)	#29	#4 (13.11)	#14 (14.99%)	#22 (1150)
#31	Mozambique	Africa's top 10 for investment (KPMG)	#21	#25 (0.8842)	#39 (2.748%)	#25 (1032)
#35	Angola	Africa's top 10 for investment (KPMG)	#28	#29 (0.7058)	#4 (33.95%)	#27 (1010)

Table 61 Analyzing potential to create value considering demographic data and social capacity

Global Competitiveness Index RANK *Data on 38 countries (#1=highest)	Country	Population (Total in 2013) *Data on 53 Countries	Population (Urban in 2013) *Data on 53 Countries 2013	Population (Rural in 2013) *Data on 53 Countries 2013	Number of Pupils in Primary School *Data on 53 Countries from 2003 to 2013	% of Female Pupils in Primary School *Data on 53 Countries from 2003 to 2013	Social Capacity Index *Data on 53 countries (#1=highest)
1	Mauritius**	#47)1,296,303)	#48 (518,249)	#46(778,054)	#49 (113,634)	49.18%	2
2	South Africa**	#5 (52,981,991)	#2 (33,796,152)	#9 (19,185,839)	#8(7,004,482)	48.5%	7
3	Rwanda*	#26 (11,776,522)	#29 (3,164,234)	#27(8,612,288)	#20 (2,394,674)	50.70%	15
4	Morocco	#11 (33,008,150)	#6 (19,540,825)	#14(13,467,325)	#14(4,021,052)	47.62%	8
5	Botswana**	#43 (2,021,144)	#42 (1,140,799)	#45(870,345)	#43 (330,775)	48.75%	5
6	Algeria	#8 (39,208,194)	#5 (27,253,616)	#18 (11,954,578)	#17(3,451,588)	47.54%	6
7	Tunisia	#29 (10,886,500)	#17(7,234,732)	#35 (3,651,768)	#33 (1,046,671)	48.2%	3
8	Namibia*	#41 (2,303,315)	#44(1,029,098)	#42 1,274,217)	#40(415,454)	49.11%	10
9	Kenya**	#7(44,353,691)	#12(10,990,845)	#6(33,362,846)	#7 (7,150,259)	49.16%	17
10	Seychelles*	#53 (89,173)	#53 (47,468)	#53 (41,705)	#53(8,695)	50.13%	1
(KPMG) 11	Zambia	#22 (14,538,640)	#20(5,819,381)	#26(8,719,259)	#18 (3,135,442)	49.97%	18
(KPMG) 14	Ghana	#12 (25,904,598)	#9 (13,660,790)	#16 (12,243,808)	#13(4,105,913)	48.94%	12
(KPMG) 19	Ethiopia	#2(94,100,756)	#7 (17,493,331)	#2(76,607,425)	#2 (14,532,477)	47.62%	33
(KPMG) 21	Tanzania	#6 (49,253,126)	#8(14,872,474)	#5(34,380,652)	#5(8,247,172)	50.45%	29
(KPMG) 22	Uganda	#10 (37,578,876)	#21(5,801,051)	#7 (31,777,825)	#6(8,098,177)	50.11%	25
(KPMG) 27	Nigeria	#1 (173,615,345)	#1(80,025,257)	#1 (93,589,099)	#1(21,558,460)	46.66%	32
(KPMG) 31	Mozambique	#13 (25,833,752)	#15 (8,181,291)	#10 (17,652,461)	#9(5,359,019)	47.49%	38
(KPMG) 35	Angola	#15(21,471,618)	#14(9,123,290)	#15(12,348,328)	#10(5,026,803)	38.9%	36

Figures.

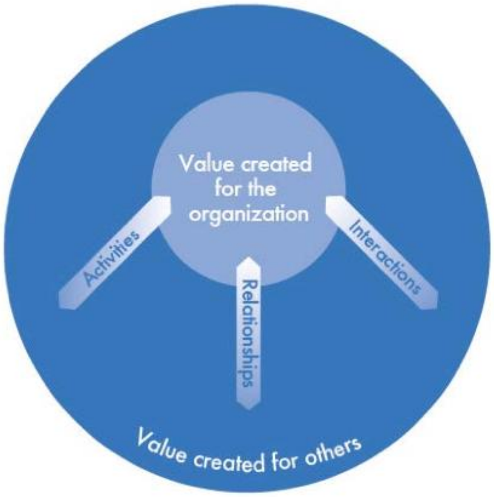

Figure 77. Value creation for both the organization and for others[386]

Simple systems	Complicated systems	Complex systems
• Contain few interactions • Extremely predictable • Example: switching a light on/off (the same action produces the same result every time)	• Have many moving parts • Operate in patterned ways • Possible to make accurate predictions about behavior • Example: electrical grid powering the light (many possible interactions, but they typically follow a pattern)	• Interactions are constantly changing • Features may operate in patterned ways • The same starting conditions can produce different outcomes, depending on interactions within the system

Figure 78. Different levels of system complexity[387]

Figure 79a. Conventional causal chain ("open loop")

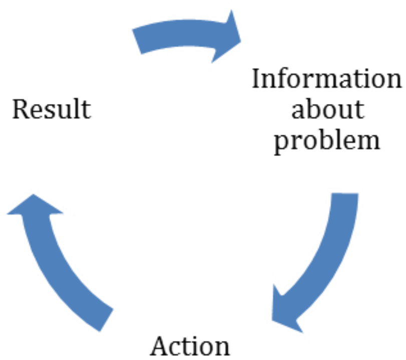

Figure 7b. "Closed-loop" causal structure

Figure 80. A systems view of our interventions leading to unexpected results

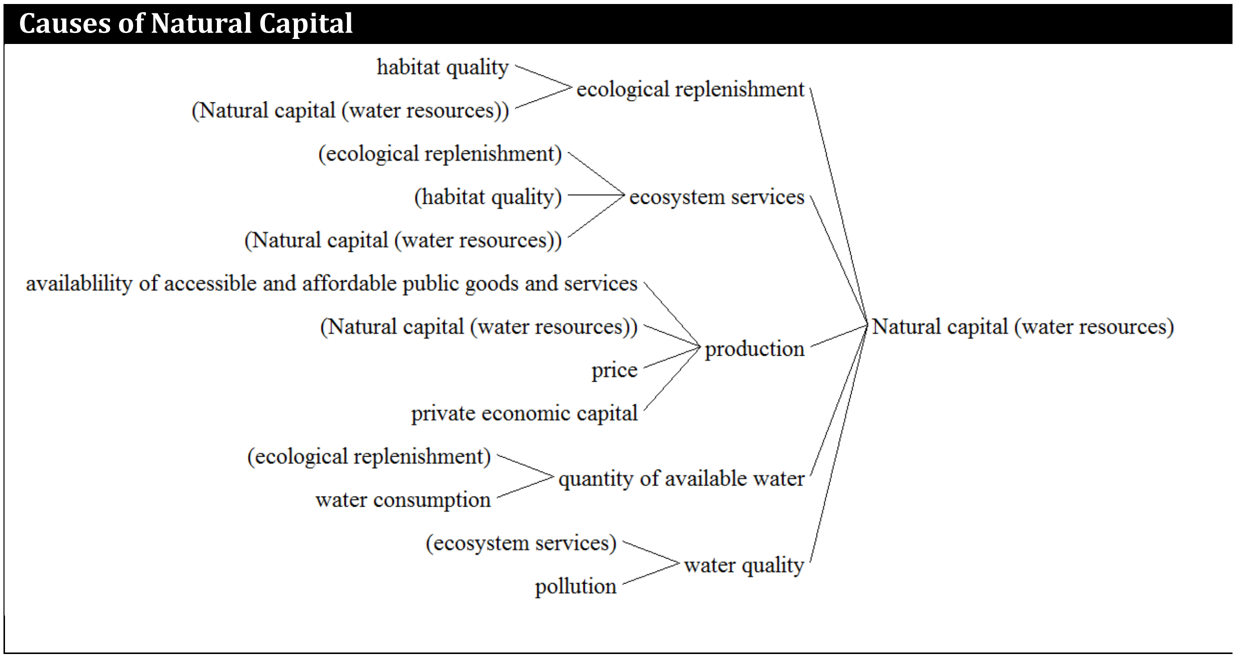

Figure 81. Causes of Natural Capital.

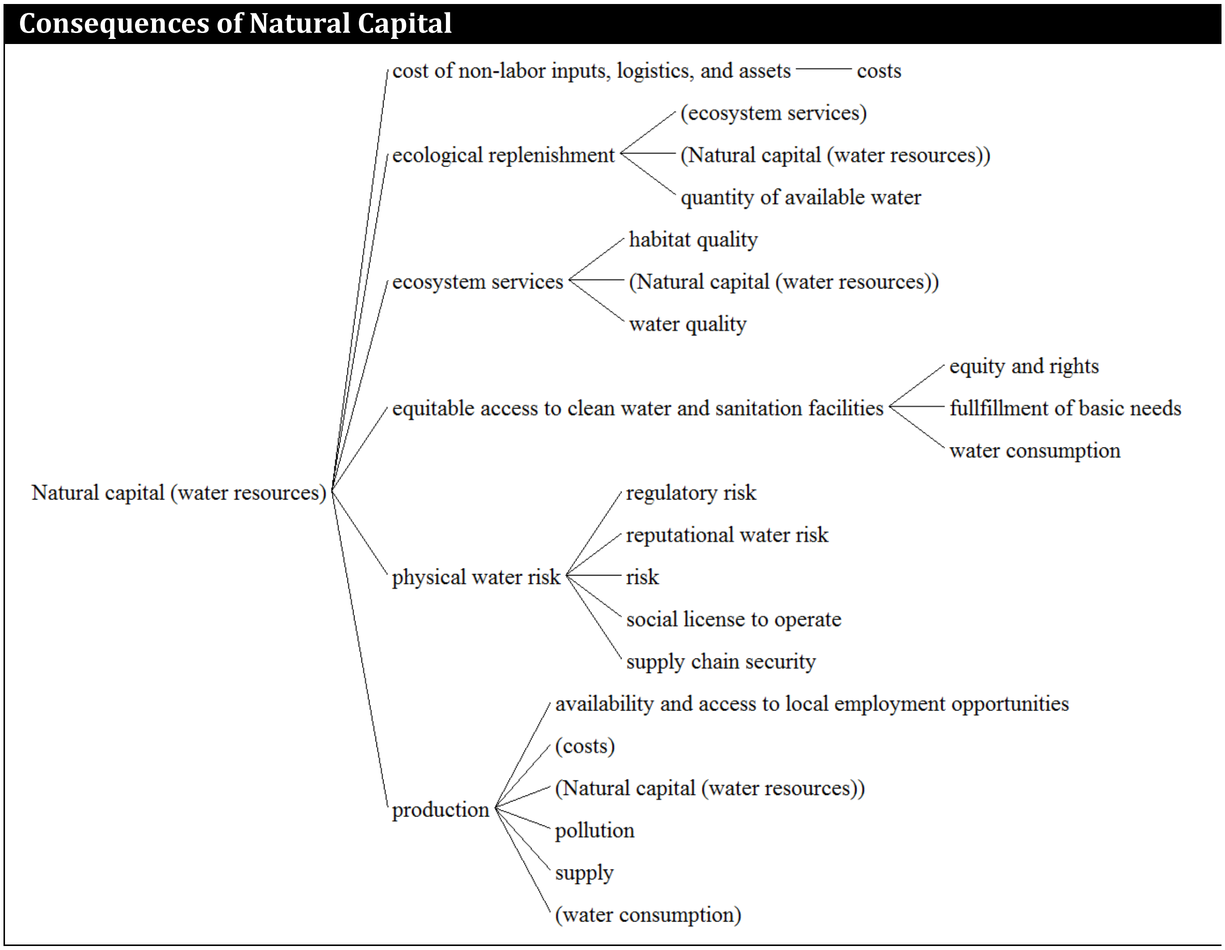

Figure 82. Natural capital is causally connect to societal economic capital, social and human capability, and firm value. Causes of Natural Capital.

Causes of societal economic capital

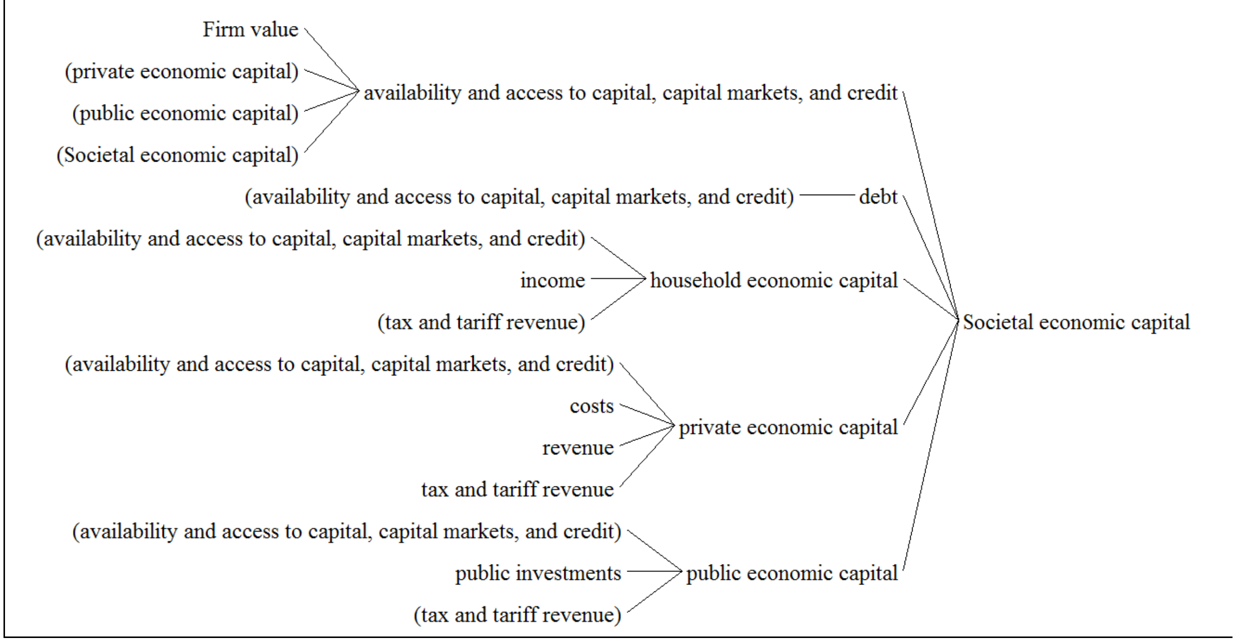

Figure 83. Societal economic capital is causally connected to natural capital, social and human capabilities and firm value.

Consequences of societal economic capital

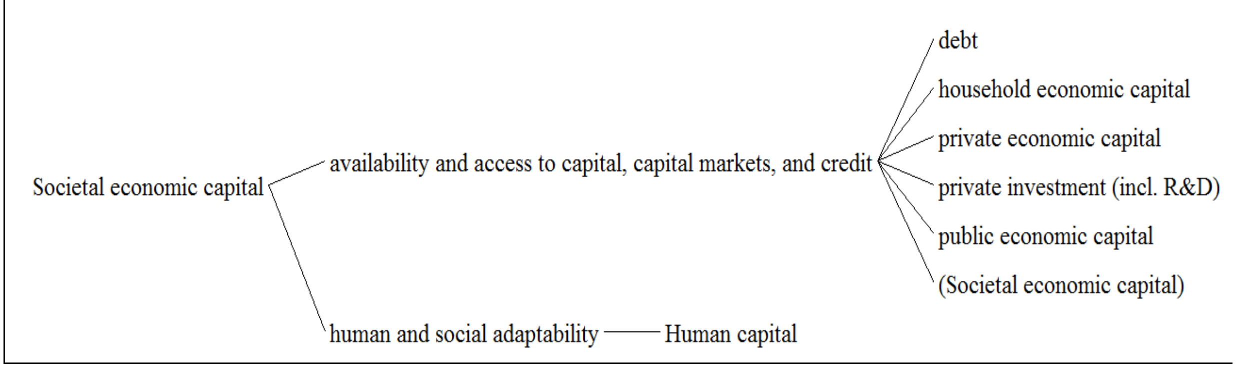

Figure 84. Societal economic capital influences availability and access to capital, capital markets and credits and increases human and social adaptability.

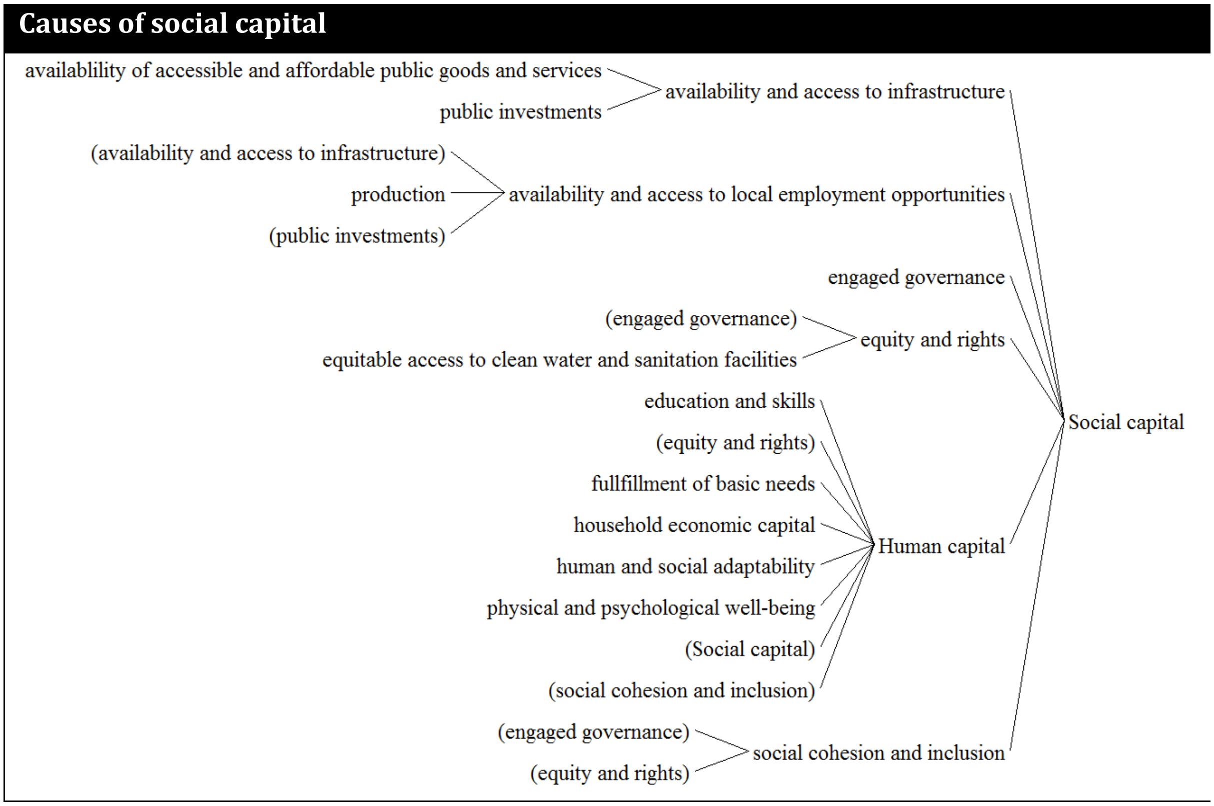

Figure 85. Social capital is causally connected to natural capital, societal economic capital, social and human capabilities and firm value.

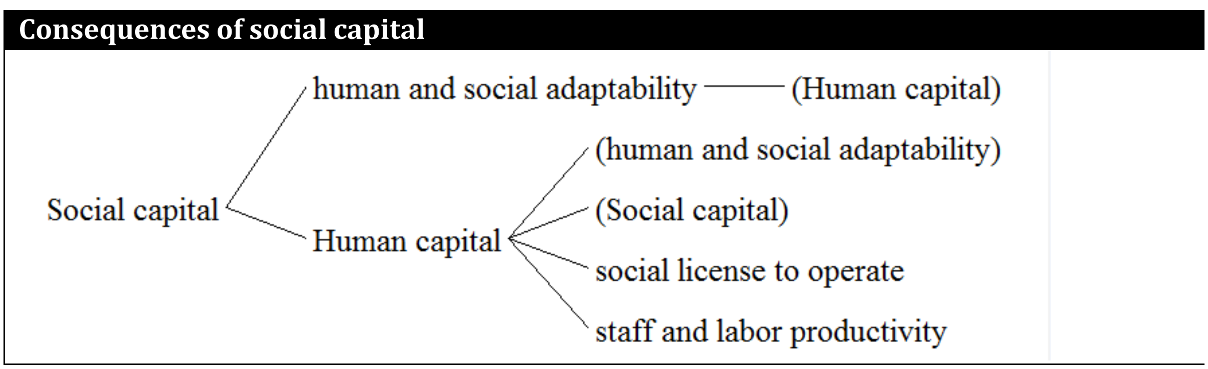

Figure 86. Social capital influences human and social adaptability and human capital.

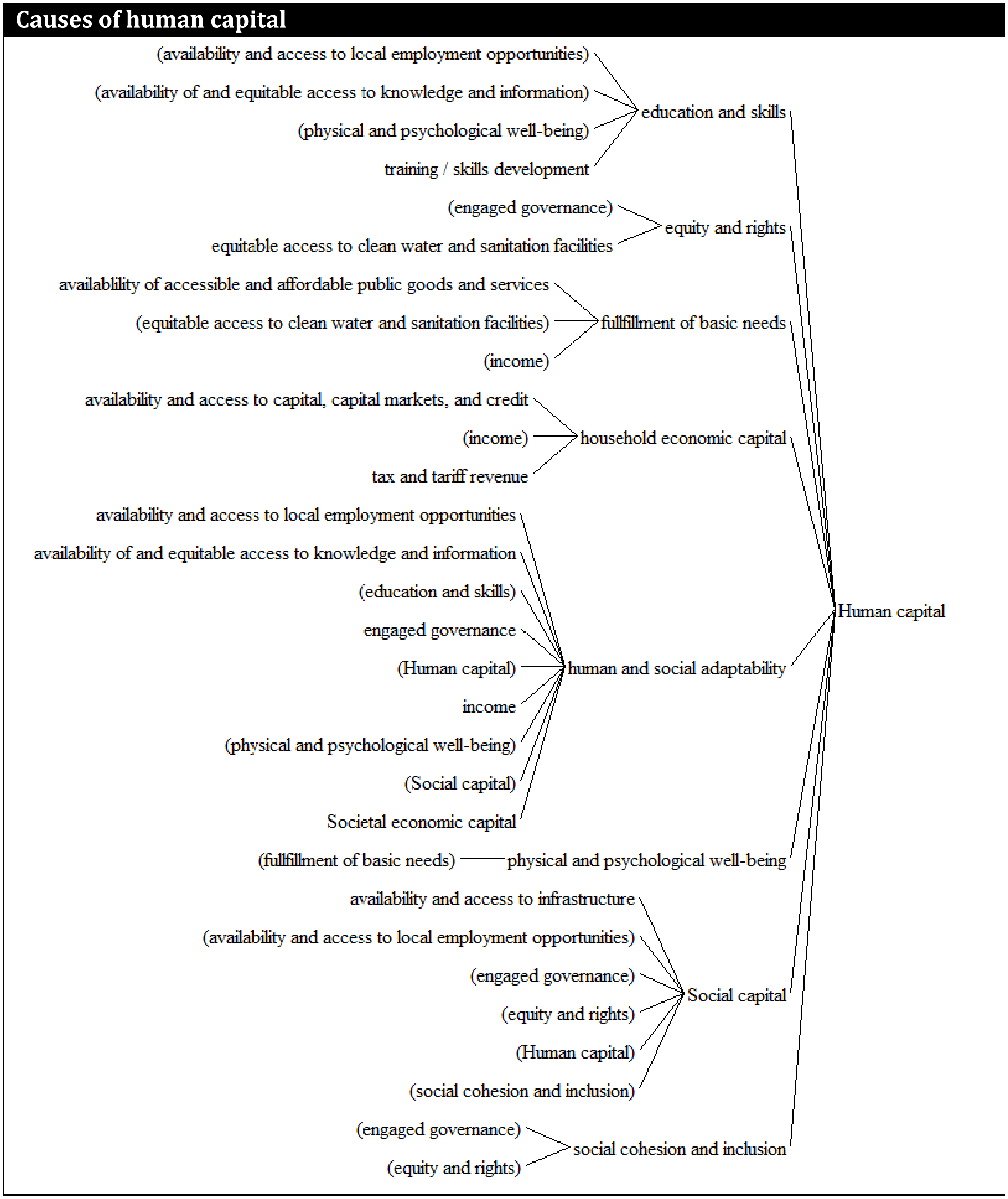

Figure 87. Human capital is causally connected to natural capital, societal economic capital, social and human capabilities and firm value.

Consequences of human capital

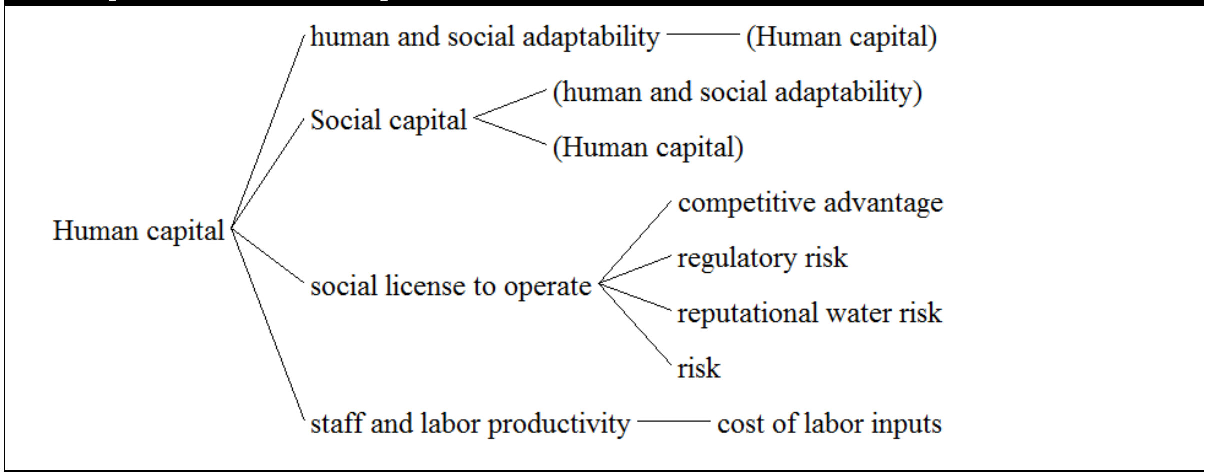

Figure 88. Human capital builds social capital, human and social adaptability, and increases staff and labor productivity while helping secure the firm's social license to operate.

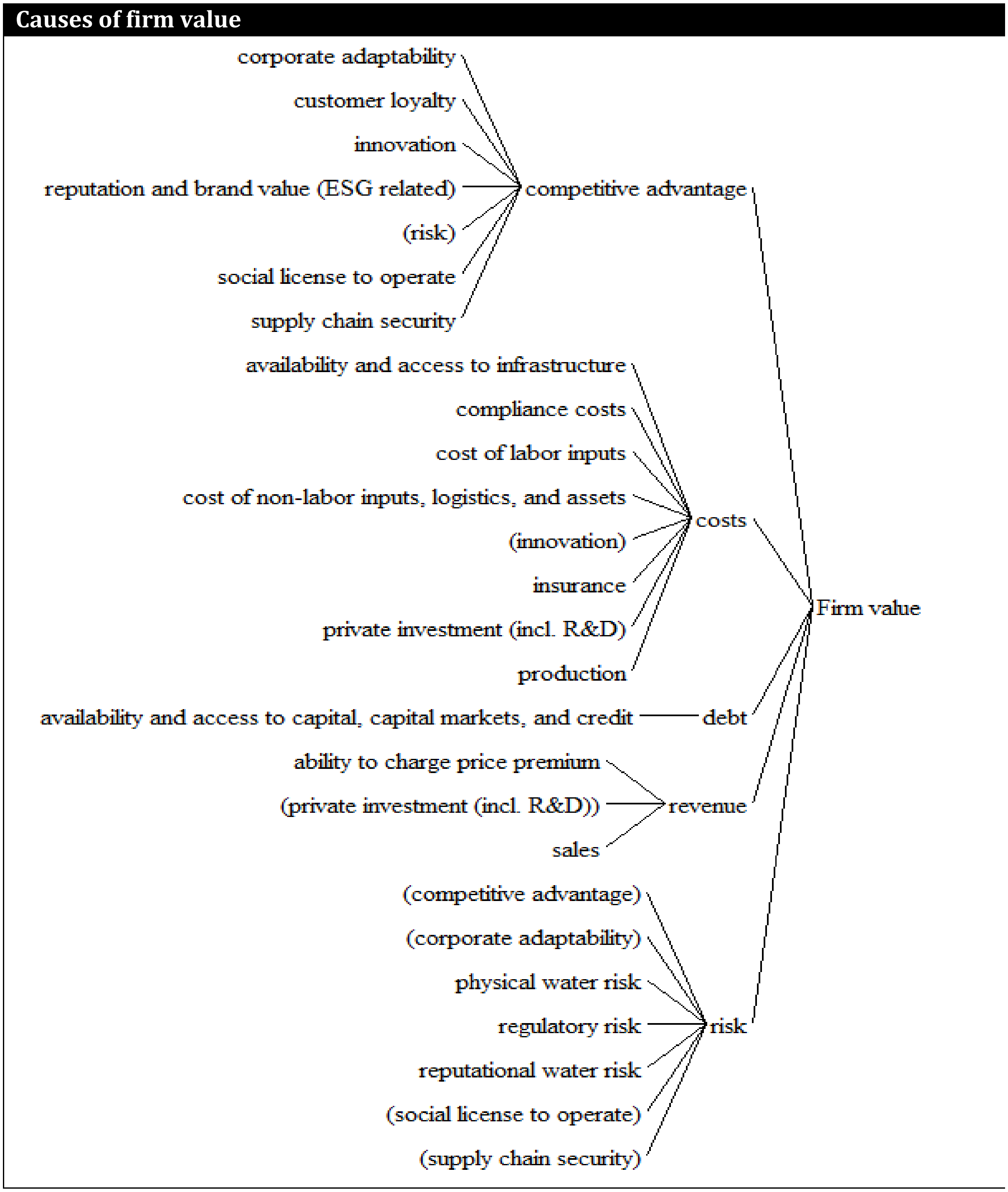

Figure 89. Firm Value is causally connected to natural capital, societal economic capital, and social and human capabilities.

Feedback loops influenced by habitat quality and watershed protection.

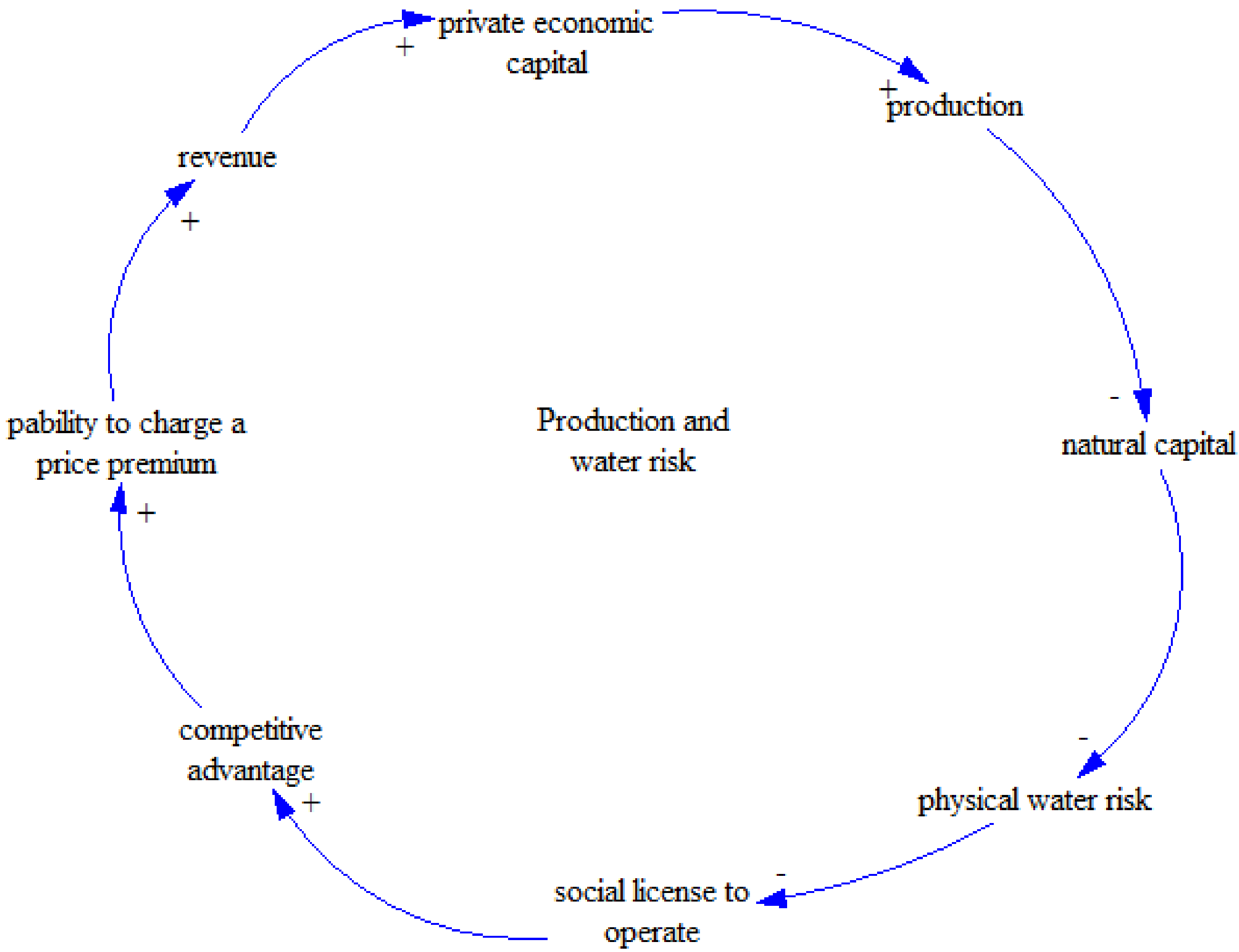

Figure 90. Production causes physical water risk and decreases private economic capital (Balancing).

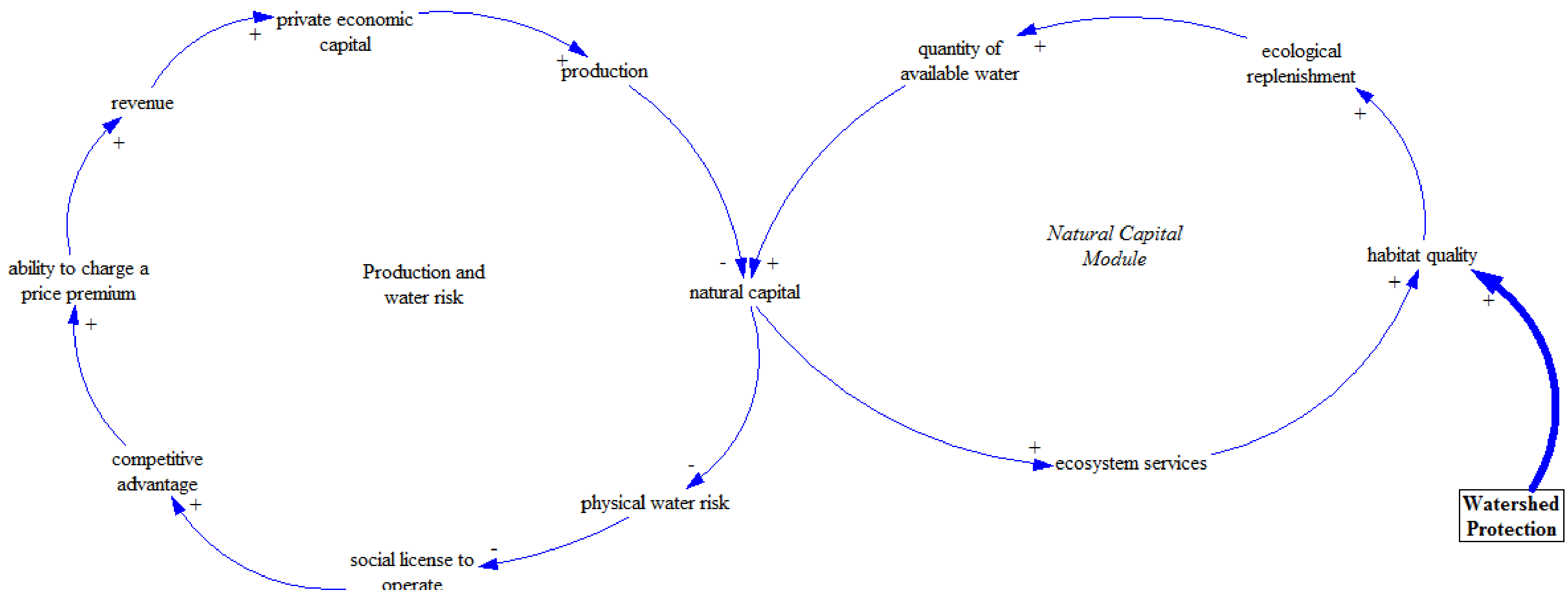

Figure 91. Watershed protection reduces physical water risk (Balancing).

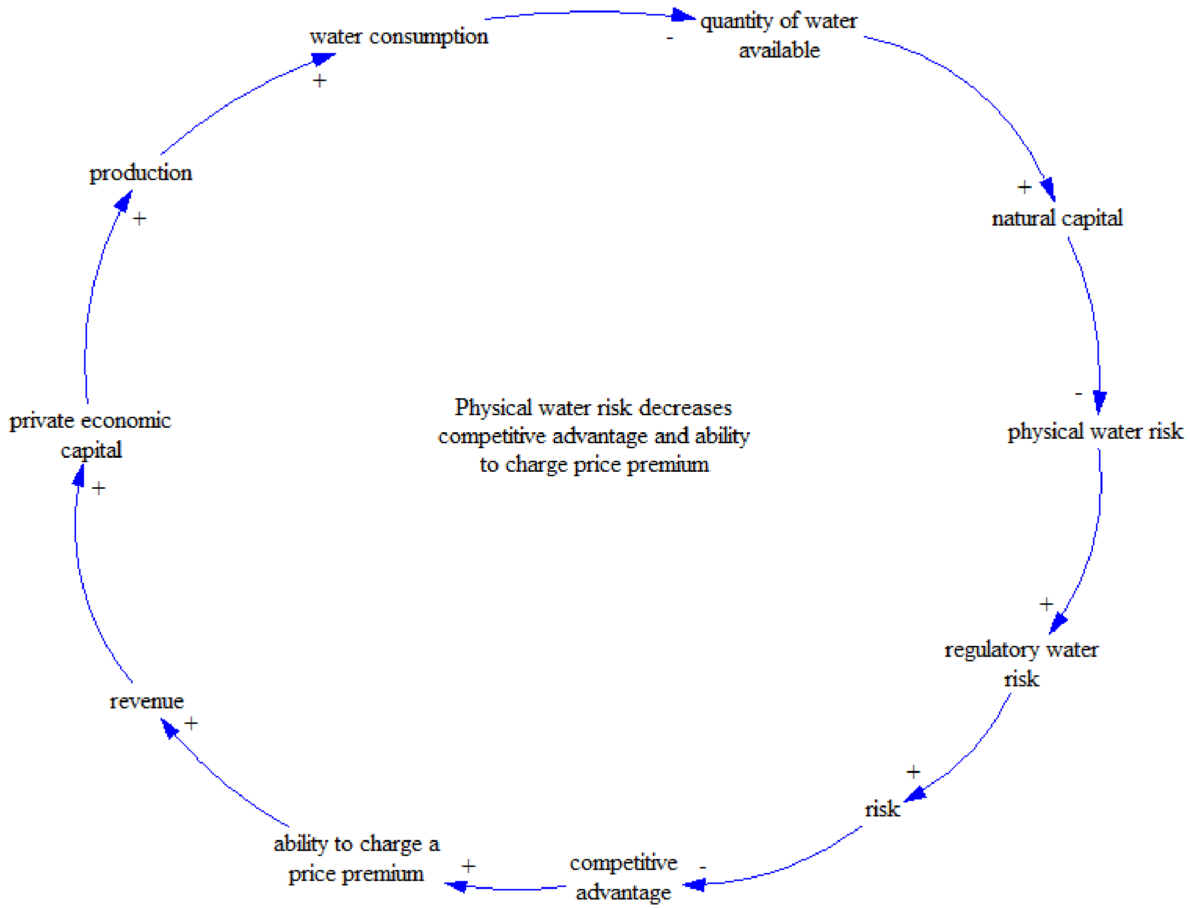

Figure 92. Physical water risk decreases competitive advantage and ability to charge price premium (Balancing).

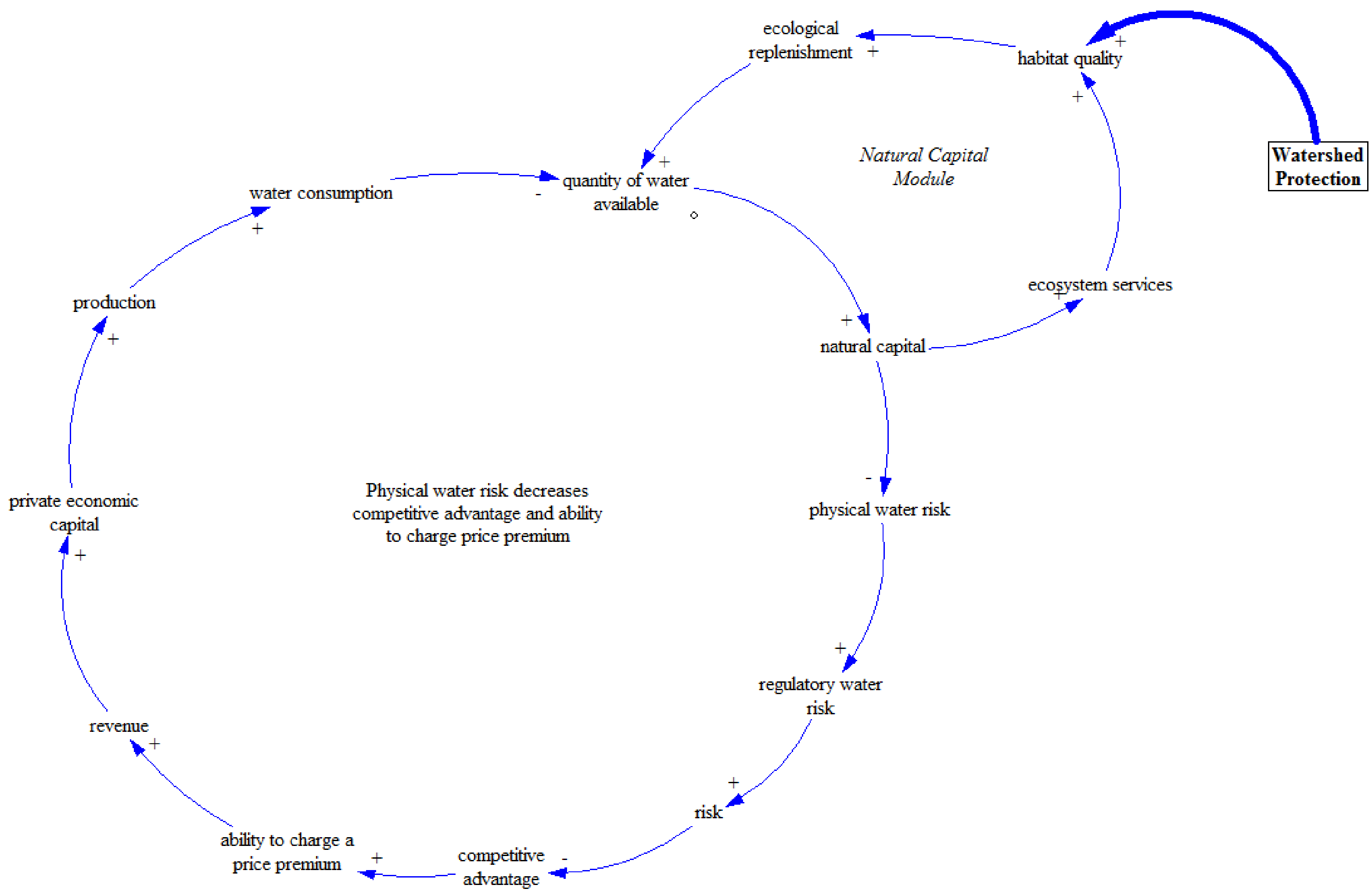
ecological
replenishment
habitat quality
Watershed
Protection
Natural Capital
Module
water consumption
quantity of water
available
production
natural capital
ecosystem services
physical water risk
private economic
capital
Physical water risk decreases
competitive advantage and ability
to charge price premium
regulatory water
risk
revenue
risk
ability to charge a
price premium
competitive
advantage

Figure 93. Watershed protection reinforces natural capital (Balancing).

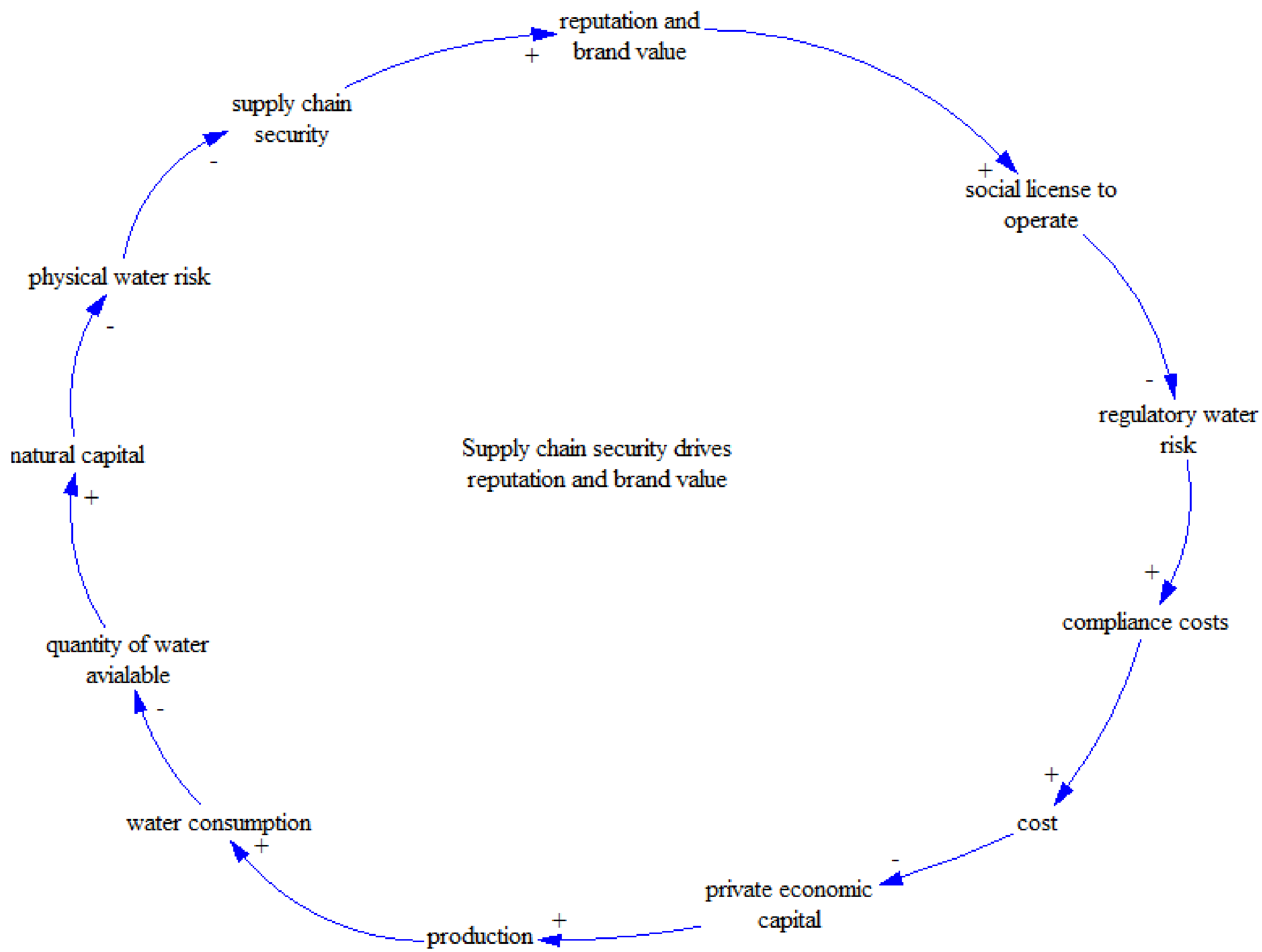

Figure 94. Physical water risk decreases supply chain security (Balancing).

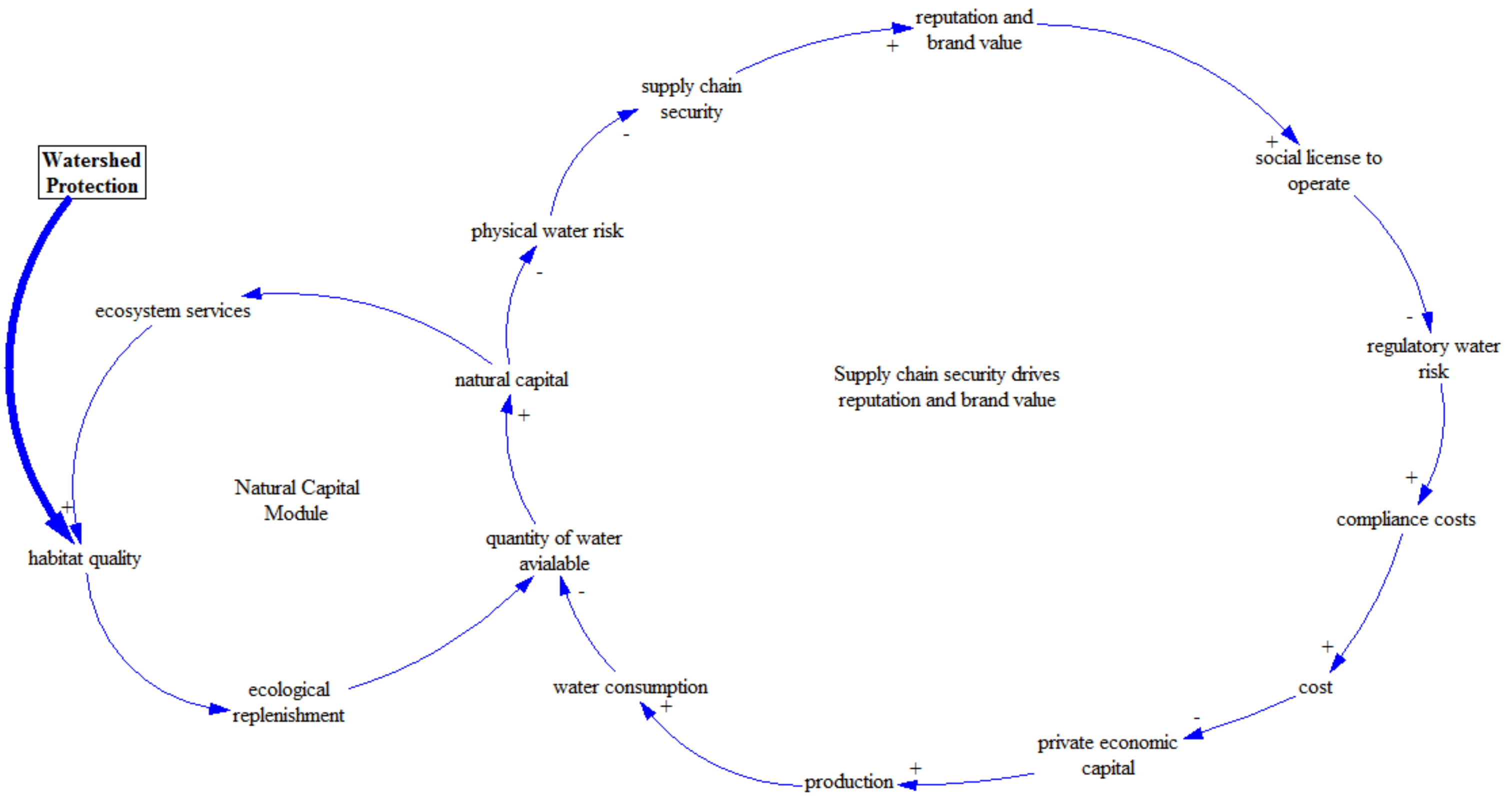

Figure 95. Investments in watershed protection facilitate supply chain security (Balancing).

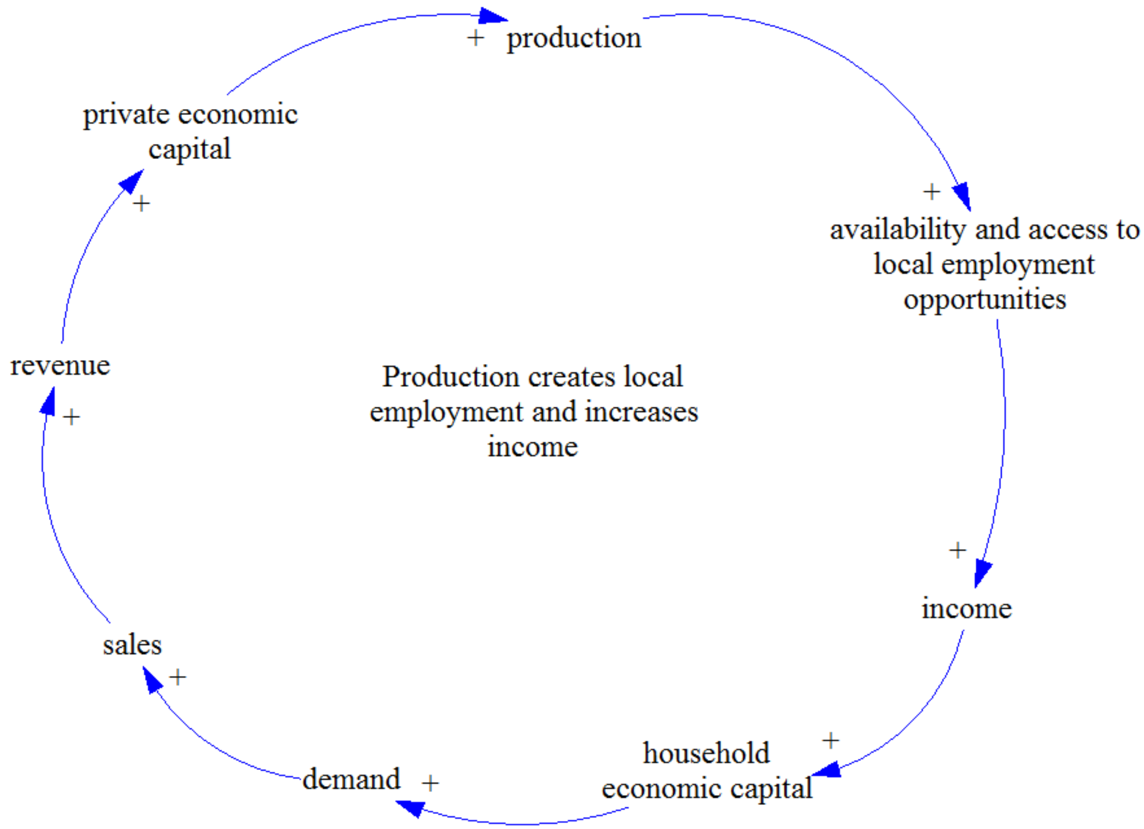

Figure 96. Production builds societal economic capacity at the cost of natural capital (Reinforcing).

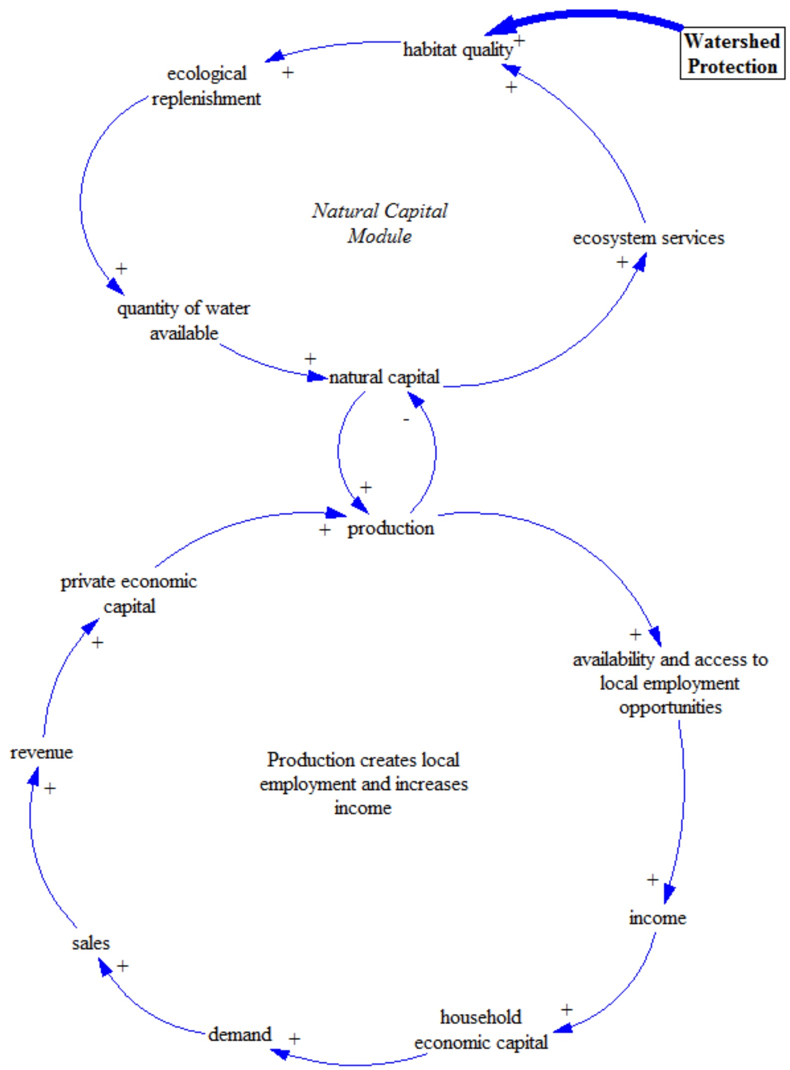

Figure 97. Investments in watershed protection counterbalance the negative impact production has on natural capital (Reinforcing).

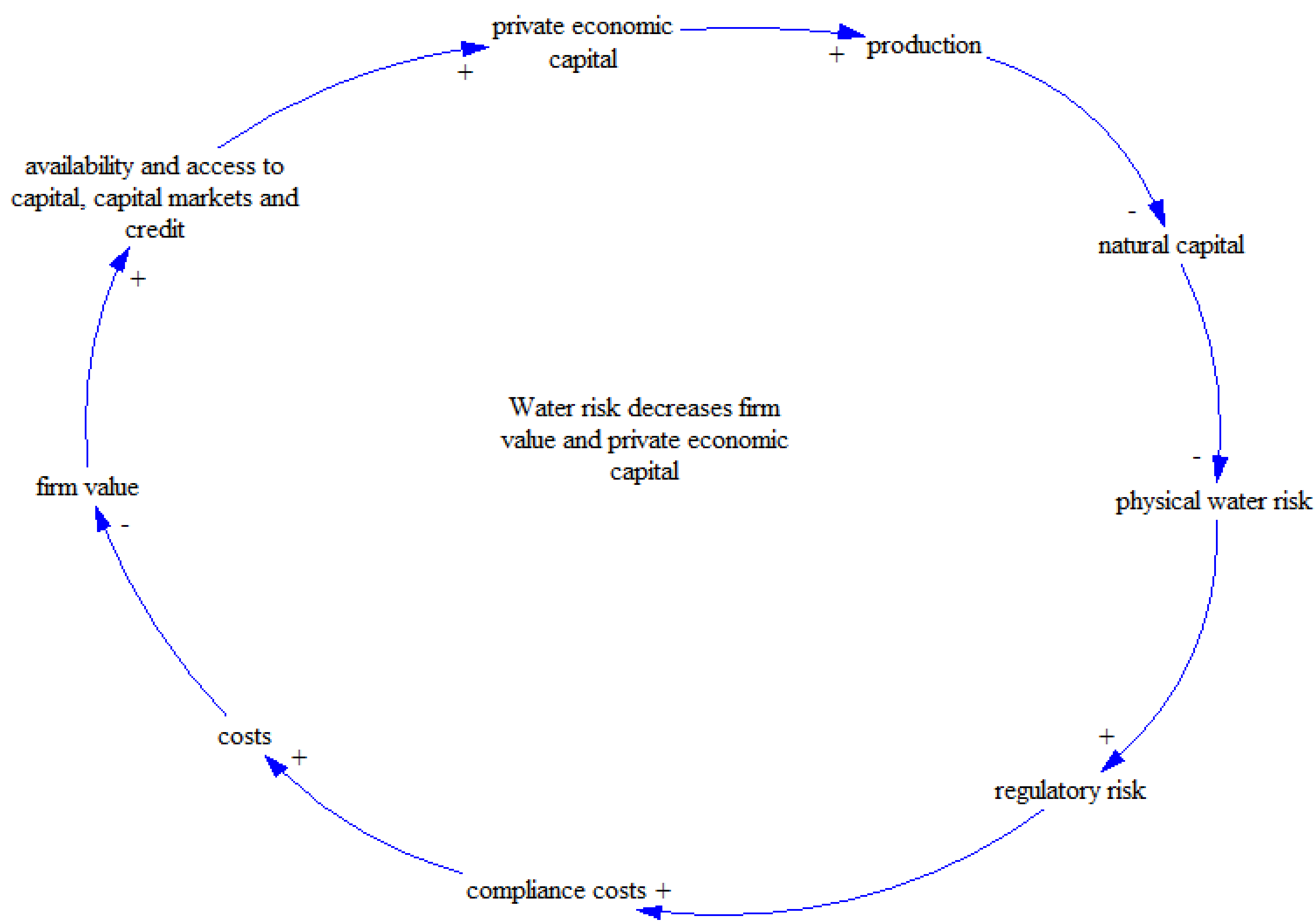

Figure 98. Physical water risk reinforces regulatory risks, which increases compliances costs and diminishes firm value (Balancing).

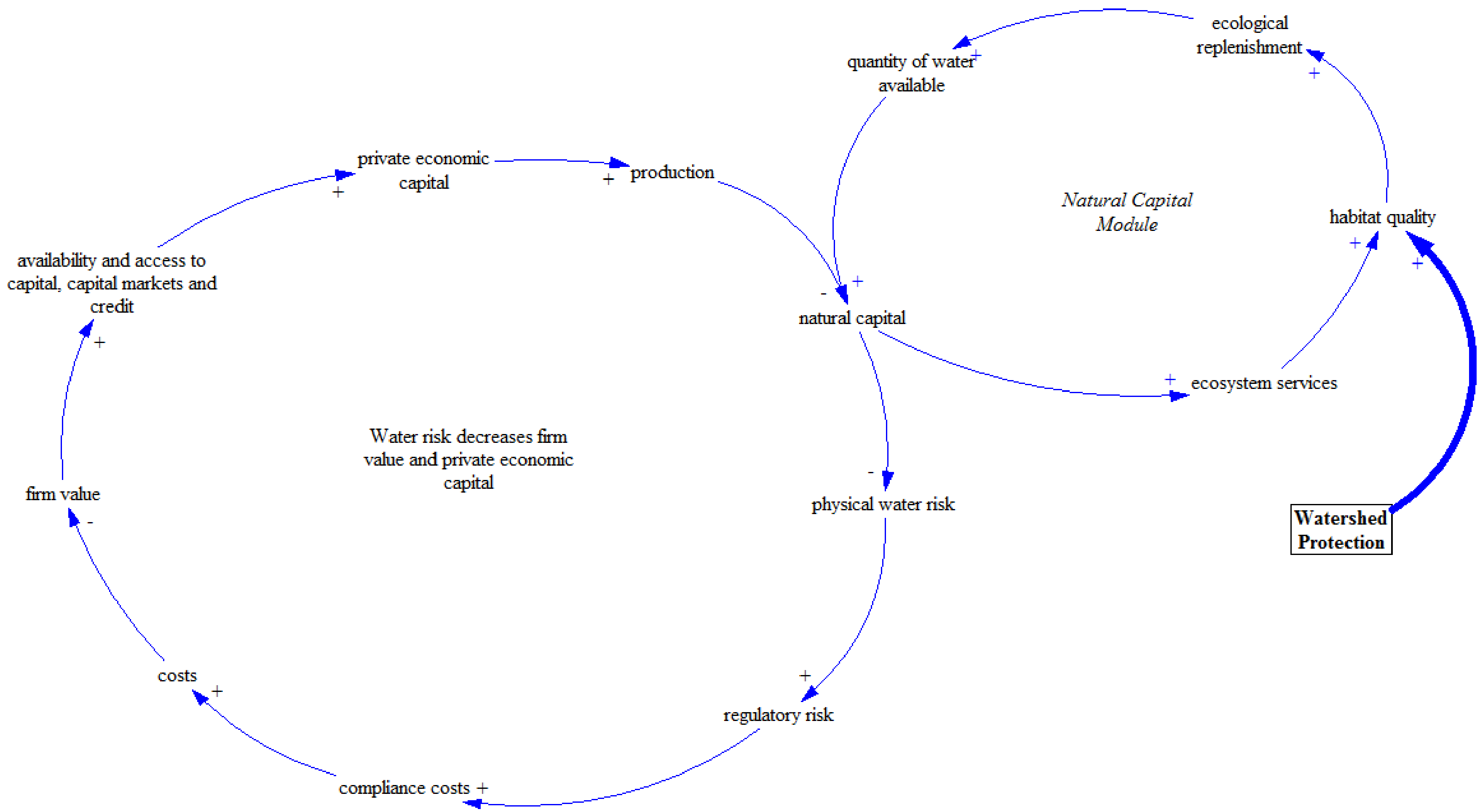

Figure 99. Investments in watershed protection reduce regulatory risks (Balancing).

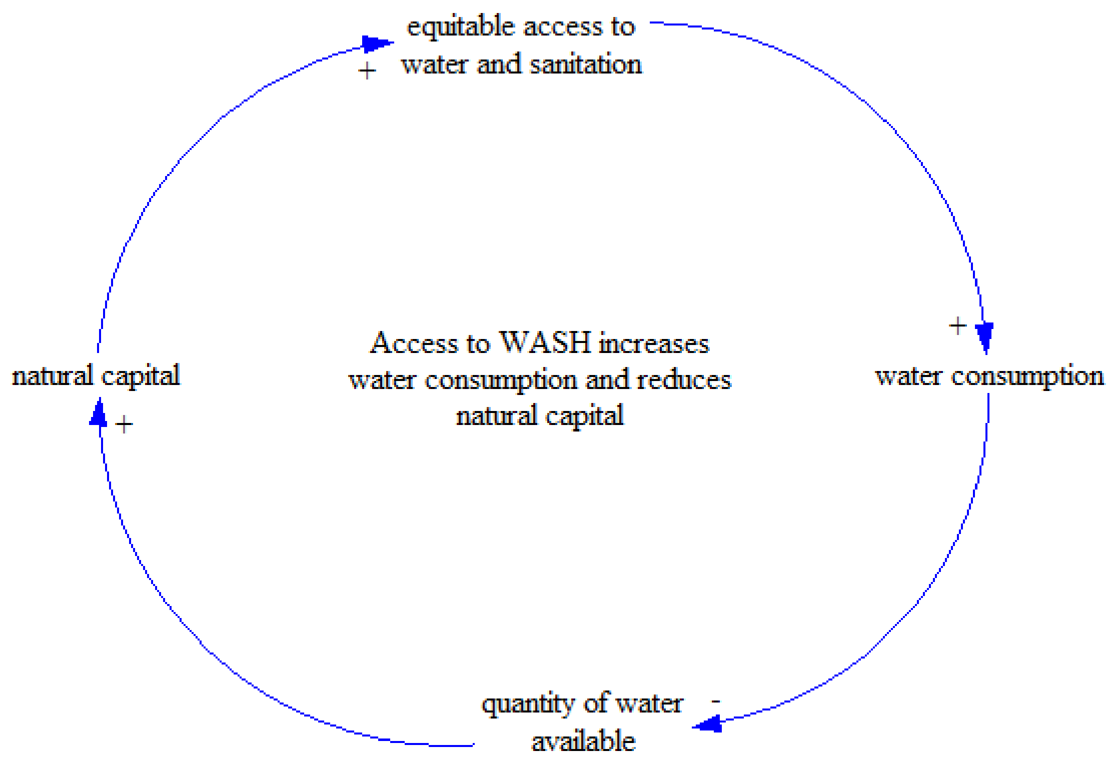

Figure 100. Unintended consequences associated with increased access to WASH (Balancing).

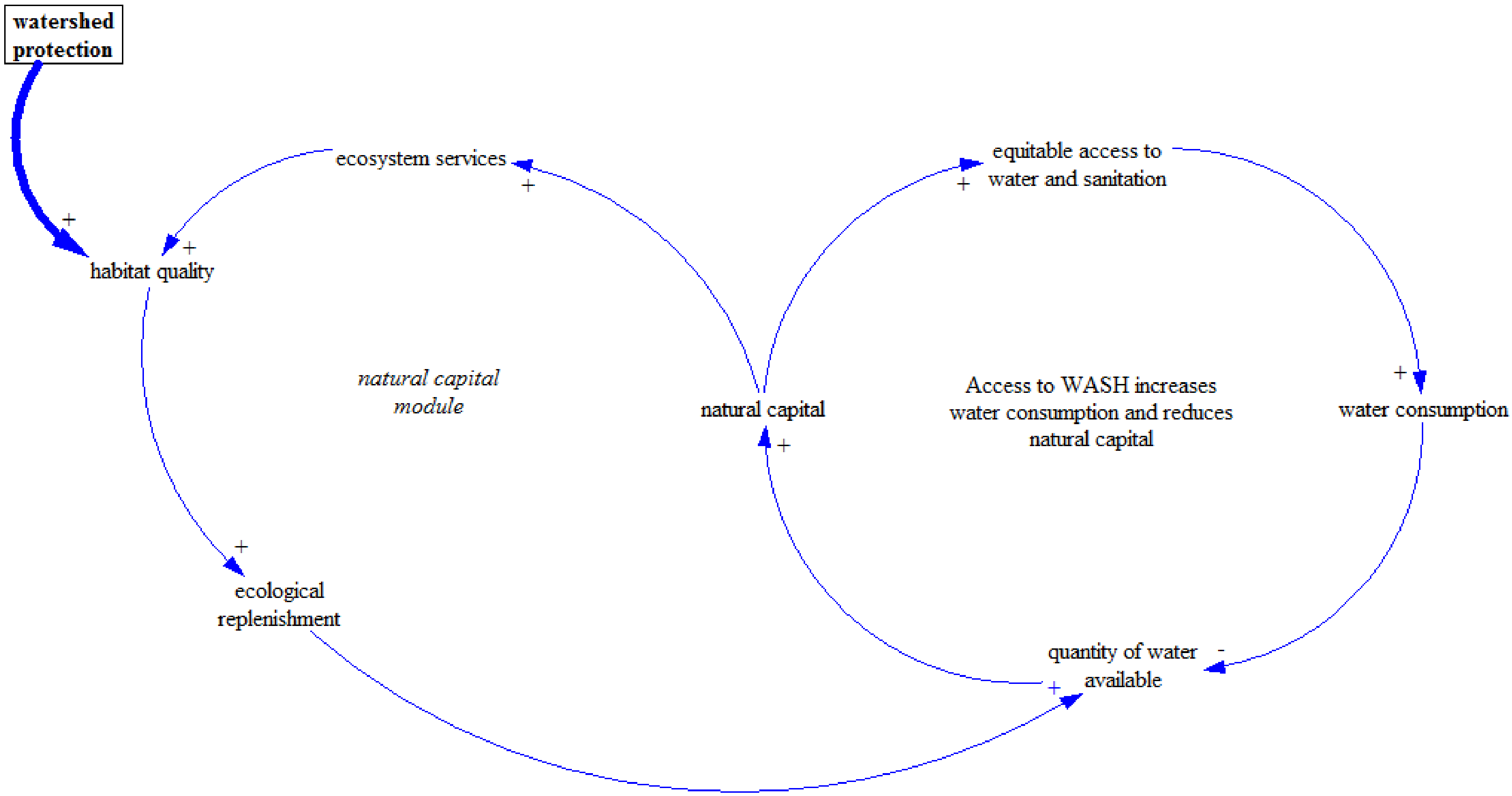

Figure 101. Investments in watershed protection counterbalance increased water consumption caused by access to WASH (Balancing).

Feedback loops influenced by equitable access to WASH and water for productive use.

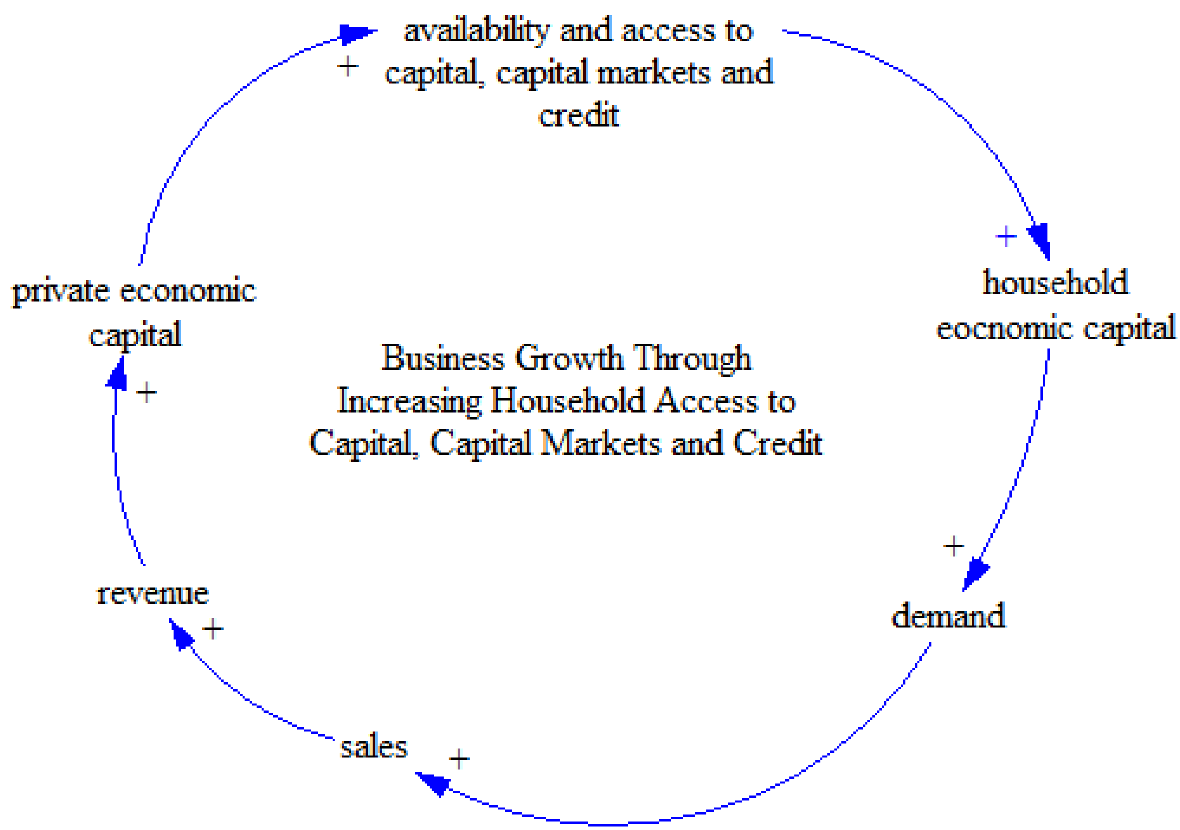

Figure 102. Increased household economic capital increases sales and drives firm value (Reinforcing)

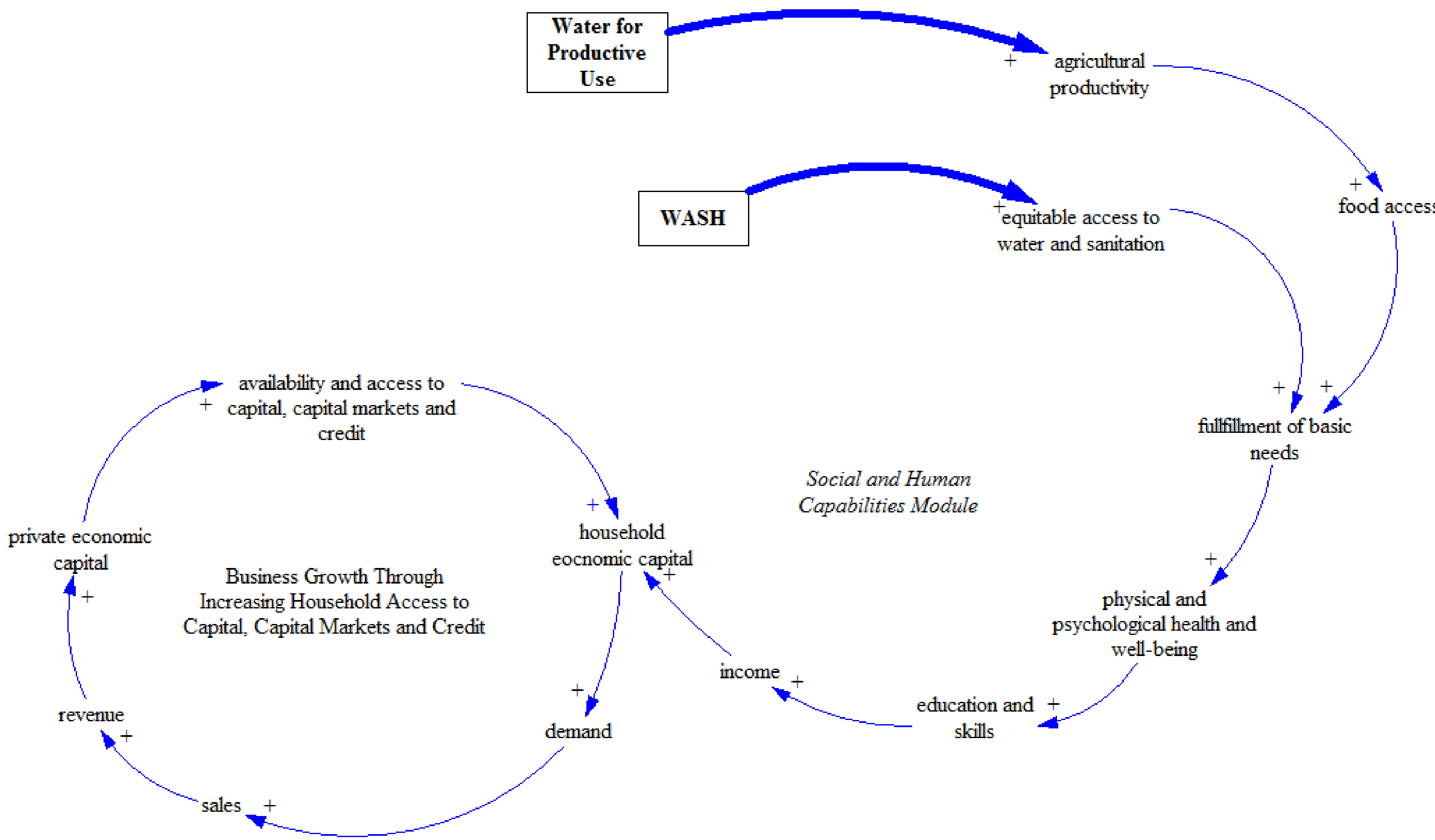

Figure 103. Investments in WASH and water for productive use causally influence household economic capital (Reinforcing).

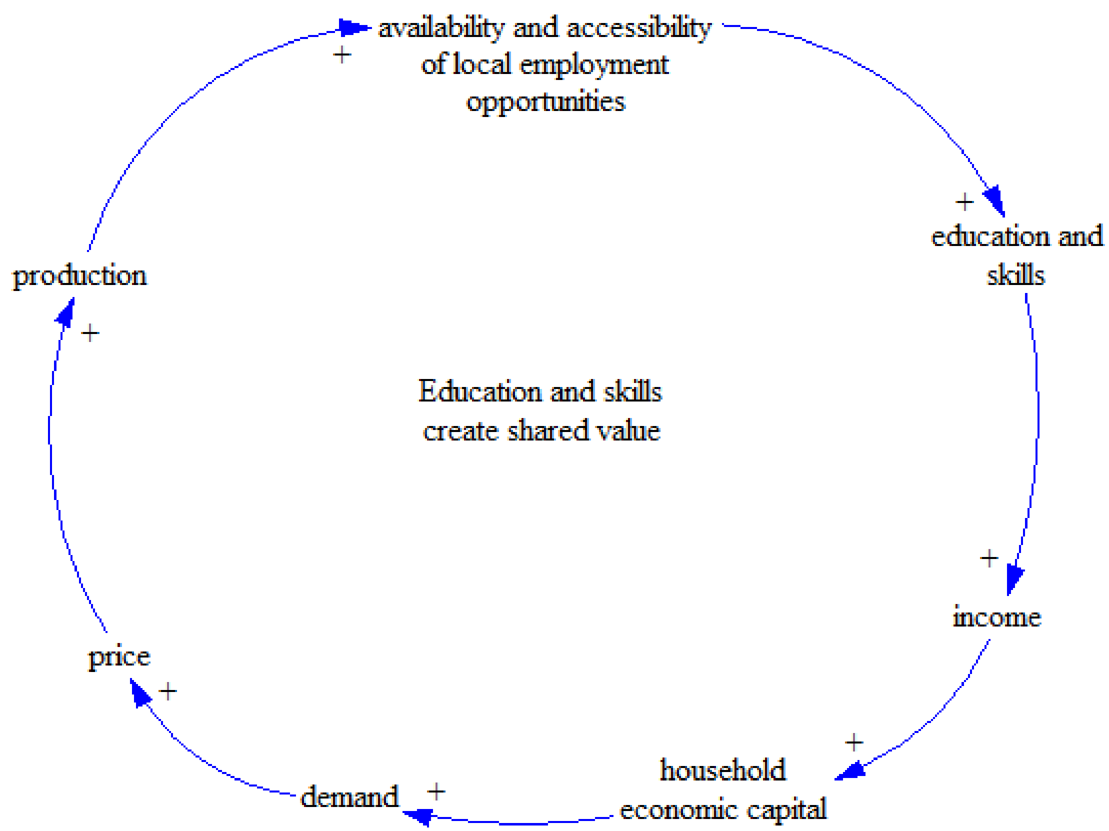

Figure 104. Production increases employment opportunity which builds skills, increases income, and drives household economic capital (Reinforcing).

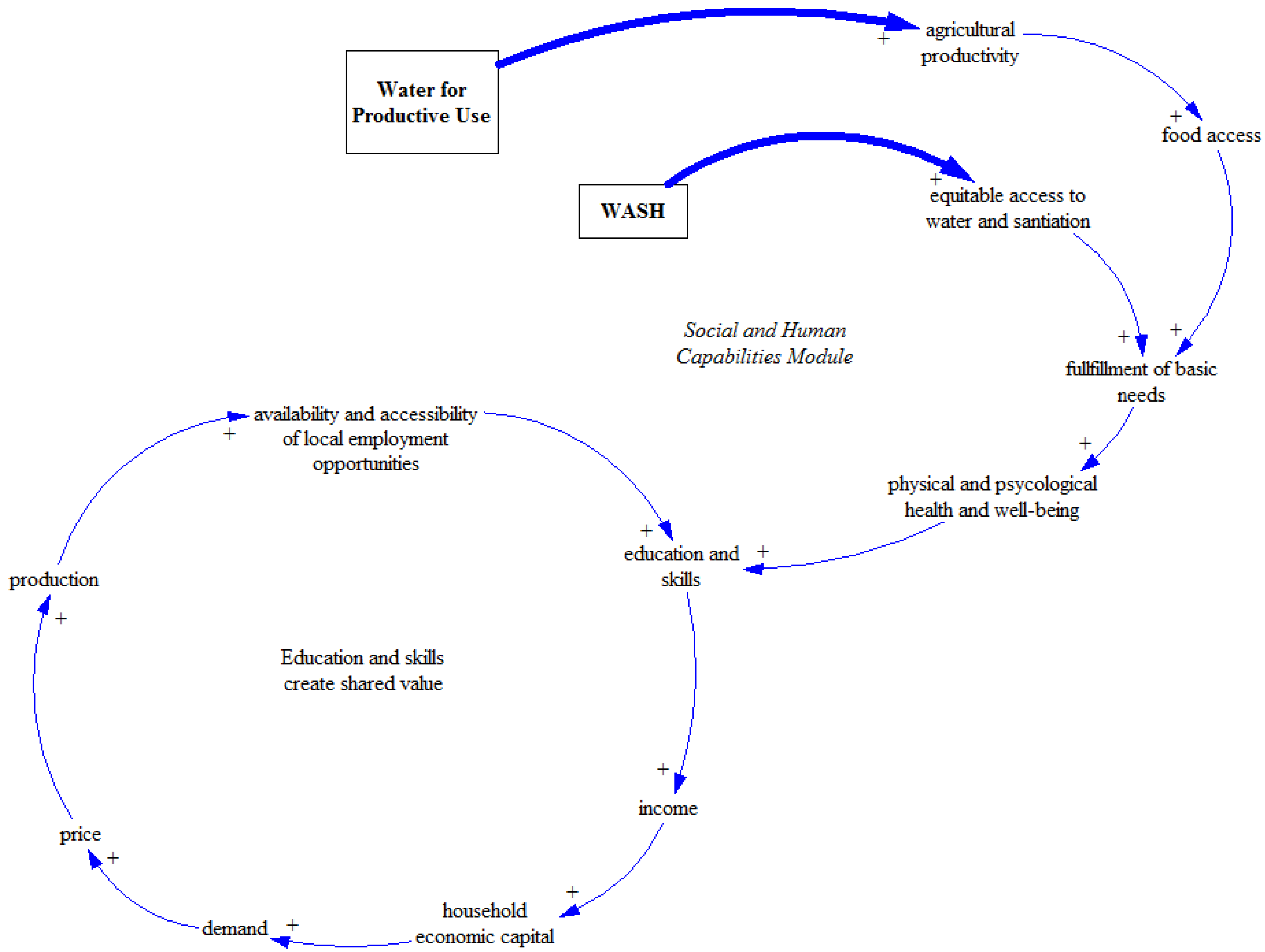

Figure 105. Investments in WASH and water for productive use increase education and skills through improved physical health (Reinforcing)

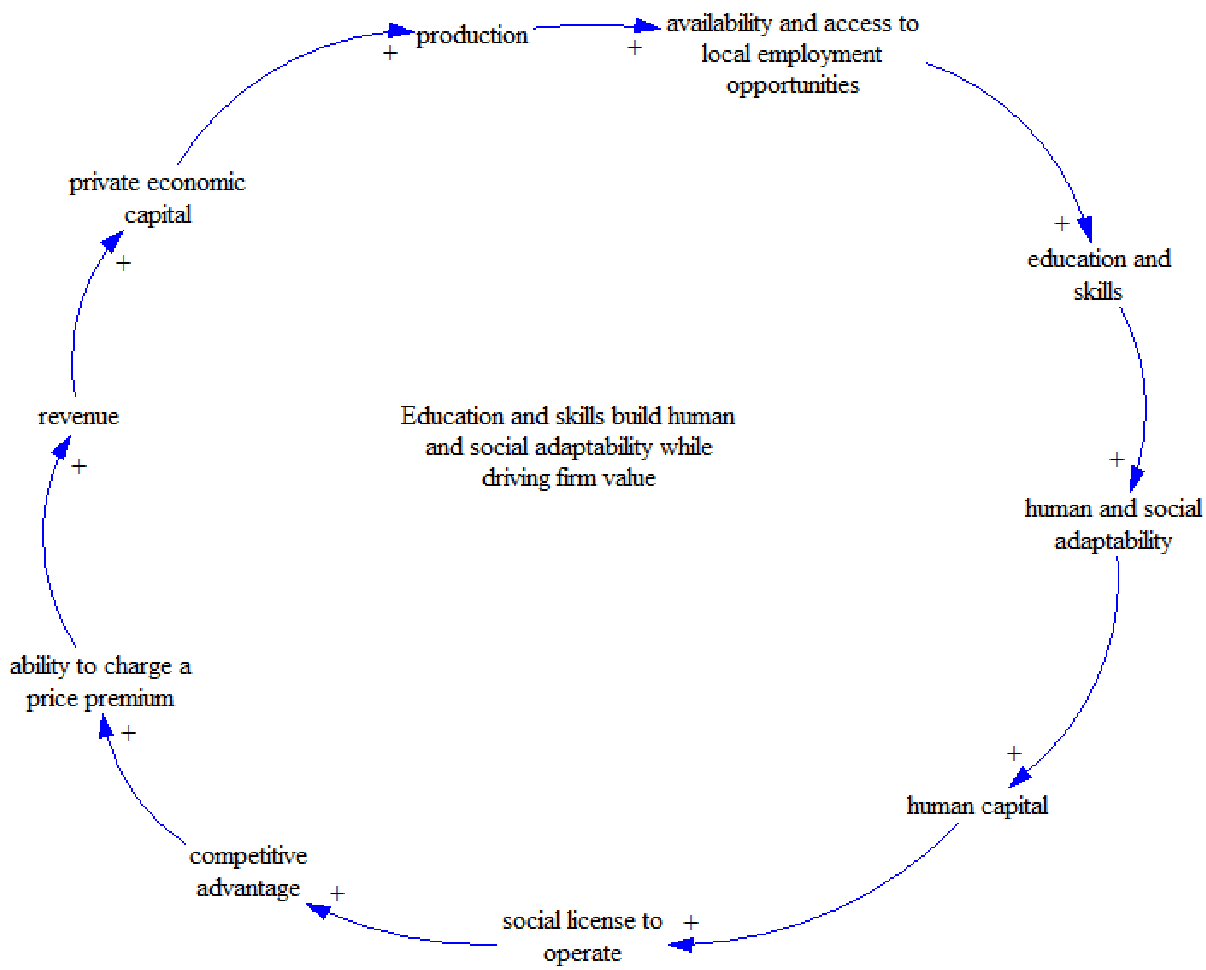

Figure 106. Investing in education builds human capital and secures the social license to operate, which increases firm value (Reinforcing).

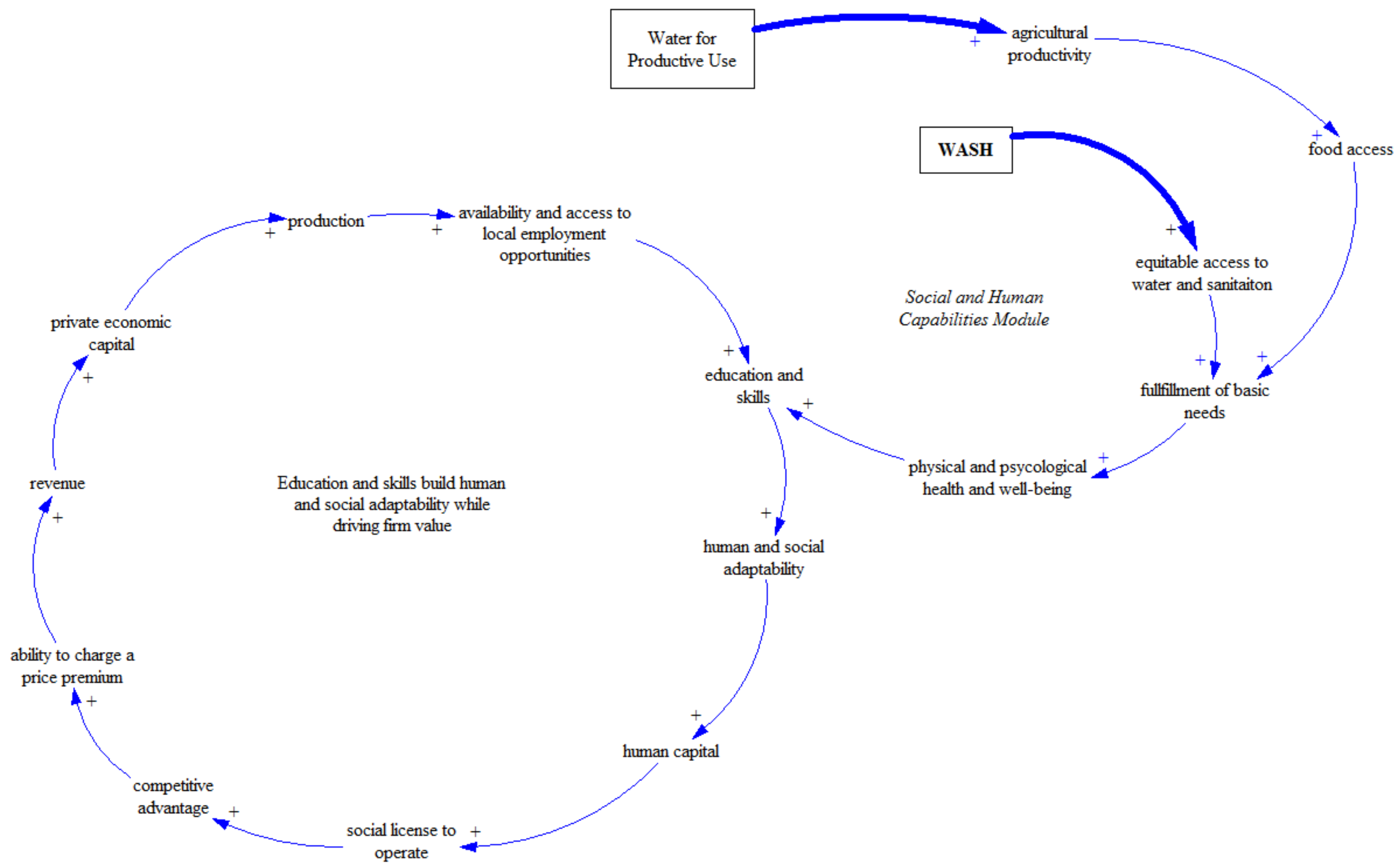

Figure 107. Investing in WASH and water for productive use reinforces education and skills, which builds human capital and increases value for the firm (Reinforcing).

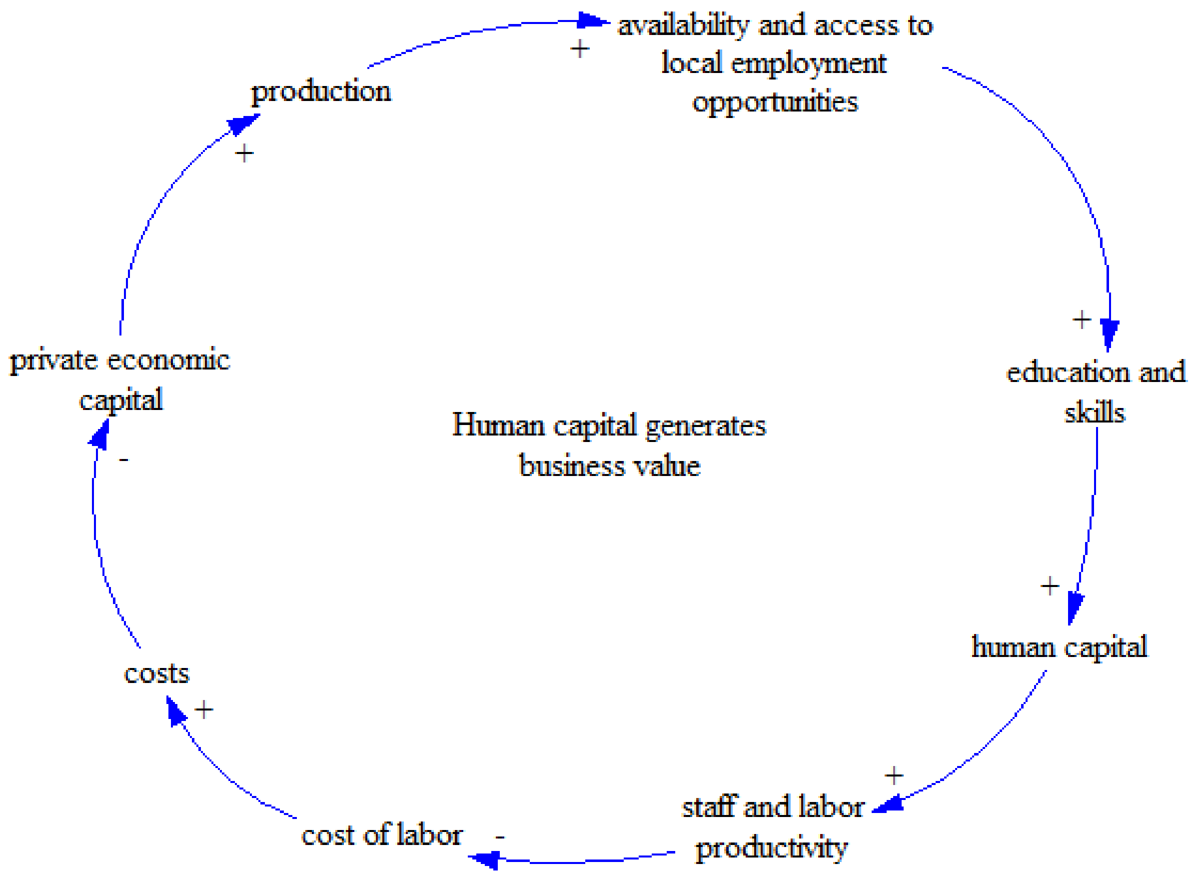

Figure 108. Human capital influences costs of labor inputs (Reinforcing).

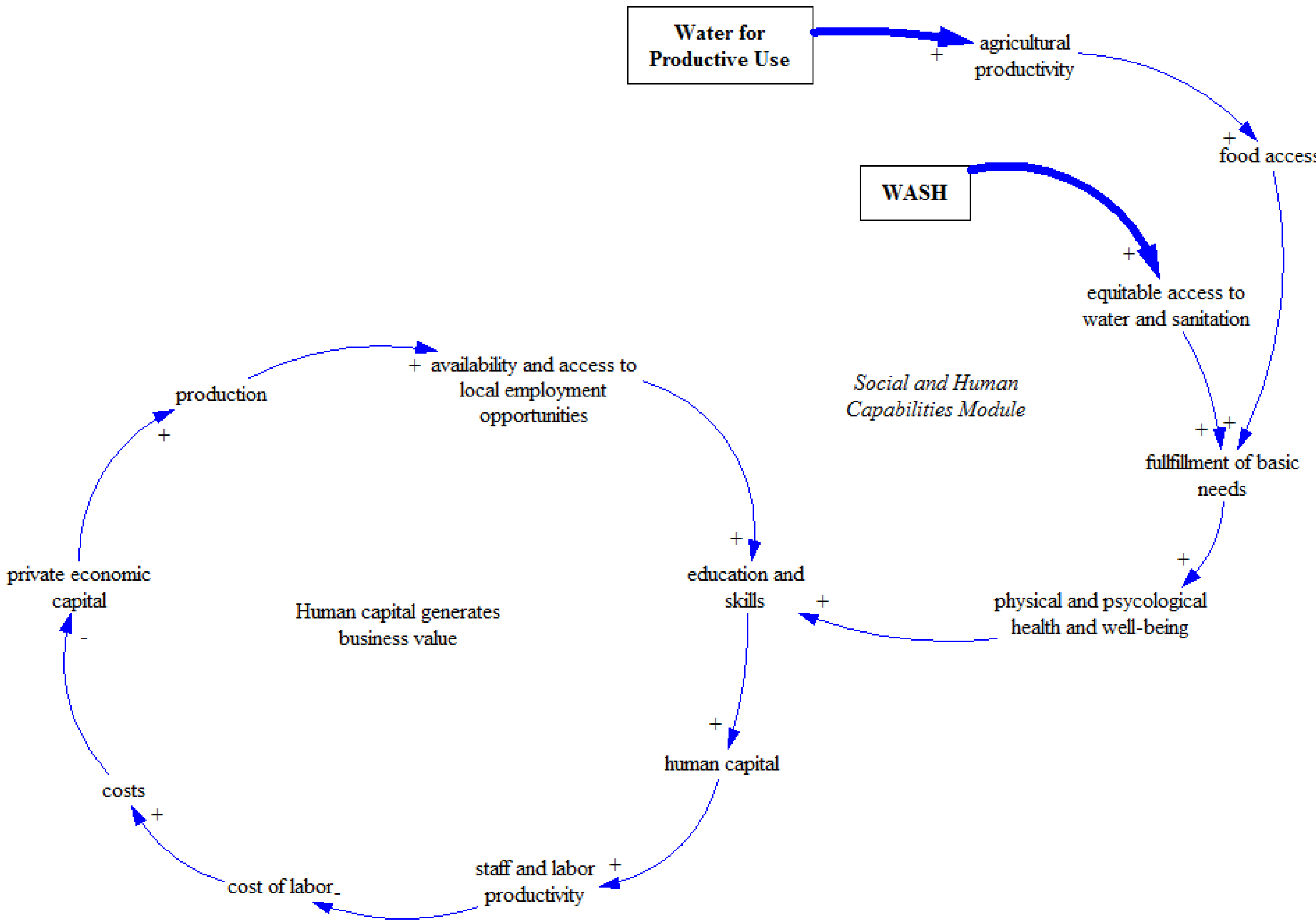

Figure 109. Investments in building human capital drive value for the firm (Reinforcing).

Appendix E: Case Study – Tables and Figures

Tables.

Table 62. Aqueduct variables and their definitions.

Variable	Definition
Total withdrawal	"The total amount of water removed from freshwater sources for human use."[388]
Total blue water	"The accumulated runoff upstream of the catchment plus the runoff in the catchment."[389]
Available blue water	"The total amount of water available to a catchment before any uses are satisfied."[390]
Baseline water stress	"Total annual water withdrawals (municipal, industrial, and agricultural) expressed as a percent of the total annual available flow."[391]
Inter-annual variability	"The variation in water supply between years."[392] This is calculated by dividing the standard deviation of annual total blue water by the mean of total blue water from the years 1950 to 2008.[393]
Seasonal variability	"Variation in water supply between months of the year."[394] It is calculated by dividing the standard deviation of monthly total blue water by the mean of monthly total blue water from the years 1950 to 2008.
Flood occurrence	"The number of floods recorded from 1985 to 2011."[395]
Drought severity	"The average length of droughts times the dryness of the droughts from 1901 to 2008."[396]
Groundwater stress	"The ratio of groundwater withdrawal relative to its recharge rate over a given aquifer."[397] Values greater than one "indicate where unsustainable groundwater consumption could affect groundwater availability and groundwater-dependent ecosystems."[398]
Return flow ratio	"The percent of available water previously used and discharged upstream as wastewater."[399] Higher values of the return flow ratio "indicate higher dependence on treatment plants and potentially lower quality in areas that lack sufficient treatment infrastructure and policies."[400]
Upstream protected land	"The percentage of total water supply that originates from protected ecosystems."[401]
Threatened amphibians	"The percentage of freshwater amphibian species classified by IUCN [the International Union for Conservation of Nature] as threatened."[402] Higher values of this indicator "indicate more fragile freshwater ecosystems and may be more likely to be subject to water withdrawal and discharge regulations."[403]

Table 63. First-order causes and consequences of equitable access to water and sanitation facilities.[1]

Social and Human Capabilities Module [C]	First-order cause	First-order consequence
Equitable access to clean water and sanitation facilities	+Availability and access to infrastructure +Natural capital	+Equity and rights +Fulfillment of basic needs + Water consumption
Fulfillment of basic needs	+Equitable access to clean water and sanitation facilities +Income +Availability of accessible and affordable public goods and services	+Human Capital +Physical and psychological well-being

[1] ***Note:*** *(+) and (-) labels are consistent with polarity assignments in module.*

- *A causal link from variable A to variable B is positive (+) when either A adds to B or when a change in A leads to a change in B in the same direction.*

Figures.

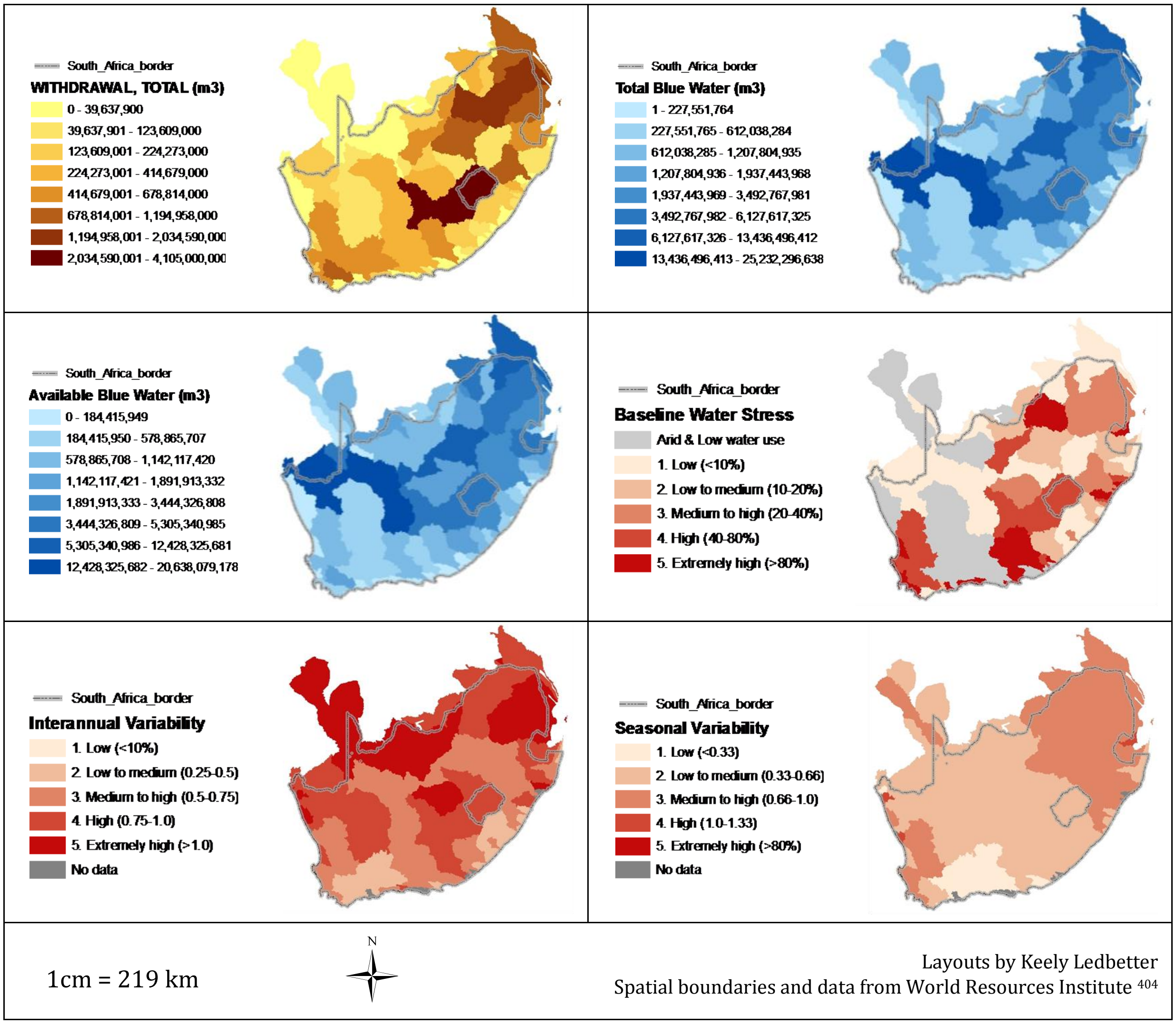

Figure 110. Climate and water variables by river basin in South Africa. This includes the following data from the World Resources Institute: total withdrawal (in cubic meters), total blue water (in cubic meters), available blue water (in cubic meters), baseline water stress, inter-annual variability, and seasonal variability.

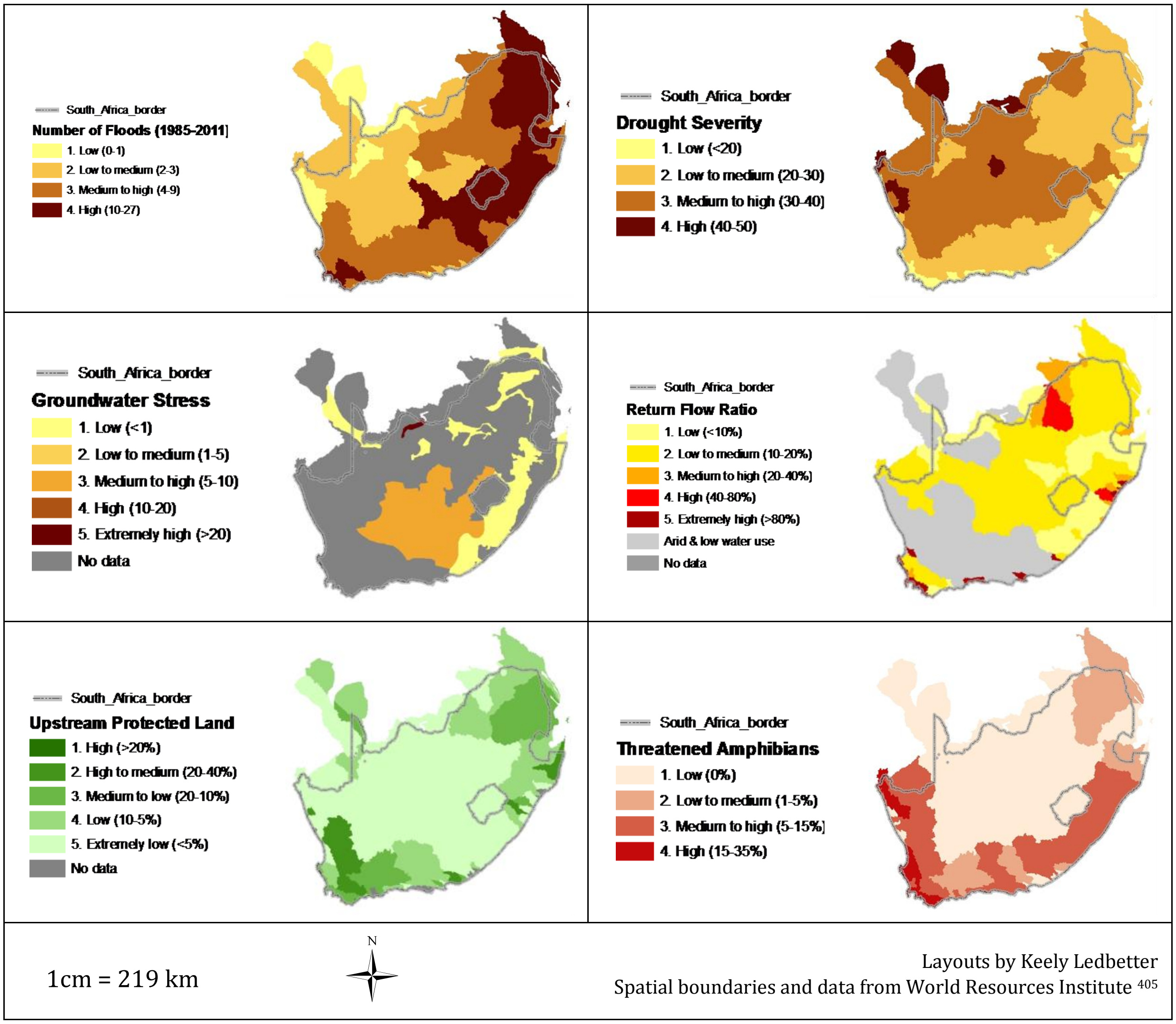

Figure 111. More climate and water variables by river basin in South Africa. This includes the following data from the World Resources Institute: flood occurrence (shown as the number of floods between 1985 and 2011), drought severity, groundwater stress, return flow ratio, upstream protected land (percent of total water supply that originates from protected ecosystems), and threatened amphibians (percent of amphibians classified by IUCN as threatened).

First and second-order causes of equitable access to clean water and sanitation

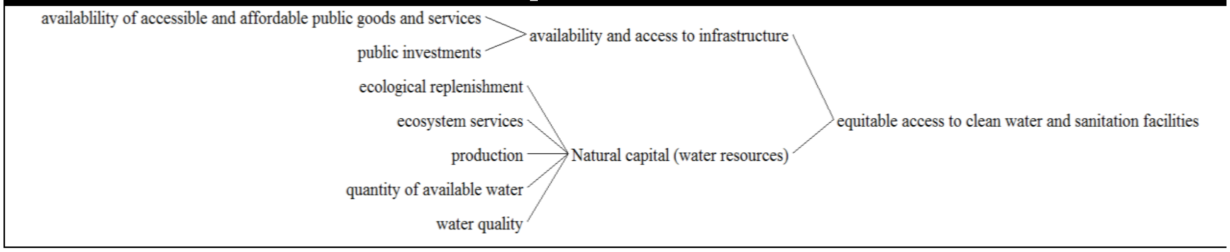

Figure 112. Natural capital and availability and access to infrastructure are needed to provide equitable access to WASH.

First and second-order consequences stemming from equitable access to clean drinking water and sanitation

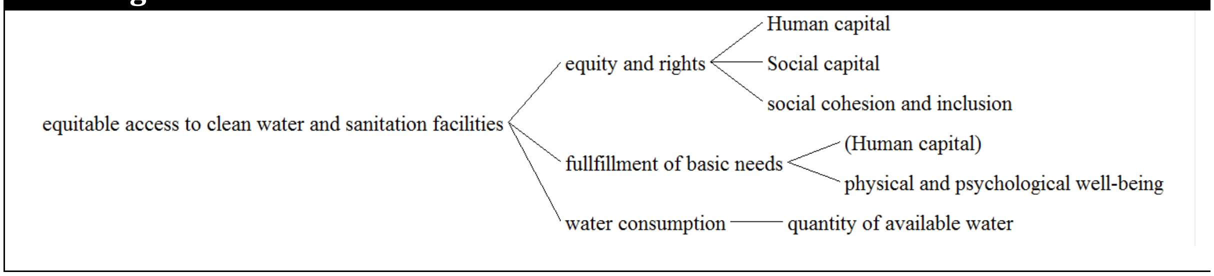

Figure 113. Equitable access to WASH increases builds human capital.

First and second order causes of fulfillment of basic needs

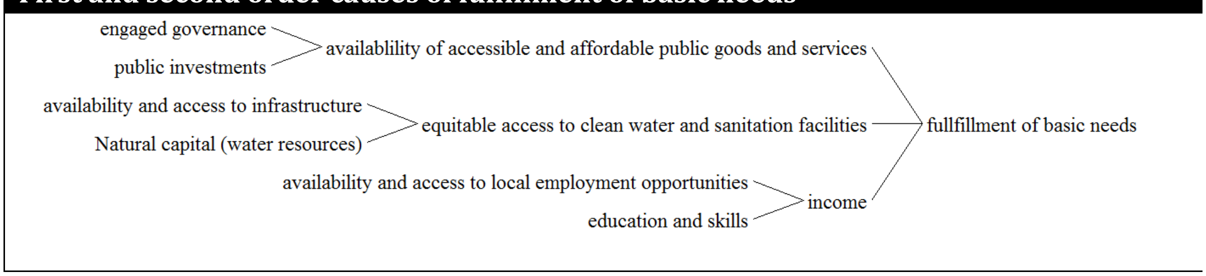

Figure 114. Equitable access to clean water and sanitation facilities enables the fulfillment of basic needs.

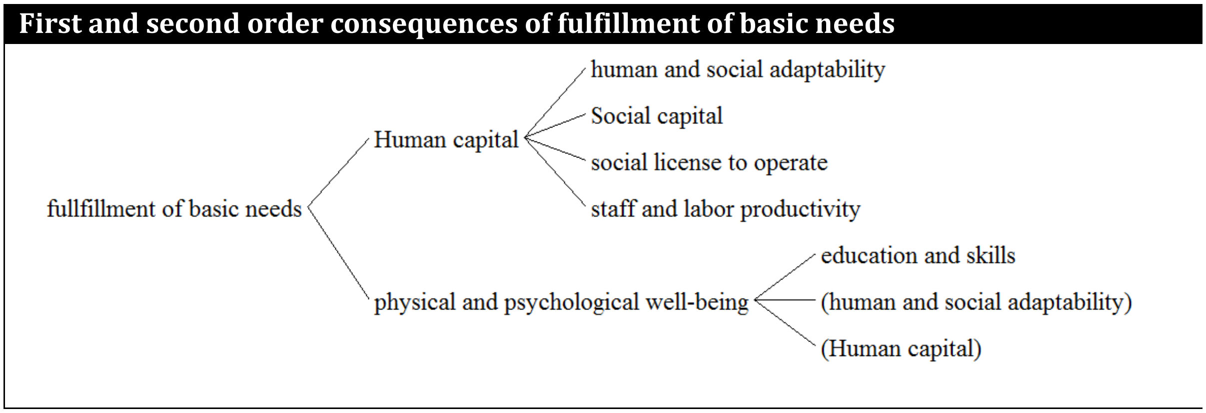

Figure 115. Fulfillment of basic needs improves physical and psychological well-being and builds human capital.

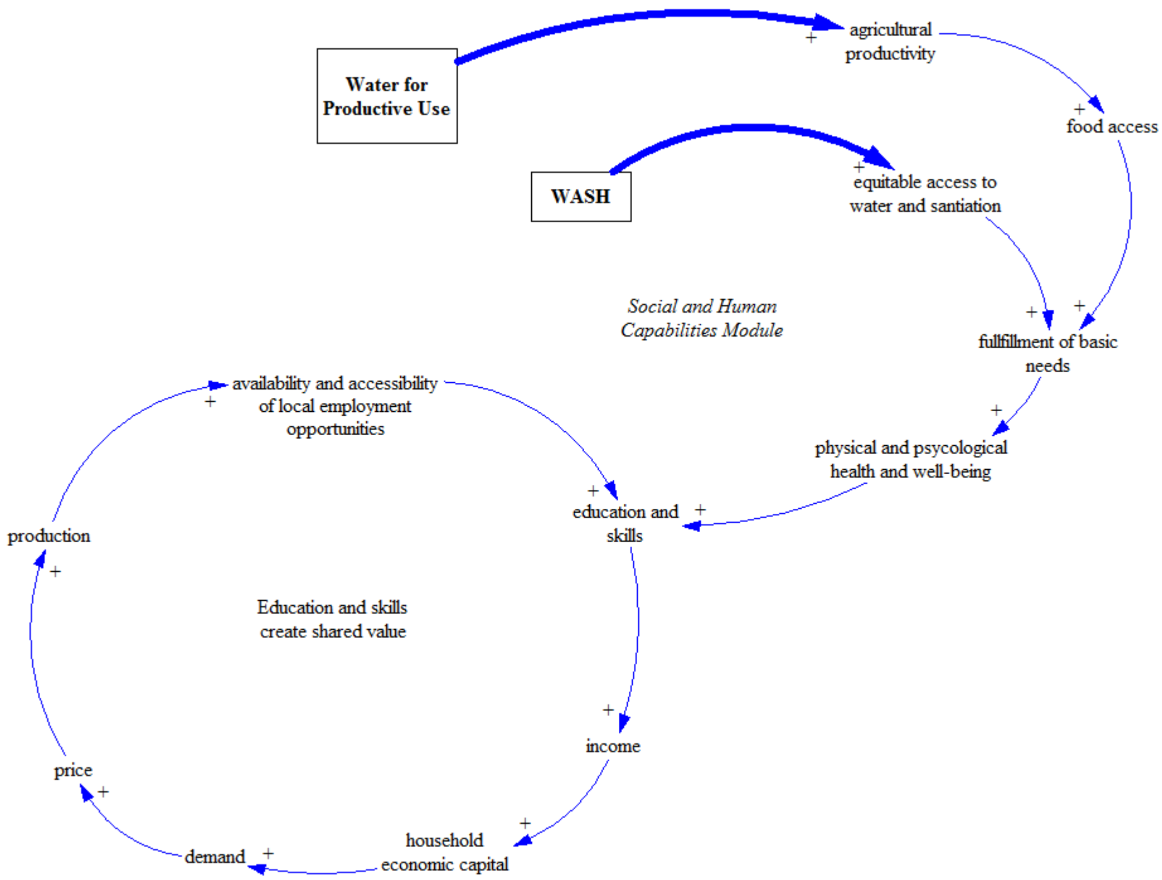

Figure 116: Investments in RAIN Water for Schools creates shared value.

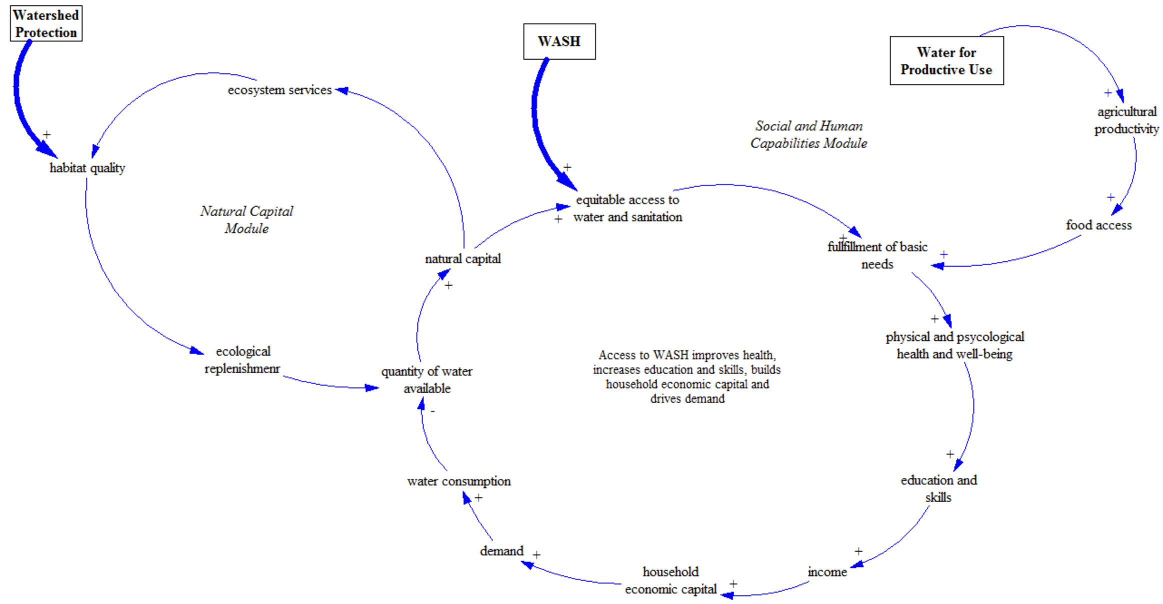

Figure 117: Investing in WASH, water for productive use, and watershed protection simultaneously can help balance complex systems that are dependent on water resources.

Appendix F: International Development Project Management (IPDM) Framework

There are many types of community development projects. They typically have different objectives, different scopes and scales, different time frames, different structures, different stakeholders, different strategies, different budgets, different measures of success, and lead to different outcomes. Despite these myriad differences, there are typically certain elements that many development projects have in common. For instance, most projects follow a linear project lifecycle, beginning with conceptualization, progressing to planning and execution, and eventually ending with project closeout.

A review of the literature revealed that many quantitative studies and qualitative assessments have been conducted to identify 'critical success factors' for projects across all industries, sectors, and fields (including international development oriented projects). However, few have sought to integrate the available literature related to international development projects, fewer still have attempted to operationalize these success factors or best practices, and none could be found that incorporated elements of systems thinking. Therefore, this evaluation seeks to fill two gaps. It is intended (1) to integrate and operationalize recognized success factors and best practices for development projects into a unified framework, and (2) to incorporate elements of systems thinking into this action-oriented framework.

The overall success of a development project can be disaggregated into two distinct categories: project management success and project success.[406] While project management success is process oriented, the success of the project itself is a reflection of the effective use of the project's outputs and the sustainable achievement of the project's purpose and goals.[407] International development projects pose a special challenge to traditional measures of project success, since objectives are often intangible,[408] and sometimes not directly observable or measurable. Therefore, it may be helpful to differentiate between project management success and project success, as well as between the inputs, activities, outputs, outcomes, and impacts of development projects. Specifically, project management success can be evaluated against inputs, activities, and outputs, as these are process-based functions. On the other hand, project success is determined more by the long-term outcomes and impacts of the project against its stated objectives.[409]

This framework can be used primarily to evaluate project management performance, not project success. However, since the outcomes and impacts of a project depend in large part on the inputs, activities, and outputs of the project, it follows that thorough and rigorous project management is a critical pre-condition for project success. Furthermore, employing an evaluative framework that is relatively objective and consistent is important in addressing a significant challenge faced by development projects: the existence of an array of stakeholders with markedly different interests and objectives.

Typical international development projects can have up to seven distinct groups of stakeholders,[410] a significant difference from the more conventional view of engineering projects, where two stakeholders (client and project manager/contractor) are generally recognized. Aside from consultants, subcontractors, and experts, the stakeholders of a development project may include a project coordinator, a project manager, a national supervisor, a project team, a steering committee, beneficiaries, and the population at large.[411] Each of these stakeholders assesses the success of a project based on dimensions unique to their own agenda or particular to the group they represent.[412] Because of this complexity, having a consistent and relatively objective framework can prove valuable.

In addition, conversations with multiple organizations and agencies involved in development projects indicated that projects are viewed in a linear lifecycle structure. This is consistent with the general project management body of knowledge, which holds that most projects can be separated into distinct phases. The boundaries and names of these phases can vary from project to project, but in general they may be distinguished based on the activities carried out, the actors involved, the expected outputs, and the way they are managed.[413] Standard international development projects usually have four phases (although they may be called by various names), outlined in Table 64 below.

Table 64: Standard four phase life-cycle of international development projects

Phase	Common activities
Conceptualization	Specific need identified; outreach to secure donors and implementing agencies; ensure alignment of priorities; stakeholder engagement
Planning	Determine objectives and scope; analyze resources needed and available; develop timeline; receive approval
Execution	Kick off the project; carry out activities; manage risks; monitor and report on progress and performance; manage relationships
Closeout	Verify project outputs meet requirements; settle all transactions; issue final report; hand over the project outputs

To align the structure of the framework with current practice, the framework is constructed around these basic life-cycle phases. To begin, the research team conducted a literature review to identify both recognized best practices and causal connections between project elements and project outcomes. The review was limited to peer-reviewed journal articles and formal impact evaluations. This survey of the literature resulted in the bulk of the framework components, and framework criteria were validated as similar criteria appeared across multiple sources. The list was further supplemented by including systems thinking based criteria suggested from USAID's Local Systems framework.[414] Finally, the framework was also supplemented with material published by Ted London, director of the Base of the Pyramid Initiative at the William Davidson Institute at the University of Michigan, and colleagues.[415]

Introducing the Integrated Development Project Management (IDPM) Framework

Conceptualization

Every phase in the project lifecycle is critical to project management success, and in turn, project success. However, the conceptualization phase is unique in that it essentially creates the foundation for the rest of the project. In the view of the University of Michigan team, many – if not most – of the challenges, setbacks, and conflicts that development projects can create or be adversely impacted by can be traced back to the conceptualization phase. For instance, low uptake rates are an oft-cited challenge facing water and sanitation projects that involve behavioral change.[416] While not necessarily always the case, low uptake rates may be the result of a limited understanding of - and thus failure to account in the project design for - relevant norms, values, beliefs, social structures, institutions, interests, challenges, and other endogenous or exogenous stressors. Indeed, it is this very insight that led the UN, in their 2006 World Water Development Report,[417] to highlight multiple context-related considerations in their key recommendations, including:

- Appreciate the context within which water issues must be approached
- Appreciate the variety of circumstances – solutions have to be tailored to the situation
- Anticipate and adapt to changing circumstances[418]

The local context at any location is composed of a tapestry of multiple nested and interacting complex systems (e.g., ecosystems, social systems, political systems, economic systems, etc.). There are numerous ways to engage with, learn about, and assess these local systems, and different approaches likely will have trade-offs to manage. Two examples of such approaches include:

1. *Extended due diligence and research*: organizational staff could conduct both primary and secondary research by (1) reviewing the available literature for case studies and other information specific to the context of interest, and (2) following a social science protocol similar to the creation of an ethnography by travelling to, and embedding themselves within the local context for an extended period to observe or even participate in daily life there.

2. *Extensive engagement with local stakeholders*: local stakeholders are by definition part of the local context, making them relative experts on an array of local dynamics that could remain obscure even after conducting extensive field visits and research. Tapping into this rich source of local knowledge could not only illuminate large parts of the local context 'map,' but could also build trust and relationships, establish communication channels, uncover possible solutions, identify risks, and much more.

Planning

The planning phase uses the intelligence generated during conceptualization to inform the creation of a robust project plan. Ensuring effective collaboration between the various actors and stakeholders involved in any given project is important when considering the number of stakeholders typically involved in a development project. This usually involves careful selection of partners and the creation of mutually agreed upon roles and responsibilities, along with clearly established and easily accessible communication channels for all actors involved, including local stakeholders.

Further, while engaging with local stakeholders plays an important role in all project phases, working with them in the planning phase is critical for a number of reasons. Not only do local stakeholders typically have practical local knowledge about contextual factors that could contribute to the success (or failure) of a project, but also they themselves have the potential to be supportive or disruptive factors. Local stakeholders can also be sources of valuable feedback and of innovation. As described in the quote that follows from two leading base of the pyramid (BoP) market theorists, a recognized best practice in BoP venture development is partnering with local stakeholders. The same principles apply in the design of effective development solutions as they do in the design of successful BoP ventures.

> *These disciplines [sociology, anthropology, and empathy-based design] stress the importance of codeveloping custom solutions to problems through two-way information flow. Rather than imposing preexisting solutions from above, the emphasis is on working with local partners to codesign every aspect of the product or service, including its delivery.*
>
> *In our study of BOP ventures, [we] discovered that successful initiatives - those that became embedded in the local community - maximized the functionality of the product or service in terms that were important to local users. This often meant allowing the product and business model to coevolve…Poorly performing ventures, on the other hand, tended to view the value proposition in terms of the product itself and often completed the development process at a geographically distant location, such as the corporate R&D center, before the business model was designed.*[419]

One of the fundamental causes underlying the need for development projects in the first place is limited, weak, broken, or nonexistent institutions and governance systems. As noted by the World Bank, "poorly functioning public sector institutions and weak governance are major constraints to growth and equitable development in many developing countries." Furthermore, good governance and effective public sector institutions are critically important for poverty reduction.[420] In the case of water- and sanitation-related issues as well, weak or ineffective governance structures and other institutional failures play a significant role in creating or perpetuating the issues.[421] [422] [423] [424] Accordingly, projects that provide infrastructure solutions in the context of weak institutions (governance or otherwise) can be described as addressing the symptom of the problem but not the problem itself.

The implications of this are that infrastructure-only projects are advisable only in settings where there is sufficient institutional capacity to support the infrastructure in the long-term. Otherwise, the project's long-term success could be exposed to substantial risk. In settings where institutional capacity is limited, development projects are more likely to be successful where those institutional issues are addressed before (or at least in parallel with) infrastructure considerations.

Execution

In addition to fairly standard considerations around project execution, monitoring (both in the short-term during execution and in the long-term after closeout) is a particularly important element of development projects. Although tangible project outputs can usually be measured fairly readily, they do not provide significant insight into the outcomes and impacts of the project, which are frequently intangible and which determine whether or not the project was successful. When the outcomes and impacts are neglected, as is the case in many projects that only measure resource mobilization and efforts, rather than results, the consequence is "the inefficient use of development funds and long-term lack of accountability."[425] Furthermore, lack of effective monitoring means that there is no way to accurately report on project success or failure, and no opportunity for social or organizational learning.

To better understand the different elements within a project that can be monitored, it is helpful to consider a logic model. Logic models have been around for decades, and typically consist of causal chains that "seek to explain the occurrence or non-occurrence of phenomena through a series of controllable activities. It explains the logic embodied in a program – that doing activity A, activity B, and so forth, will result in products or services that will eventually affect people or problems in a desired manner."[426] The standard logic model for development projects differentiates between five elements, described below:

1. **Inputs**: resources used during the project, such as financial capital, social capital, organizational staff, partners, and material goods.
2. **Activities**: actions occurring throughout the project lifecycle.
3. **Outputs**: tangible and intangible consequences of project activities. Can include product and information outputs (e.g., new practices developed with stakeholders, new community management approaches, baseline data collected) as well as more concrete outputs (such as number of people trained or number of toilets installed).
4. **Outcomes**: intermediate impacts that can be at least partially attributed to the activities and outputs of the project. "They can be negative or positive, expected or unexpected, and encompass both 'functional' effects," such as greater use of new infrastructure, or "intangible 'empowering' effects (e.g., improved

community confidence or self-esteem, improved local ability to resolve conflict or solve problems)."[427]

5. **Impacts**: the changes or benefits resulting from the project. These changes may be seen as negative or positive (and may be seen differently by different stakeholders) and are influenced by many factors external to the project. Often, changes are only observable in the long-term, and due to the extended time frame and presence of many external variables, assessing the impacts of development projects is generally quite difficult and costly. For this reason, some researchers recommend using outcomes as 'intermediate' signs of impact.[428]

A critical distinction must be made between outputs and outcomes. Outputs are relatively straightforward to measure and a useful metric of how well the project was managed, but they do not offer much insight into if or to what extent a project is improving a problem or situation, which is what most development projects intend to accomplish. To understand these actual results, <u>outcomes</u> or longer-term <u>impacts</u> must be measured. Measuring outcomes and impacts is often a time-consuming and resource intensive undertaking, but the data and results generated are well worth it, as they enable evidence-based decision-making.[m]

Closeout

Long-term project sustainability and success depend heavily on the successful exit of the sponsoring or managing organization. Traditional thinking within the international development field, however, has emphasized specific technical outputs, with less focus on long-term sustainability.[429] A well-designed and executed exit strategy, according to CDA Collaborative Learning Projects (a U.S. nonprofit focused on facilitating organizational learning in the development field), promotes a "stronger constructive relationship with the community during operation – with more attention to mutual long-term interests over short-term objectives and continued local impact, leaving a strong positive legacy behind."[430]

Unfortunately, there is currently no universally accepted definition of the exit strategy concept. It has various interpretations in different fields and amongst different actors even within the same field.[431] Additionally, it appears there may be a misguided belief amongst practitioners that "everyone is using the same language and there is a universal consensus on how to proceed."[432] This suggests that not only is it possible that many development organizations do not employ effective exit strategies, but they may also be unaware of this situation as well.

One relatively comprehensive definition comes from a USAID report. They state that the "goal of an exit strategy is not only to maintain benefits achieved, but also to enable further progress toward the program's development goals. Ideally, an exit

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[m] Readers interested in learning more are encouraged to use a guidebook published by the World Bank: http://siteresources.worldbank.org/EXTHDOFFICE/Resources/5485726-1295455628620/Impact_Evaluation_in_Practice.pdf

strategy sets in place a system whereby the benefits expand beyond the original beneficiaries and their communities."[433]

On an operational level, one of the most highly cited works comes from two U.S. researchers, Levinger and McLeod, who identified three basic exit strategies: phasing-out, phasing-down, and phasing-over. In their words:

> *"Phasing-out refers to the withdrawal of project inputs without making any arrangements for another organization to continue implementation. Phasing-down refers to the gradual reduction of aid and is a precursor to phasing-out or phasing-over. Phasing-over refers to the transfer of project goals, responsibilities, and activities to another organization. This is contingent on planned individual and institution capacity-building to assure uninterrupted quality services can continue under localized management."*[434]

They identified the following six primary phase-over tactics, which have been incorporated into the *IDPM Framework*:

Table 65: Specific tactical elements of an exit strategy[435]

Plan for exit from the earliest stages of program design
"Early planning allows donors and local partners to work together and make incremental steps toward exit within a reasonable period. This gives local partners time to build capacity and take ownership of services. This also allows for any unexpected delays or changes, assuring that when exit is complete everyone is fully prepared."
Develop Partnerships and Local Linkages
"This two-prong tactic identifies present and potential leaders within local organizations who support the project's goals. It refers to building or reinforcing a network between 'northern' and 'southern' partners, as well as linkages between local actors in the public or private sector in which they operate."
Building local organizational and human capacity
"To continue providing high quality services, it is essential that an organization has the capability to do so. When an organization and individuals within that organization can design/plan and execute demanded services, they are in a position to perpetuate benefits and positively impact the community. Development practitioners have not always identified capacity-building as a key element in development projects, but when undertaken this can lead to long-term sustainability. An assessment should be taken to determine local actors' strengths and weaknesses and capacity-building customized to fit the individual for their ongoing role. To continue benefit flows, it might be necessary to develop a broad spectrum of capabilities to contribute to

organizational longevity."

Mobilize local and external resources

"Any development activity stream relies on an accompanying funding stream. Implementing an exit strategy is no different. Further, when a sponsor exits, so too will its financial resources, and mobilizing alternative sources of income is vital.

These sources might be international or domestic, public or private sector. Tapping into these channels for an uninterrupted flow of funds will depend on designing a funding plan and building fundraising skills. The more successful the phase-over recipient organization is in cultivating other donors or income streams, the more its management can focus on delivering high quality programming. Using a business model and market-based approaches are best practices for financial sustainability"[436] [437]

Stagger the phase-out of program activities and resources

"Development work by its nature is community-based, complex, and detailed. The most effective phase-overs are those that use a gradual, staggered approach. Staggering the transition of a sponsor's managerial, administrative, and programmatic activities to a local organization will give the recipient organization time to adjust. It will also reveal any weaknesses in their abilities to take on new roles or handle new responsibilities. Should additional training of local staff be necessary, it can take place during this period."

Allow roles and relationships [to] evolve

"Donors should help recipient organizations develop themselves within their environment, establish their name and be known for excellent work. Local organizations can also benefit from donors helping them build relationships and networks within the local community in which the donor has a recognizable track record. An implementing agency can act as an on-going mentor to the recipient organization, enhance the gradual transition during the period of shifting responsibilities and activities, and might even continue to offer complementary services within the same geographic area. This would allow the donor to take on a collegial and cooperative role in relation to the local organization, relating with it as an equal partner."

Using the Framework

The original framework developed by the University of Michigan team is called the *IDPM (Integrated Development Project Management) Framework*, and may be used before, during, and/or after any of the project lifecycle phases. Consulting it before beginning any phase can help ensure that the activities engaged in are grounded in recognized best practices. Referencing it as activities are in-progress can be helpful in resolving questions as they arise, in thinking through challenges, as well as in minimizing the risk of missing important project elements or considerations.

The *IDPM Framework* can also be used to assist with evaluations of projects after they have been completed and as a mechanism for organizational learning. The *Framework* is an inherently qualitative tool, so using it in post-completion project evaluations should reflect this attribute. It may be most effective to use it as a basis for dialogue, ideally with the same stakeholders and actors involved in the project itself, or at least within the managing/sponsoring organization. One possible approach is to go through each criterion in a facilitated multi-day, multi-stakeholder workshop, using the following questions to guide and frame the conversation:

1. What is your understanding or interpretation of this criterion? (This could include its theoretical underpinnings, its importance, or its operational elements)
2. To what extent was this criterion addressed?
3. What were some enabling or disruptive factors?
4. What tools were helpful or would have been helpful?
5. What outcomes or impacts did you notice from following or not following the criterion?
6. Did this criterion generate any costs or benefits? What were they? How were they distributed among different stakeholders?
7. Is there anything you would recommend being done differently during the next project?

The results from such a dialogue are likely to be rich and highly useful for organizational learning and improving the success of both project management and projects themselves.

The decision of whether, when, and to what extent to make use of the IDPM Framework should be grounded in an honest appraisal of its trade-offs. The primary benefits for its use may include higher project success rates, greater and longer-lasting project impacts, stronger partner relationships and larger partner networks, and increases in innovation. Together, these could cause a virtuous cycle, enhancing organizational reputation and making the organization more appealing to investors and donors, as well as generating further opportunities for growth. The primary costs of its use may include increased organizational and project resource needs (including financial, staffing, knowledge, and other resources) and project timeline impacts.

The Integrated Development Project Management (IDPM) Framework

1. Conceptualization	
1.1	The local context has been studied prior to objective setting, and the information collected has been shared with project administrators, designers, and other relevant stakeholders.
1.1.1	Stakeholder groups and their relationship dynamics (such as previous interactions, levels of trust, mutual understanding, competing interests, histories, cultures, etc.) and societal roles have been identified and examined.
1.1.2	A preliminary understanding of local, regional, and national systems (e.g., social, ecological, economic, political, and other systems) has been developed.
1.1.3	A preliminary understanding of local 'rules' (e.g., norms, values, beliefs, goals, cultures, etc.) representing relevant social classes (e.g., different stakeholders, gender groups, age groups, socioeconomic groups, religious, education, occupational, or other groups) has been developed.
1.1.4	Dialogues have been conducted with stakeholder groups to better understand their perspectives on the current situation or challenge, the reasons for the current circumstances, and what their goals are.
1.1.5	Available resources (such as human capital, social capital, natural capital, economic capital, institutional, and governance structures) and the equity of the distributions have been assessed.
1.1.6	Physical/geographic factors (e.g., climate, location, flora, fauna, terrain, land, and natural resources) have been examined.
1.2	Local systems and the local context have been mapped out and recorded, to assist with knowledge sharing, change tracking, and organizational memory.
1.3	Based on the above systems studies, the particular interests and objectives of various stakeholders have been noted and shared with project administrators and designers.
1.4	Major risk factors have been assessed and analyzed relative to the type of project under consideration.
1.5	Previous projects, case studies, and impact evaluations related to the current geography, project, or other contextual factors have been reviewed.
Objective setting	
1.6	Alternative objectives, interventions, and project designs have been considered, and the opportunity costs associated with each have been evaluated.
1.7	The project has clearly defined and measurable objective(s).
1.8	The project's vision and objectives align with the priorities of the donor(s)

	and the interests of the stakeholders (including the beneficiary country and government).

2. Planning	
Partnerships and collaboration	
2.1	The most appropriate implementing partner been selected. *The ideal implementing partner is one that is capable and willing to deliver. They should have an established and effective communication system (internally and externally), support from top management, an organizational structure responsive to change and capable of making adjustments on the fly, sufficient resources, and be very capable of managing risks.*
2.2	The project allows and encourages resource users and/or project beneficiaries to meaningfully, autonomously, and interactively participate in decision-making from the very beginning. Potential obstacles have been identified and addressed in the project design. Special attention has been paid to groups that may be marginalized or less likely to participate.
2.2.1	The legitimacy and authority of any such group among local community members and other stakeholders (particularly institutional and bureaucratic/administrative ones) have been verified. Where lacking, the project includes early mechanisms for building these dynamics.
2.3	Clear structures, norms, processes, and roles have been established around coordination, cooperation, communication, and information exchange between all involved stakeholder groups (e.g., businesses, donors, governments, NGOs, implementing agencies, user groups, etc.).
2.4	Clear lines of authority and responsibility have been established, agreed upon, and communicated between project managers, implementing partners, administrators, and others involved.
2.5	From the very beginning, all actors involved have an understanding of how levels of involvement are expected to change over time, as well as an understanding of any exit strategies.
2.6	Consider whether it is more appropriate to use social or legal contracts with partners. In many informal sectors, relationships are based largely in social, not legal contracts.[438] Decide on which may be more useful based on contextual information and stakeholder feedback.
Stakeholder engagement	
2.7	Time has been built-in to the project at the beginning to build strong relationships with local institutional structures and traditional leaders.
2.8	Local stakeholders are able to easily and conveniently participate in the project planning process as a partner. Rather than attempting to use a pre-

	constructed solution from the top-down, local partners are engaged to co-design every aspect of the solution. Obstacles to their participation have been identified and removed where possible.
2.9	The approval and commitment of stakeholders to the project objectives and design has been voluntarily secured.
2.10	All stakeholder engagement plans have been designed with the local context in mind. They are based on current locally accepted/relevant norms, values, and processes.
2.11	There is a clear plan for engaging with any potentially marginalized stakeholder groups.
2.12	Project designers have engaged with local stakeholders and have incorporated local/indigenous knowledge, values, and norms into the project design.
2.13	Local stakeholders, particularly beneficiaries, are able to easily connect with project staff and administrators, and requests for mid-project shifts and changes to project objectives and design can be accommodated.
Local capacity	
2.14	The project is based in an area with public institutions capable of independently running the project at the level necessary to meet the objectives. If not, the project includes mechanisms to strengthen local institutions and build capacity so that they will become so capable.
2.15	Where a project involves commercial interests in any capacity, a well-functioning regulatory system is in place.
2.16	There are strong local institutional systems capable of avoiding the problems of elite capture of project benefits, or this capacity will be built by the project.
Resources	
2.17	An analysis was conducted up-front to identify and analyze short-term and long-term financial requirements and other resource needs, ultimately assessing the viability of the project.
2.18	The project has both short-term funding sources confirmed and accessible, and long-term plans to ensure consistent access to capital.
2.19	Buffers against unanticipated events, setbacks, or obstacles have been included in project budgets and other resource planning.
2.20	Supply chain risks have been assessed and minimized.
2.21	Where possible, resources (including funding) needed for the project have been obtained locally.
Adaptability and risk	
2.22	Robust feedback and control mechanisms for early problem detection have been built into the project design.
2.23	Contingency plans have been developed to address major risk factors.

2.24	The potential for delay caused by bureaucratic administration systems has been accounted for in the project design.
Benefits and beneficiaries	
2.25	The project promotes equity in access to project benefits.
2.26	The project includes an explicit focus on poverty alleviation.
2.27	The project beneficiaries are clearly defined.
2.28	The project is based on beneficiary demand.
Misc.	
2.29	Environmental sustainability considerations have been factored into the project design.

3. Execution	
General Operations	
3.1	Resources are being mobilized successfully and usage is accounted for and as planned.
3.2	Activities are carried out as scheduled.
3.3	Outputs produced meet the planned specifications and quality.
3.4	Rules or norms related to the project have been clearly defined, created with the local community, and understood and accepted by beneficiaries and relevant others.
3.5	Where possible, beneficiaries and other local stakeholders have been involved in executing all stages of the project/program.
3.6	Compliance with operational rules and norms is encouraged internally within beneficiary communities, with external assistance and support available.
3.7	Beneficiaries and others who violate operational rules are likely to be assessed graduated sanctions (depending on the seriousness and context of the offence) by other beneficiaries, by officials accountable to these beneficiaries, or by both.
3.8	Beneficiaries and their representatives/officials have rapid access to low cost local arenas to resolve conflicts between beneficiaries or between beneficiaries and their representatives/officials.
Feedback	
3.9	Key stakeholders (both local and remote) are kept informed of progress, and there is a high degree of transparency related to challenges, delays, successes, changes, and other relevant factors.
3.10	Periodic reviews are conducted with relevant stakeholders (both local and remote) and groups to evaluate current progress and performance and to receive feedback.
3.11	Stakeholders (both local and remote) are largely satisfied with current

	progress and performance. Dissatisfaction is actively investigated and remedied to the greatest extent possible.
3.12	Processes for adjusting the project/program and any operational rules on the fly are in place, and staff is willing and able to undertake such adjustments.
Monitoring and Evaluation	
3.13	Clear performance targets (including short- and long-term outcomes) have been mutually established, with contingency plans for significant variation.
3.14	Program/project effectiveness is measured by the most granular level data available (e.g., household data rather than aggregated neighborhood data).
3.15	Local capacity around the appropriate skills, tools, and technologies is built-upon to empower beneficiaries and community members to monitor the performance of the program/intervention and analyze the results.
3.16	Beneficiaries and local stakeholders have opportunities to participate in evaluations of the project/program, and formal processes are established to ensure project/program accountability to beneficiaries and local stakeholders.
3.17	Administrators and managers play a facilitative and coordinative role, connecting locals with access to relevant information, tools, experts, decision-makers, and other resources, thereby building social capital and capacity.

4. Closeout	
4.1	Relevant stakeholders have confirmed their acceptance and satisfaction of outputs and outcomes.
4.2	Project assets have been transferred, financial settlements completed, and the team dissolved to the satisfaction of key stakeholders.
4.3	Local stakeholders have been consulted and there is mutual understanding of and agreement to new roles, responsibilities, and expectations.
4.4	Structures and resources for ongoing support (including financial, operational, administrative, and technical) have been established and confirmed as functional.
4.5	The transition or phase-out of managerial, administrative, and programmatic activities is conducted using a gradual, staggered approach.
4.6	Long-term advisory support and facilitation is available and readily accessible.
4.7	Project has built the institutional capacity needed for ongoing success.
4.8	The project is well regarded with a positive reputation by leaders, administrators, politicians, funders, and other key stakeholders.
4.9	Resources needed for ongoing maintenance, repairs, and replacements are

	ensured either through local economic empowerment or through other means.
4.10	Ecological factors and constraints are reviewed periodically to ensure minimal risk.

Appendix G: Overview of Recent and Relevant Impact Evaluations

In this Appendix, you will find summaries of various studies on the impacts of programs related to water, sanitation, and hygiene. Credible evidence is crucial for determining what works, why, and at what cost.

[Review of multiple studies]

The joint effects of water and sanitation on diarrhoeal disease: a multicountry analysis of the Demographic and Health Surveys

Fuller, J. A., Westphal, J. A., Kenney, B. and Eisenberg, J. N. S. (2015), The joint effects of water and sanitation on diarrhoeal disease: a multicountry analysis of the Demographic and Health Surveys. Tropical Medicine & International Health, 20: 284–292. doi: 10.1111/tmi.12441

- The study: Data from 217 Demographic and Health Surveys conducted in 74 countries between 1986 and 2013 were used to assess the impact of water and sanitation infrastructure on the prevalence of diarrhea among children under 5.

- Results: Sanitation had more impact than water infrastructure, however that impact diminished over time. Based on survey data from the past 10 years, they found no evidence for benefits in improving drinking water or sanitation alone, but they estimated a 6% reduction in prevalence from both sanitation and water infrastructure combined.

- Conclusions: “Water and sanitation interventions should be combined to maximize the number of cases of diarrheal disease prevented in children under 5.”

[Review of multiple studies]

Systematic review: Assessing the impact of drinking water and sanitation on diarrhoeal disease in low- and middle-income settings: systematic review and meta-regression

Wolf, J., Prüss-Ustün, A., Cumming, O., Bartram, J., Bonjour, S., Cairncross, S., Clasen, T., Colford, J. M., Curtis, V., De France, J., Fewtrell, L., Freeman, M. C., Gordon, B., Hunter, P. R., Jeandron, A., Johnston, R. B., Mäusezahl, D., Mathers, C., Neira, M. and Higgins, J. P. T. (2014), Systematic review: Assessing the impact of drinking water and sanitation on diarrhoeal disease in low- and middle-income settings: systematic review and meta-regression. Tropical Medicine & International Health, 19: 928–942.
doi: 10.1111/tmi.12331

- Objective: "To assess the impact of inadequate water and sanitation on diarrheal disease in low- and middle-income settings"

- Results: "Overall, improvements in drinking water and sanitation were associated with decreased risks of diarrhea. Specific improvements, such as the use of water filters, provision of high-quality piped water and sewer connections, were associated with greater reductions in diarrhea compared with other interventions."

- Conclusions: "The results show that inadequate water and sanitation are associated with considerable risks of diarrheal disease and that there are notable differences in illness reduction according to the type of improved water and sanitation implemented."

[Review of multiple studies]
Hand washing for preventing diarrhoea

Ejemot-Nwadiaro RI, Ehiri JE, Meremikwu MM, Critchley JA. Hand washing for preventing diarrhoea. Cochrane Database of Systematic Reviews 2008, Issue 1. Art. No.: CD004265. DOI: 10.1002/14651858.CD004265.pub2.

- Objectives: "To evaluate the effects of interventions to promote hand washing on diarrheal episodes in children and adults."

- Conclusions: "Interventions that promote hand washing can reduce diarrhea episodes by about one-third. This significant reduction is comparable to the effect of providing clean water in low-income areas. However, trials with longer follow up and that test different methods of promoting hand washing are needed."

[Review of multiple studies]

The impact of school water, sanitation, and hygiene interventions on the health of younger siblings of pupils: A cluster-randomized trial in Kenya

Dreibelbis, R., Freeman, M. C., Greene, L. E., Saboori, S., & Rheingans, R. (2014). The impact of school water, sanitation, and hygiene interventions on the health of younger siblings of pupils: A cluster-randomized trial in Kenya. *American Journal of Public Health, 104*(1), E91-E97. Retrieved from http://search.proquest.com/docview/1477881574?accountid=14667

- <u>Objectives</u>: To examine the impact of "school water, sanitation, and hygiene (WASH) interventions on diarrhea-related outcomes among younger siblings of school-going children."

- <u>Conclusions</u>: "In water-scarce areas [but not areas with greater water availability], school WASH interventions that include robust water supply improvements can reduce diarrheal diseases among young children."

[Review of multiple studies]

Effectiveness and sustainability of water, sanitation, and hygiene interventions in combating diarrhoea

By: Hugh Waddington , Birte Snilstveit
In: Journal of Development Effectiveness, Vol. 1, Iss. 3, 2009

- Objective: To review impact evaluations examining the effectiveness of water, sanitation, and hygiene interventions in reducing diarrhea among children in low- and middle-income countries.

- Conclusions: "The paper challenges the existing consensus that water treatment at point-of-use and hygiene interventions are necessarily the most effective and sustainable interventions for promoting reduction of diarrhea. The analysis suggests that sanitation 'hardware' interventions are highly effective in reducing diarrhea morbidity. Moreover, while there is a wealth of trials documenting the effectiveness of water treatment interventions, studies conducted over longer periods tend to show smaller effectiveness and evidence suggests compliance rates and therefore impact may fall markedly over time."

[Review of multiple studies]

Interventions to improve water quality for preventing diarrhea: systematic review and meta-analysis

Clasen Thomas, Schmidt Wolf-Peter, Rabie Tamer, Roberts Ian, Cairncross Sandy. Interventions to improve water quality for preventing diarrhoea: systematic review and meta-analysis BMJ 2007; 334 :782

- Objective: "To assess the effectiveness of interventions to improve the microbial quality of drinking water for preventing diarrhea."

- Conclusions: "Interventions to improve water quality are generally effective for preventing diarrhoea in all ages and in under 5s. Significant heterogeneity among the trials suggests that the level of effectiveness may depend on a variety of conditions that research to date cannot fully explain."

[Review of multiple studies]

Water, sanitation, and hygiene interventions to reduce diarrhoea in less developed countries: a systematic review and meta-analysis

By: Lorna Fewtrell, Rachel B Kaufmann, David Kaya, Wayne Enanoria, Laurence Haller, and John M Colford Jr.
In: The Lancet Infectious Diseases; Volume 5, Issue 1, January 2005, Pages 42–52

- <u>Objective</u>: To conduct a systematic review of all published studies that reported interventions in water quality, water supply, hygiene, and sanitation in less developed countries.

- <u>Conclusions</u>: “Our review suggests that water, sanitation, and hygiene interventions, as well as their combination, are effective at reducing diarrheal illness, and water quality interventions (point-of-use water treatment) were more effective than has been previously acknowledged. However, publication bias may have been present in the subset of studies on water quality. Surprisingly, there was no evidence of an additive benefit from the application of concurrent multiple interventions.”

[Review of multiple studies]

Treating Water With Chlorine At Point-Of-Use To Improve Water Quality And Reduce Child Diarrhea In Developing Countries: A Systematic Review And Meta-Analysis

By: Benjamin F. Arnold and John M. Colford Jr
In: Am J Trop Med Hyg February 2007 vol. 76 no. 2 354-364
Available online at: http://www.ajtmh.org/content/76/2/354.full

- <u>Objectives</u>: To conduct a systematic review of "all studies that measured diarrheal health impacts in children and the impact on water quality of point-of-use chlorine drinking water treatment."

- <u>Results and conclusions</u>: Point-of-use chlorine treatment was found to reduce the risk of child diarrhea by 29% compared with traditional practices. This study notes that there are serious issues with available data. Most significantly, nearly all trials have been short-term (median length was 30 weeks). Further, outcomes were self-reported and control groups were unblended. This combination of factors can often lead to biasing the results towards finding a greater impact. Indeed, the two identified studies that were single-blinded found no impact from the point-of-use chlorine intervention.

[Review of multiple studies]

Does clean water matter? An updated meta-analysis of water supply and sanitation interventions and diarrhoeal diseases

By: Rebecca E Engell, BA and Stephen S Lim, PhD
In: The Lancet, Volume 381, Special Issue, S44, 17 June 2013
Available online at: http://www.thelancet.com/journals/lancet/article/PIIS0140-6736%2813%2961298-2/abstract

- Objectives: "We conducted an updated review of epidemiological studies on the effect of water and sanitation interventions on self-reported diarrhoea episodes."

- Conclusions: Improved water and improved sanitation both reduced diarrhea risk. Did not find significantly greater effects of piped water or source water treatment compared with improved water supply or significant effects by age.

  "Our reanalysis of quasi-experimental and experimental studies suggests much smaller impacts of water and sanitation interventions than previously thought. Given the emphasis placed on these interventions in improving livelihood, continued epidemiological research to assess the full effects of such interventions remains imperative."

[Review of multiple studies]
Rural Water and Sanitation: Assessing Impacts (2012)

Published by the OECD Development Assistance Committee Network on Development Evaluation

Available online at:
http://www.oecd.org/dac/evaluation/Evaluation%20insights%20WASH%20final%20draft.pdf

Main findings and points:

- "The health impact of the water and sanitation interventions evaluated by the five studies was limited in most cases. The full potential of health benefits is realized only when all of these conditions are met:
    1. Drinking water is safe (uncontaminated);
    2. Enough water is available all year round and within a short distance of the household;
    3. There is large-scale access to, and hygienic use of, toilets; and,
    4. Hands are washed with soap or ash at all critical times (after using toilet, before eating, etc.).

  Complete fulfillment of *all* of these mutually reinforcing conditions is rare, limiting health impacts."

- "Improved access to safe water supplies has beneficial effects for women and girls, who enjoy time savings and sometimes a reduced work load as a result. […] But time savings and reduced work load only achieve limited benefits in terms of increased income. The time saved is usually devoted to other unpaid work such as collection of firewood or unpaid agricultural labour. […] Typically, poor households with better access to safe water still face the same severe limits on economic opportunity. More time does not mean more money."

- "However, capacity for longer-term maintenance of these systems is insufficient at all levels, even when local management institutions appear well motivated. Weak institutions are the root cause of many failed water and sanitation systems. Technical sustainability depends on institutional sustainability, so institutional maintenance is vitally important. However, in the areas reviewed, support to institutions is typically inadequate. Institutional monitoring is lacking. Capacity of community level and lower level government structures has improved but these still face major capacity constraints. The capacity and sustainability of NGOs in the sector is questionable. Relying on NGOs and external finance (from donors) may dilute slower, but ultimately more sustainable, efforts to build the role and capacity of local government institutions."

- "Despite many references to sustainable development, policy and programmes are still too focused on the short-term delivery of infrastructure. More realism is needed about the mid- to long-term necessity of sector support, and there should be more clarity about how the cost of water service delivery is to be funded in the absence of full cost recovery from users, which has proven unrealistic in poor rural settings. There is inadequate recognition of the on-going need for institutional maintenance, in addition to technical maintenance. Greater clarity and realism are needed about the role, capacity and sustainability of NGOs in the sector."

- "Not enough attention has been given so far to the environmental sustainability of rural water supply programmes, especially in the context of climate change. More environmentally integrated approaches to rural water supply and sanitation are needed, for example in the context of integrated water resource management."

- "The poorest people in the beneficiary communities usually enjoy the benefits of improved water supplies too. But the very poorest and most marginalized communities typically have less access to these programmes and benefit less from them."

- "In all the cases of communal water points that were studied, part of the population continues to use less safe traditional water sources, sometimes also for drinking water."

- "The impact studies show that, where there is access to an improved water source, varying proportions of households in the communities studied do not use it at all, or do not use it during part of the year. The reasons vary. They include long distance to the improved source, particularly in cases of scattered rural households; high number of users per water point causing long queuing time; availability of rain water as an alternative source during the rainy season and decrease in the water output of some improved water sources, particularly during the dry season."

[Individual Impact evaluation]

RAIN-specific relevance (out of 5)	□□□□□
Title	Cleaning Springs in Kenya
Location	Kenya: rural Busia
Intervention / solution evaluated	Encasement of spring water sources in concrete, forcing water to flow through a pipe, protecting against groundwater contamination. User committees of local residents were created and responsible for maintaining the protected springs.

Key findings	• 66% less E-coli contamination in protected springs than in unprotected ones
	• 24% less (on average) contamination in home water supplies among households using only protected sources
	• Diarrheal incidence in children under age 3 fell by 25%, but no significant effect on children ages 5-12
	• Diarrhea reduction was disproportionately concentrated among girls
	• Households began increasing their use of protected springs for drinking water (relative to other sources), but no significant changes in water transportation, home water chlorination, bottling or hygiene practices: experience with cleaned water did not increase people's tastes for water improvement
	• Willingness to pay
	    ○ [Estimate] Residents willing to spent at most 10.1 work days, or US$0.89 to avert a diarrhea case (1/3 of what households report as their willingness to pay)
	    ○ [Estimate] Approximate valuation of US$2,715 per averted child diarrhea death (far below estimated value of a statistical life and cost-effectiveness cutoffs typically used in analyzing health projects in LDCs)
	    ○ Implies that households may place a lower value on improving infant and child health than typically assumed

Additional information	http://www.povertyactionlab.org/evaluation/cleaning-springs-kenya

[Individual Impact evaluation]

RAIN-specific relevance (out of 5)	□□□□
Location	India: rural Madhya Pradesh
Intervention / solution evaluated	"Total Sanitation Campaign," including activities designed to change social norms and behaviors, such as school sanitation and hygiene education, as well as technical and financial support for latrine building.

Key findings	• Increased IHL availability and reduced open defecation practices had <u>no</u> impact on child health outcomes
	• Availability of individual household latrines (IHL) increased, while open defecation practices were reduced
	• Increased proportion of households with improved sanitation facilities meeting WHO standards
	• Despite a 11-12% decrease in the odds of practicing open defecation, more than 70% of men, women, and children continued to practice daily open defecation
	• 41% of households with improved sanitation facilities reported that adult men or women practiced daily open defecation
	    o Primary reason why: culture, habit, or preference
	    o Secondary reason why: inadequate water availability

Additional information	http://www.povertyactionlab.org/evaluation/effect-indias-total-sanitation-campaign-defecation-behaviors-and-child-health-rural-madhy

[Individual Impact evaluation]

RAIN-specific relevance (out of 5)	□□□□
Title	Source Dispensers and Home Delivery of Chlorine in Kenya
Location	Kenya: rural Western Kenya
Intervention / solution evaluated	Multi-phase, multi-part evaluation to assess various ways to improve adoption of WaterGuard (a commonly available individual water treatment product)

Key findings	• Marketing campaigns and coupon schemes were ineffective at encouraging point-of-use chlorination
	• Free chlorination dispensed at water sources, combined with community promoters was the most effective evaluated strategy to improve water cleanliness
	• Impact of free home distribution
	    o Detection of chlorine in households rose from 2% to 58%
	    o Only 10% of the half-off discount coupons were redeemed
	    o Persuasive messaging had no impact on up-take when WaterGuard was freely distributed
	    o No “social networking” effects (i.e., higher community levels of use leading to increased individual adoption) were found
	    o No evidence was found that price was an effective screening mechanism to target households more likely to benefit
	• Impact of persuasion
	    o Hiring local community members at low wages to promote chlorine use among their neighbors was highly effective at increasing use
	    o Incentivizing local promoters had only modest effects
	    o Communities combining promoters with point-of-collection chlorine dispensers had 61% of households chlorinate their water (compared to only 2% of households before the intervention)

Additional information	http://www.povertyactionlab.org/evaluation/source-dispensers-and-home-delivery-chlorine-kenya

[Individual Impact evaluation]

RAIN-specific relevance (out of 5)	□□□□
Title	Impact Evaluation of Water, Sanitation, and Hygiene (WASH) Within the UNICEF Country Programme of Cooperation, Government of Nigeria and UNICEF, 2009-2013
Location	Nigeria: rural areas within Bauchi, Benue, Katsina, Jigawa, Cross-River, and Osun
Intervention / solution evaluated	Intervention began with Community-Led Total Sanitation (CLTS): communities ere sensitized to their current sanitation situation and its effects on health and environment, communities then took action to become open defecation free (ODF). Communities understood that ODF status was a pre-condition for receiving water supply interventions. WASH committees were established in each community to manage local WASH facilities, support continued hygiene behavior and promote proper sanitation practices. Capacity-building activities also carried out at the state-level, local government area level, and community-level, as well as with relevant stakeholders and NGOs.
Key findings	• Outcomes o Children under 5 had two times less diarrhea o Open defecation was reportedly reduced by 66% in program areas o Children in program areas attended school at a 1.7 times greater rate than non-program areas (due to time savings) o Women gained credibility and voice in decision making relating to WASH through active participation in WASH committees o Apart from increased uptake of immunization, the program did not result in other development efforts • Most important drivers of change leading to positive results included: o Having ODF as a precondition for a water intervention o Community evidence and understanding that WASH behavior can reduce health risks o Education on WASH behavior, combined with evidence of WASH intervention benefits o Informed choice in obtaining (technically and financially) feasible WASH solutions o Private resources and funds to implement WASH interventions o Community pressure in adopting WASH-supportive behavior o Using the WASH committee as a motor for social

	action around WASH
Additional information	http://www.unicef.org/evaldatabase/files/Nigeria_Impact_Evaluation_of_WASH_within_the_UNICEF_Country_Programme_of_Cooperation_Report.pdf

[Individual Impact evaluation]

RAIN-specific relevance (out of 5)	□□□□
Title	Evaluation Of The WASH Sector Strategy "Community Approaches To Total Sanitation" (CATS)
Location	45 countries worldwide, in-depth focus on India, Mauritania, Mozambique, Nepal and Sierra Leone
Intervention / solution evaluated	Wide range of community-based sanitation programming. All solutions had the elimination of open defecation as their goal, and all were rooted in community demand and leadership, focused on behavior and social change, and were "committed to local innovation." Examples of solutions include Community-Led Total Sanitation (CLTS), School-Led Total Sanitation (SLTS), and Total Sanitation Campaigns (TSC).

Key findings	• Outcomes
	    ○ CATS programs contributed to the rapid reduction of open defecation and encouraged the large-scale construction of latrines
	    ○ CATS programs contributed to the re-orientation of the sanitation sector towards demand-led approaches
	    ○ CATS programs faced numerous major constraints including: they work best only in rural settings, the presence of sanitation subsidies in the same or neighboring communities, availability and affordability of materials, and a lack of local capacity and resources
	• Sustainability
	    ○ The long-term sustainability of CATS programs is a key concern, as long-term data consists mainly of output and proxy indicators
	    ○ Households are not progressing up the sanitation ladder
	    ○ Follow-up activities are scarce

Additional information	http://www.unicef.org/evaldatabase/files/CATSExecSummaryEng.pdf

[Individual Impact evaluation]

RAIN-specific relevance (out of 5)	□□□□
Title	Impact evaluation of drinking water supply and sanitation programmes in rural Benin
Location	Benin: rural areas
Intervention / solution evaluated	Various – primarily increasing access to improved water sources and sanitation facilities
Key findings	• Providing new water supply points leads to a substantial increase in the use of improved water points as the main source of drinking water; nevertheless, a considerable share of households continue to use traditional water sources, instead of or in addition to the newly installed points • Improved water at the *source* is of much better quality than water from traditional sources. However, as a result of recontamination during transport and storage, the quality difference practically vanishes at point of *use* ○ The impact of water point installation on point-of-use quality is thus close to zero • New water points considerably reduce the time taken to collect water; however, water collection time is still substantial in many localities because of queuing. Time saved is mostly spent on housework and on economic activities that may provide income. • No evidence was found of an effective integrated water supply, sanitation, and hygiene-promotion approach. Safe hygienic behavior is not widespread and did not change much over the study period. The lack of an effective integrated strategy is partly explained by institutional factors • Improved water sources had no impact on water-related diseases
Additional information	http://www.susana.org/en/resources/library/details/1479

[Individual Impact evaluation]

RAIN-specific relevance (out of 5)	□□□
Title	Encouraging Adoption of Rainwater Harvesting Tanks Through Collateralized Loans in Kenya
Location	Kenya: Central and Rift Valley provinces
Intervention / solution evaluated	Asset collateralized loans (using the loaned assets themselves as collateral) to improve the take-up of rainwater harvesting tanks. Primary impact areas targeted were dairy production, time use, or girls' enrollment in school.

Key findings	• Take-up increased significantly from standard joint-liability loans from 2.4% loan acceptance to between 23.5 – 44% acceptance
	• The only major difference in repayment performance between standard loan groups and the new loan groups was that standard loan recipients took on average 9 months to repay, while the new loan recipients took on average 17-22 months to repay
	• Benefits from new, asset collateralized loan:
	    ○ Milk production was improved among those without access to piped water
	    ○ Reduced time spent fetching water by girls by 35%
	    ○ Increased probability of girls enrollment in school by 4 percentage points [attributed directly to the time-savings and not additional capital for school fees]

Additional information	http://www.povertyactionlab.org/evaluation/encouraging-adoption-rainwater-harvesting-tanks-through-collateralized-loans-kenya

[Individual Impact evaluation]

RAIN-specific relevance (out of 5)	□□□
Title	Can Higher Prices Stimulate Product Use? Evidence from a Randomized Experiment in Zambia
Location	Zambia: Lusaka
Intervention / solution evaluated	Door-to-door sale of Clorin (a popular commercial point-of-use chlorine based water sanitizer) at a below market price to households with poor access to piped water or chlorine home-delivery
Key findings	• <u>No</u> evidence found that higher prices screened out poorer or less educated households • Fewer people bought Clorin as the price rose (every 1% rise in price had a 0.67% decrease in quantity demanded) • Higher prices appeared to screen out those who would not have used the product in any event • Higher willingness to pay associated with greater propensity to use (on average, as price increased by 10%, use increased by 4%) • Use of chlorine does decrease with higher prices due to lower demand, but this is partially offset by better targeting of product to families who are likely to use it
Additional information	http://www.povertyactionlab.org/evaluation/can-higher-prices-stimulate-product-use-evidence-randomized-experiment-zambia

[Individual Impact evaluation]

RAIN-specific relevance (out of 5)	▯▯▯
Title	Impact Evaluation of a Large-Scale Rural Sanitation Project in Indonesia
Location	East Java, Indonesia
Intervention / solution evaluated	"Total Sanitation and Sanitation Marketing" (TSSM) program, attempted to improve child health outcomes by generating demand. 3 main components: 1. Community-Led Total Sanitation (CLTS): used a community facilitation process aimed at eliminating open defecation 2. Social marketing of sanitation to increase the appeal of improved sanitation 3. Sustainable scale-up: supporting government policies at different levels and providing training and support for other stakeholders
Key findings	• The TSSM program significantly raised caregiver awareness of the environmental links (e.g., food and water) to diarrhea in young children • TSSM led to a significant increase (almost 30%) in improved sanitation facilities for everyone except the poorest 20% of households • Reduced open defecation mainly among households that lacked access to sanitation at program start (suggests program did not lead to changes in beliefs or behaviors among households that already had toilets) • Caregivers reported significantly fewer cases of diarrhea in children under age 5 • Among households in the top 80% of the wealth distribution (not the bottom 20%), there was also a significant reduction in parasitic infections, along with improvements in height and weight
Additional information	https://www.wsp.org/sites/wsp.org/files/publications/WSP-Indonesia-Sanitation-Impact-Evaluation-Research-Brief.pdf

[Individual Impact evaluation]

RAIN-specific relevance (out of 5)	□□□
Title	Promoting Handwashing and Sanitation: An Impact Evaluation of Two Large-Scale Campaigns in Rural Tanzania
Location	Tanzania: rural areas
Intervention / solution evaluated	Programs attempted to influence people's behavior, change marketplace dynamics, and strengthen the role of local government in service delivery (did not provide hardware subsidies) on the large scale. Two main programs: 1. "Hand washing with Soap" (HWWS) program: enlisted community members to educate caregivers with young children about proper hand washing, as well as use of radio and print promotional materials 2. "Rural Sanitation" program: used promotional materials and Community-Led Total Sanitation (CLTS) to increase demand to upgrade latrines and stop open defecation; trained local masons to build and market concrete slabs to cover latrine pits; and worked with local supply chains to provide materials
Key findings	• "Rural Sanitation" program spurred households to construct new latrines, as well as better quality ones • Proportion of households that usually defecate in the open was halved, but occasional open defecation remains pervasive • HWWS program increased people's knowledge about hand washing with soap, but this did <u>not</u> translate into significant behavioral change • Communities receiving both programs (but not either one individually) had a 12.5% reduction in diarrhea symptoms in children under age 5 • Communities receiving both programs (but not either one individually) displayed unintended negative health outcomes: children under age 5 were more likely to have iron-deficiency anemia and also weighed slightly less for their age
Additional information	https://www.wsp.org/sites/wsp.org/files/publications/WSP-Tanzania-Sanitation-HWWS-Research-Brief.pdf

[Individual Impact evaluation]

RAIN-specific relevance (out of 5)	□□
Title	Household Water Connections in Tangier, Morocco
Location	Urban Morocco (Tangier)
Intervention / solution evaluated	Interest-free loan for the installation of a water connection in households that did not have one already but were in neighborhoods that had piped water network infrastructure (high quality public taps were otherwise available)
Key findings	• No improvement in quality of water consumed • No improvement in incidence of waterborne illness • Increase in water quantity consumed • Increase in time available for leisure • Households willing to pay a substantial amount of money to have a private tap at home • Household tap connections created time gains, but did not lead to increases in labor market participation, income, or schooling attainment – spare time was used for leisure and social activities • Since water was a source of inter-household tension, private connections appeared to improve social integration and subjective quality of life
Additional information	http://www.povertyactionlab.org/evaluation/household-water-connections-tangier-morocco

[Individual Impact evaluation]

RAIN-specific relevance (out of 5)	□□
Title	Evaluation of the WaSH project in the Integrated Rural Villages of Nkurye and Murembera in the Commune of Giharo in the province of Rutana, Burundi
Location	Burundi: Rutana province
Intervention / solution evaluated	(1) Rehabilitate/create/extend 2 new and existing water networks and construct latrines in schools; (2) train and provide maintenance of water management committees in targeted communities; and (3) hygiene promotion in targeted communities and schools
Key findings	• Unexpected impacts included time gained from closer access to water, food security and diversity, and contribution to social cohesion • High risk that many of the project benefits will not be sustainable over the long term (without range of further support from UNICEF and government partners)
Additional information	http://www.unicef.org/evaldatabase/files/Burundi_2013-003_Final_Report.pdf

[1] WWAP (World Water Assessment Programme). 2012. The UN World Water Development Report 4: Managing Water under Uncertainty and Risk. Paris, UNESCO. Page 2.
[2] World Economic Forum. 2015 Global Risks 2015: 10th Edition. Insight Report
[3] World Economic Forum. 2014. Global Risks 2014: Insight Report. World Economic Forum, Geneva. Pg. 15
[4] Grey, D., Sadoff, C.W., The World Bank and IUCN (2007). *Sink or Swin? Water Security for Growth and Development*. Water Policy Vol 9 No 6 pp 545–571
[5] Reig, P., T. Shiao and F. Gassert. 2013. *Aqueduct Water Risk Framework*. Working Paper. Washington, DC: World Resources Institute. Available online at http://www.wri.org/publication/aqueduct-water- risk-framework. Pg. 4
[6] Reig, P., T. Shiao and F. Gassert. 2013. *Aqueduct Water Risk Framework*. Working Paper. Washington, DC: World Resources Institute. Available online at http://www.wri.org/publication/aqueduct-water- risk-framework. Pg. 4
[7] United Nations Millennium Development Goals. (n.d.). Retrieved April 21, 2015, from http://www.un.org/millenniumgoals/environ.shtml
[8] UN. 2012. *The Millennium Development Goals Report*. New York: UN: Pg. 6
[9] Post-2015 Development Agenda (Post-2014 Development Agenda) http://www.undp.org/content/undp/en/home/mdgoverview/mdg_goals/post-2015-development-agenda.html
[10] Reig, P., T. Shiao and F. Gassert. 2013. *Aqueduct Water Risk Framework*. Working Paper. Washington, DC: World Resources Institute. Available online at http://www.wri.org/publication/aqueduct-water-risk-framework. Pg. 4
[11] UN. 2012. *The Millennium Development Goals Report*. New York: UN: Pg. 6
[12] Drinking-water quality. (n.d.). Retrieved April 21, 2015, from http://www.who.int/water_sanitation_health/dwq/en/
[13] Estimated with data from WHO/UNICEF Joint Monitoring Programme (JMP) for Water Supply and Sanitation. (2012). Progress on Sanitation and Drinking-Water, 2012 Update.
[14] Drinking-water quality. (n.d.). Retrieved April 21, 2015, from http://www.who.int/water_sanitation_health/dwq/en/
[15] Improved and unimproved water and sanitation facilities. (n.d.). Retrieved April 21, 2015, from http://www.wssinfo.org/definitions-methods/watsan-categories
[16] United Nations Millennium Development Goals. (n.d.). Retrieved April 21, 2015, from http://www.un.org/millenniumgoals/environ.shtml
[17] United Nations Millennium Development Goals. (n.d.). Retrieved April 21, 2015, from http://www.un.org/millenniumgoals/environ.shtml
[18] Tackling a global crisis: International Year of Sanitation 2008. (2002, January 1). Retrieved April 21, 2015, from http://esa.un.org/iys/docs/IYS_flagship_web_small.pdf
[19] World Health Organization (WHO). (2008). Safer Water, Better Health: Costs, benefits, and sustainability of interventions to protect and promote health; Updated Table 1: WSH deaths by region, 2004.
[20]*Improved and unimproved water and sanitation facilities. (n.d.).* Retrieved April 21, 2015, from http://www.wssinfo.org/definitions-methods/watsan-categories/
[21] UN. 2012. *The Millennium Development Goals Report*. New York: UN
[22] UN. 2012. *The Millennium Development Goals Report*. New York: UN
[23] Morrison, J., Morikawa, M., Murphy, M., and Shulte, P. 2009, Water Scarcity & Climate Change: Growing Risks for Businesses & Investors, Pacific Institute, Ceres Report http://www.pacinst.org/wp-content/uploads/sites/21/2013/02/full_report30.pdf
[24] Morrison, J., Morikawa, M., Murphy, M., and Shulte, P. 2009, Water Scarcity & Climate Change: Growing Risks for Businesses & Investors, Pacific Institute, Ceres Report

[25] Morrison, J., Morikawa, M., Murphy, M., and Shulte, P. 2009, Water Scarcity & Climate Change: Growing Risks for Businesses & Investors, Pacific Institute, Ceres Report
[26] Morrison, J., Morikawa, M., Murphy, M., and Shulte, P. 2009, Water Scarcity & Climate Change: Growing Risks for Businesses & Investors, Pacific Institute, Ceres Report
[27] Morrison, J., Morikawa, M., Murphy, M., and Shulte, P. 2009, Water Scarcity & Climate Change: Growing Risks for Businesses & Investors, Pacific Institute, Ceres Report
[28] Morrison, J., Morikawa, M., Murphy, M., and Shulte, P. 2009, Water Scarcity & Climate Change: Growing Risks for Businesses & Investors, Pacific Institute, Ceres Report
[29] Morrison, J., Morikawa, M., Murphy, M., and Shulte, P. 2009, Water Scarcity & Climate Change: Growing Risks for Businesses & Investors, Pacific Institute, Ceres Report
[30] Morrison J. , Schulte P. , Koopman L. , Allan N., Norton M. , Souza K., Iceland C., Shiao T., Rieg P, and Otto B. 2012, *The CEO Water Mandate's Corporate Water Disclosure Guidelines*, Pacific Institute, PricewaterhouseCoopers, Carbon Disclosure Project, and World Resources Institute, P55
[31] Morrison, J., Morikawa, M., Murphy, M., and Shulte, P. 2009, Water Scarcity & Climate Change: Growing Risks for Businesses & Investors, Pacific Institute, Ceres Report
[32] Morrison J. , Schulte P. , Koopman L. , Allan N., Norton M. , Souza K., Iceland C., Shiao T., Rieg P, and Otto B. 2012, *The CEO Water Mandate's Corporate Water Disclosure Guidelines*, Pacific Institute, PricewaterhouseCoopers, Carbon Disclosure Project, and World Resources Institute, P55
[33] Morrison J. , Schulte P. , Koopman L. , Allan N., Norton M. , Souza K., Iceland C., Shiao T., Rieg P, and Otto B. 2012, *The CEO Water Mandate's Corporate Water Disclosure Guidelines*, Pacific Institute, PricewaterhouseCoopers, Carbon Disclosure Project, and World Resources Institute, P55
[34] Morrison, J., Morikawa, M., Murphy, M., and Shulte, P. 2009, Water Scarcity & Climate Change: Growing Risks for Businesses & Investors, Pacific Institute, Ceres Report
[35] Morrison, J., Morikawa, M., Murphy, M., and Shulte, P. 2009, Water Scarcity & Climate Change: Growing Risks for Businesses & Investors, Pacific Institute, Ceres Report
[36] Morrison, J., Morikawa, M., Murphy, M., and Shulte, P. 2009, Water Scarcity & Climate Change: Growing Risks for Businesses & Investors, Pacific Institute, Ceres Report
[37] Morrison, J., Morikawa, M., Murphy, M., and Shulte, P. 2009, Water Scarcity & Climate Change: Growing Risks for Businesses & Investors, Pacific Institute, Ceres Report http://www.pacinst.org/wp-content/uploads/sites/21/2013/02/full_report30.pdf
[38] WWAP (World Water Assessment Programme). 2012. The UN World Water Development Report 4: Managing Water under Uncertainty and Risk. Paris, UNESCO
[39] Morrison, J., Morikawa, M., Murphy, M., and Shulte, P. 2009, Water Scarcity & Climate Change: Growing Risks for Businesses & Investors, Pacific Institute, Ceres Report
[40] Morrison J. , Schulte P. , Koopman L. , Allan N., Norton M. , Souza K., Iceland C., Shiao T., Rieg P, and Otto B. 2012, *The CEO Water Mandate's Corporate Water Disclosure Guidelines*, Pacific Institute, PricewaterhouseCoopers, Carbon Disclosure Project, and World Resources Institute, P37
[41] Morrison J. , Schulte P. , Koopman L. , Allan N., Norton M. , Souza K., Iceland C., Shiao T., Rieg P, and Otto B. 2012, *The CEO Water Mandate's Corporate Water Disclosure Guidelines*, Pacific Institute, PricewaterhouseCoopers, Carbon Disclosure Project, and World Resources Institute, P37
[42] CEO Water Mandate - About. (n.d.). Retrieved April 21, 2015, from http://ceowatermandate.org/about/
[43] Morrison, J., Morikawa, M., Murphy, M., and Shulte, P. 2009, Water Scarcity & Climate Change: Growing Risks for Businesses & Investors, Pacific Institute, Ceres Report
[44] Morrison J. , Schulte P. , Koopman L. , Allan N., Norton M. , Souza K., Iceland C., Shiao T., Rieg P, and Otto B. 2012, *The CEO Water Mandate's Corporate Water Disclosure Guidelines*, Pacific Institute, PricewaterhouseCoopers, Carbon Disclosure Project, and World Resources Institute
[45] Morrison J. , Schulte P. , Koopman L. , Allan N., Norton M. , Souza K., Iceland C., Shiao T., Rieg P, and Otto B. 2012, *The CEO Water Mandate's Corporate Water Disclosure Guidelines*, Pacific Institute, PricewaterhouseCoopers, Carbon Disclosure Project, and World Resources Institute

[46] Morrison J. , Schulte P. , Koopman L. , Allan N., Norton M. , Souza K., Iceland C., Shiao T., Rieg P, and Otto B. 2012, *The CEO Water Mandate's Corporate Water Disclosure Guidelines*, Pacific Institute, PricewaterhouseCoopers, Carbon Disclosure Project, and World Resources Institute
[47] Morrison J. , Schulte P. , Koopman L. , Allan N., Norton M. , Souza K., Iceland C., Shiao T., Rieg P, and Otto B. 2012, *The CEO Water Mandate's Corporate Water Disclosure Guidelines*, Pacific Institute, PricewaterhouseCoopers, Carbon Disclosure Project, and World Resources Institute
[48] United States Securities and Exchange Commission Form 10-K. The Coca-Cola Company (2015) http://assets.cocacolacompany.com/d2/78/7d7cad454f3fbd033d55d786b890/2014-annual-report-on-form-10-k.pdf
[49] The Coca-Cola System. (n.d.). Retrieved April 21, 2015, from http://www.coca-colacompany.com/sustainabilityreport/our-reporting/the-coca-cola-system.html
[50] The Coca-Cola Foundation. (n.d.). Retrieved April 21, 2015, from http://www.coca-colacompany.com/our-company/the-coca-cola-foundation#TCCC
[51] The Coca-Cola Africa Foundation. (n.d.). Retrieved May 20, 2015, from http://www.tccaf.org/coca-cola-africa-foundation.asp
[52] United States Securities and Exchange Commission Form 10-K. The Coca-Cola Company (2015) http://assets.cocacolacompany.com/d2/78/7d7cad454f3fbd033d55d786b890/2014-annual-report-on-form-10-k.pdf
[53] Morrison, J., Morikawa, M., Murphy, M., and Shulte, P. 2009, Water Scarcity & Climate Change: Growing Risks for Businesses & Investors, Pacific Institute, Ceres Report
[54] Morrison, J., Morikawa, M., Murphy, M., and Shulte, P. 2009, Water Scarcity & Climate Change: Growing Risks for Businesses & Investors, Pacific Institute, Ceres Report
[55] Gulati, Nikhil & Ahmed, Rumman (2012). *India Has 1.2 Billion People but Not Enough Drink Coke*. http://online.wsj.com/news/articles/SB10001424052702304870304577490092413939410
[56] Coca-Cola Sustainability Report 2014. (n.d.). Retrieved April 21, 2015, from http://assets.coca-colacompany.com/77/4c/2a44a5234a3ca65d449d174a0ded/2013-2014-coca-cola-sustainability-report-pdf
[57] Replenish. (n.d.). Retrieved April 21, 2015, from http://www.coca-colacompany.com/stories/replenish#TCCC
[58] Coca-Cola Sustainability Report 2014. (n.d.). Retrieved April 21, 2015, from http://assets.coca-colacompany.com/77/4c/2a44a5234a3ca65d449d174a0ded/2013-2014-coca-cola-sustainability-report-pdf
[59] Mitigating Water Risk for Communities and for Our System. (n.d.). Retrieved April 21, 2015, from http://www.coca-colacompany.com/mitigating-water-risk-for-communities-and-for-our-system#TCCC
[60] Mitigating Water Risk for Communities and for Our System. (n.d.). Retrieved April 21, 2015, from http://www.coca-colacompany.com/mitigating-water-risk-for-communities-and-for-our-system#TCCC
[61] Mitigating Water Risk for Communities and for Our System. (n.d.). Retrieved April 21, 2015, from http://www.coca-colacompany.com/mitigating-water-risk-for-communities-and-for-our-system#TCCC
[62] True Blue Communications (2012). *The Water Stewardship and Replenish Report, Coca-Cola*.http://assets.cocacolacompany.com/8d/d8/8f1cc9e3464e8b152f97aa91857b/TCCC_WSRR_2012_FINAL.pdf
[63] True Blue Communications (2012). *The Water Stewardship and Replenish Report, Coca-Cola*.http://assets.cocacolacompany.com/8d/d8/8f1cc9e3464e8b152f97aa91857b/TCCC_WSRR_2012_FINAL.pdf
[64] Coca-Cola (n.d.). *RAIN: The Replenish Africa Initiative*. retrieved April 20,2015 http://www.coca-colacompany.com/rain-the-replenish-africa-initiative#TCCC
[65] Coca-Cola (n.d.). *RAIN: The Replenish Africa Initiative*. retrieved April 20,2015 http://www.coca-colacompany.com/rain-the-replenish-africa-initiative#TCCC
[66] Coca-Cola (n.d.). *RAIN: The Replenish Africa Initiative*. retrieved April 20,2015 http://www.coca-colacompany.com/rain-the-replenish-africa-initiative#TCCC
[67] Coca-Cola (n.d.). *RAIN: The Replenish Africa Initiative*. retrieved April 20,2015http://www.coca-colacompany.com/rain-the-replenish-africa-initiative#TCCC

[68] RAIN 2020 Investments Broll. (n.d.). Retrieved April 21, 2015, from http://www.coca-colacompany.com/press-center/a-v-library/rain-2020-investments-broll-bc3714359874001#TCCC
[69] Coca-Cola (n.d.). *RAIN: The Replenish Africa Initiative*. retrieved April 20, 2015 from http://www.coca-colacompany.com/rain-the-replenish-africa-initiative
[70] Global Environment & Technology Foundation. (n.d.). Retrieved April 21, 2015, from http://www.getf.org/our-projects-partnerships/rain/
[71] Global Environment & Technology Foundation. (n.d.). Retrieved April 21, 2015, from http://www.getf.org/our-projects-partnerships/rain/
[72] Global Water Challenge. (n.d.). Retrieved April 21, 2015, from http://www.globalwaterchallenge.org/
[73] Global Water Challenge. (n.d.). Retrieved April 21, 2015, from http://www.globalwaterchallenge.org/
[74] The U.S. Water Partnership. (n.d.). Retrieved April 21, 2015, from http://www.uswaterpartnership.org
[75] Ernst & Young. (2014). *Africa 2030: Realizing the possibilities*. Retrieved from http://www.ey.com/Publication/vwLUAssets/EY-Africa-2030-realizing-the-possibilities/$FILE/EY-Africa-2030-realizing-the-possibilities.pdf
[76] Ernst & Young. (2014). *Africa 2030: Realizing the possibilities*. Retrieved from http://www.ey.com/Publication/vwLUAssets/EY-Africa-2030-realizing-the-possibilities/$FILE/EY-Africa-2030-realizing-the-possibilities.pdf
[77] Ernst & Young. (2014). *Africa 2030: Realizing the possibilities*. Retrieved from http://www.ey.com/Publication/vwLUAssets/EY-Africa-2030-realizing-the-possibilities/$FILE/EY-Africa-2030-realizing-the-possibilities.pdf
[78] Prevos, P. (2009, November 5). The effects of Privatisation on Customer Satisfaction in the Water Supply Chain. Retrieved from http://water.prevos.net/privatisation/
[79] Hutton, Guy. (2004). *Evaluation of the costs and benefits of water and sanitation improvements at the global level*. Retrieved from Water, Sanitation, and Health, Protection of the Human Environment, World Health Organization website: http://www.who.int/water_sanitation_health/wsh0404.pdf
[80] Cameron, J., & World Health Organization. (2011). Social cost–benefit analysis – summarizing the available global evidence on drinking-water interventions. In *Valuing water, valuing livelihoods: Guidance on social cost-benefit analysis of drinking-water interventions, with special reference to small community water supplies* (pp. 217-237). London: IWA Pub.
[81] Hutton, Guy. (2004). *Evaluation of the costs and benefits of water and sanitation improvements at the global level*. Retrieved from Water, Sanitation, and Health, Protection of the Human Environment, World Health Organization website: http://www.who.int/water_sanitation_health/wsh0404.pdf
[82] Hutton, Guy. (2004). *Evaluation of the costs and benefits of water and sanitation improvements at the global level*. Retrieved from Water, Sanitation, and Health, Protection of the Human Environment, World Health Organization website: http://www.who.int/water_sanitation_health/wsh0404.pdf
[83] Hutton, G., Haller, L., & Bartram, J. (2007). *Economic and health effects of increasing coverage of low cost household drinking-water supply and sanitation interventions to countries off-track to meet MDG target 10*. Retrieved from World Health Organization website: http://www.who.int/water_sanitation_health/economic/mdg10_offtrack.pdf?ua=1
[84] Hutton, Guy. (2012). *Global costs and benefits of drinking-water supply and sanitation interventions to reach the MDG target and universal coverage*. Retrieved from World Health Organization website: http://apps.who.int/iris/bitstream/10665/75140/1/WHO_HSE_WSH_12.01_eng.pdf
[85] US EPA. (2015, April). Ecosystems services. Retrieved from http://www2.epa.gov/eco-research/ecosystems-services
[86] De Groot, R., Brander, L., Van der Ploeg, S., Costanza, R., Bernard, F., Braat, L., . . . Christie, M. (2012). Global estimates of the value of ecosystems and their services in monetary units. *Ecosystem Services*, *1*(1), 50-61. Retrieved from http://www.sciencedirect.com/science/article/pii/S2212041612000101

[87] Postel, S. L., & Thompson, B. H. (2005). Watershed protection: Capturing the benefits of nature's water supply services. *Natural Resources Forum*, *29*, 98-108. doi:10.1111/j.1477-8947.2005.00119.x

[88] Millennium Ecosystem Assessment (Program). (2005). Freshwater ecosystem services. In *Ecosystems and human well-being*. Retrieved from http://www.millenniumassessment.org/documents/document.312.aspx.pdf

[89] De Groot, R., Brander, L., Van der Ploeg, S., Costanza, R., Bernard, F., Braat, L., . . . Christie, M. (2012). Global estimates of the value of ecosystems and their services in monetary units. *Ecosystem Services*, *1*(1), 50-61. Retrieved from http://www.sciencedirect.com/science/article/pii/S2212041612000101

[90] CDP. (2014). *From water risk to value creation: CDP global water report 2014*. Retrieved from https://www.cdp.net/CDPResults/CDP-Global-Water-Report-2014.pdf

[91] About the PRI initiative. (n.d.). Retrieved from http://www.unpri.org/about-pri/about-pri/

[92] The Equator Principles: members & reporting. (n.d.). Retrieved from http://www.equator-principles.com/index.php/members-reporting

[93] The World Bank. (2013, August 29). Study reveals large, untapped potential for water and sanitation services for the world's poor. Retrieved from http://www.worldbank.org/en/news/press-release/2013/08/29/study-reveals-large-untapped-potential-water-sanitation-services-world-poor

[94] CDP. (2014). *From water risk to value creation: CDP global water report 2014*. Retrieved from https://www.cdp.net/CDPResults/CDP-Global-Water-Report-2014.pdf

[95] Shiao, T., & Maddocks, A. (2014, September 18). Finding solutions for South Africa's coal-fired water and energy problems. Retrieved from http://www.theguardian.com/sustainable-business/2014/sep/18/south-africa-coal-water-energy-problems-mining

[96] Lloyd's,. *Global Water Scarcity: Risks and challenges for business*. Retrieved from http://awsassets.panda.org/downloads/lloyds_global_water_scarcity.pdf

[97] Managing climate and natural disaster risk. (n.d.). Retrieved from http://www.swissre.com/rethinking/climate_and_natural_disaster_risk/

[98] Koloc, N. (2013, April 18). What job candidates really want: meaningful work. Retrieved from https://hbr.org/2013/04/what-job-candidates-really-wan/

[99] Koloc, N. (2013, April 18). What job candidates really want: meaningful work. Retrieved from https://hbr.org/2013/04/what-job-candidates-really-wan/

[100] Moyer, J. (2015, May 12). Starbucks moves Ethos water from California after droughtshaming. Retrieved from http://www.washingtonpost.com/news/morning-mix/wp/2015/05/12/starbucks-moves-ethos-water-from-california-after-droughtshaming/

[101] CEO Water Mandate. (n.d.). Physical risks. Retrieved from http://ceowatermandate.org/business-case/water-related-business-risks/physical-risks/

[102] Larson, W., Freedman, P., Passinsky, V., Grubb, E., & Adriaens, P. (2015). *Mitigating Corporate Water Risk : Financial Market Tools and Supply Management Strategies*. Ann Arbor. Retrieved from http://limno.com/pdfs/2012_Larson_WatAlt_Art5-3-5%5B1%5D.pdf

ttp://issuu.com/undp/docs/wwdr-report-2015

outlook.org/fileadmin/uploads/aeo/2014/PDF/Chapter_PDF/01_Chapter1_AEO2014_EN.light.pdf

014_EN.light.pdf

www.worldbank.org/en/news/feature/2014/12/15/african-water-utility-ceos-share-common-issues-in-pursuit-of-solutions

/AMCEN_Events/climate-change/2ndExtra_15Dec/FACT_SHEET_CC_Africa.pdf

[109] Esri. (2015). ArcGIS for Desktop: Release 10.2. Redlands, CA: Environmental Systems Research Institute, Inc. (Esri). Retrieved from http://www.esri.com/

[110] Nardo, M., Saisana, M., Saltelli, A., Tarantola, S., Hoffmann, A., & Giovannini, E. (2008). *Handbook on constructing composite indicators: Methodology and user guide.* OECD publishing. Retrieved from http://publications.jrc.ec.europa.eu/repository/handle/JRC47008

[111] Haken, N., Messner, J. J., Hendry, K., Taft, P., Lawrence, K., Brisard, L., & Umana, F. (2014). *The Fragile States Index 2014.* Washington, D.C.: The Fund for Peace. Retrieved from http://library.fundforpeace.org/library/cfsir1423-fragilestatesindex2014-06d.pdf

[112] Nardo, M., Saisana, M., Saltelli, A., Tarantola, S., Hoffmann, A., & Giovannini, E. (2008). *Handbook on constructing composite indicators: Methodology and user guide.* OECD publishing. Retrieved from http://publications.jrc.ec.europa.eu/repository/handle/JRC47008

[113] Nardo, M., Saisana, M., Saltelli, A., Tarantola, S., Hoffmann, A., & Giovannini, E. (2008). *Handbook on constructing composite indicators: Methodology and user guide.* OECD publishing. Retrieved from http://publications.jrc.ec.europa.eu/repository/handle/JRC47008

[114] *Organisation for Economic Co-operation and Development*. (2015). Retrieved from About the OECD: http://www.oecd.org/about/

[115]Nardo, M., Saisana, M., Saltelli, A., Tarantola, S., Hoffmann, A., & Giovannini, E. (2008). *Handbook on constructing composite indicators: Methodology and user guide.* OECD publishing. Retrieved from http://publications.jrc.ec.europa.eu/repository/handle/JRC47008

[116] Nardo, M., Saisana, M., Saltelli, A., Tarantola, S., Hoffmann, A., & Giovannini, E. (2008). *Handbook on constructing composite indicators: Methodology and user guide.* OECD publishing. Retrieved from http://publications.jrc.ec.europa.eu/repository/handle/JRC47008

[117] *Organisation for Economic Co-operation and Development*. (2015). Retrieved from About the OECD: http://www.oecd.org/about/

[118] *Organisation for Economic Co-operation and Development*. (2015). Retrieved from About the OECD: http://www.oecd.org/about/

[119] *Organisation for Economic Co-operation and Development*. (2015). Retrieved from About the OECD: http://www.oecd.org/about/

[120] Schwab, K. (2014). *The Global Competitiveness Report 2014-2015: Full Data Edition.* Geneva: The World Economic Forum. Retrieved from http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2013-14.pdf

[121] European Commission. (2014, December 18). *What is a composite indicator?* Retrieved 10 February, 2015, from COIN: Composite Indicators Research Group: https://composite-indicators.jrc.ec.europa.eu/?q=content/what-composite-indicator

[122] Schwab, K. (2014). *The Global Competitiveness Report 2014-2015: Full Data Edition.* Geneva: The World Economic Forum. Retrieved from http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2013-14.pdf

[123]*The World Economic Forum*. (n.d.). Retrieved from The World Economic Forum: http://www.weforum.org/world-economic-forum

[124] European Commission. (2014, December 18). *What is a composite indicator?* Retrieved 10 February, 2015, from COIN: Composite Indicators Research Group: https://composite-indicators.jrc.ec.europa.eu/?q=content/what-composite-indicator

[125] European Commission. (2014, December 18). *What is a composite indicator?* Retrieved 10 February, 2015, from COIN: Composite Indicators Research Group: https://composite-indicators.jrc.ec.europa.eu/?q=content/what-composite-indicator

[126] European Commission. (2014, December 18). *What is a composite indicator?* Retrieved 10 February, 2015, from COIN: Composite Indicators Research Group: https://composite-indicators.jrc.ec.europa.eu/?q=content/what-composite-indicator

[127] Nardo, M., Saisana, M., Saltelli, A., Tarantola, S., Hoffmann, A., & Giovannini, E. (2008). *Handbook on constructing composite indicators: Methodology and user guide.* OECD publishing. Retrieved from http://publications.jrc.ec.europa.eu/repository/handle/JRC47008

[128] Brown, A., & Matlock, M. D. (2011). *A Review of Water Scarcity Indices and Methodologies.* The Sustainability Consortium.

[129] World Bank. (2015). *World Development Indicators*. Retrieved from The World Bank: http://data.worldbank.org/data-catalog/world-development-indicators

[130] Brown, A., & Matlock, M. D. (2011). *A Review of Water Scarcity Indices and Methodologies.* The Sustainability Consortium.
[131] Falkenmark. (1989). The massive water scarcity threatening Africa-why isn't it being addressed. *Ambio, 18*(2), 112-118.
[132] J.P. Morgan. (2008). *Watching water: a guide to evaluating corporate risks in thirsty world.* JPMorgan Chase & Co.
[133] Brown, A., & Matlock, M. D. (2011). *A Review of Water Scarcity Indices and Methodologies.* The Sustainability Consortium.
[134] Raskin, P., Gleick, P., Kirshen, P., Pontius, G., & Strzepek, K. (1997). *Water Futures: Assessment of Long-Range Patterns and Prospects.* Stockholm, Sweden: Stockholm Environment Institute.
[135] Vorosmarty, C. J., Douglas, E. M., Green, P. A., & Revenga, C. (2005, May). Geospatial Indicators of Emerging Water Stress: An Application to Africa. *Ambio (Royal Sweedish Academy of Sciences), 34*(3), 230-236.
[136] J.P. Morgan. (2008). *Watching water: a guide to evaluating corporate risks in thirsty world.* JPMorgan Chase & Co.
[137] World Bank. (2015). *World Development Indicators*. Retrieved from The World Bank: http://data.worldbank.org/data-catalog/world-development-indicators
[138] Chapagain, A. K., & Hoekstra, A. Y. (2004). *Water footprints of nations, Volume 1: Main Report.* Delft: UNESCO-IHE. Retrieved 2015, from http://www.waterfootprint.org
[139] Mekonnen, M. M., & Hoekstra, A. Y. (2011). National Water Footprint Accounts: The Green, Blue and Grey Water Footprint of Production and Consumption. *Value of Water Research Report Series, 50*. Delft, The Netherlands: UNESCO-IHE.
[140] Mekonnen, M. M., & Hoekstra, A. Y. (2011). National Water Footprint Accounts: The Green, Blue and Grey Water Footprint of Production and Consumption. *Value of Water Research Report Series, 50*. Delft, The Netherlands: UNESCO-IHE.
[141] MacDonald, A., Bonsor, H., Dochartaigh, B., & Taylor, R. (2012). Quantitative maps of groundwater resources in Africa. *Environmental Research Letters, 7*. doi:10.1088/1748-9326/7/2/024009
[142] Edmunds, W. M., & Smedley, P. L. (2013). Fluoride in natural waters. In B. Alloway, J. Centeno, R. Finkelman, R. Fuge, U. Lindh, O. Selinus, & P. Smedley (Eds.), *Essentials of Medical Geology: Revised Edition* (pp. 311-336). London: Springer.
[143] MacDonald, A., Bonsor, H., Dochartaigh, B., & Taylor, R. (2012). Quantitative maps of groundwater resources in Africa. *Environmental Research Letters, 7*. doi:10.1088/1748-9326/7/2/024009
[144] MacDonald, A., Bonsor, H., Dochartaigh, B., & Taylor, R. (2012). Quantitative maps of groundwater resources in Africa. *Environmental Research Letters, 7*. doi:10.1088/1748-9326/7/2/024009
[145] MacDonald, A., Bonsor, H., Dochartaigh, B., & Taylor, R. (2012). Quantitative maps of groundwater resources in Africa. *Environmental Research Letters, 7*. doi:10.1088/1748-9326/7/2/024009
[146] Liu, C., Kroeze, C., Hoekstra, A. Y., & Gerbens-Leenes, W. (2012). Past and future trends in grey water footprints of anthropogenic nitrogen and phosphorous inputs to major world rivers. *Ecological Indicators, 18*, 42-49. Retrieved from http://www.waterfootprint.org/Reports/Liu-et-al-2012.pdf
[147] Liu, C., Kroeze, C., Hoekstra, A. Y., & Gerbens-Leenes, W. (2012). Past and future trends in grey water footprints of anthropogenic nitrogen and phosphorous inputs to major world rivers. *Ecological Indicators, 18*, 42-49. Retrieved from http://www.waterfootprint.org/Reports/Liu-et-al-2012.pdf
[148] Liu, C., Kroeze, C., Hoekstra, A. Y., & Gerbens-Leenes, W. (2012). Past and future trends in grey water footprints of anthropogenic nitrogen and phosphorous inputs to major world rivers. *Ecological Indicators, 18*, 42-49. Retrieved from http://www.waterfootprint.org/Reports/Liu-et-al-2012.pdf
[149] Hoekstra, A. Y., & Chapagain, A. K. (2008). *Globalization of Water: Sharing the Planet's Freshwater Resources.* Oxford, UK: Blackwell Publishing.
[150] Hoekstra, A. Y., Chapagain, A. K., Aldaya, M. M., & Mekonnen, M. M. (2011). *The water footprint assessment manual: setting the global standard.* London, UK: Erthscan London.
[151] Liu, C., Kroeze, C., Hoekstra, A. Y., & Gerbens-Leenes, W. (2012). Past and future trends in grey water footprints of anthropogenic nitrogen and phosphorous inputs to major world rivers. *Ecological Indicators, 18*, 42-49. Retrieved from http://www.waterfootprint.org/Reports/Liu-et-al-2012.pdf

[152] Liu, C., Kroeze, C., Hoekstra, A. Y., & Gerbens-Leenes, W. (2012). Past and future trends in grey water footprints of anthropogenic nitrogen and phosphorous inputs to major world rivers. *Ecological Indicators, 18*, 42-49. Retrieved from http://www.waterfootprint.org/Reports/Liu-et-al-2012.pdf
[153] Chaves, H. M., & Alipaz, S. (2007). An integrated indicator based on basin hydrology, environment, life, and policy: the watershed sustatinability index. *Water Resource Management, 21*, 883-895.
[154] Ingrid, R. (2011). The Capability Approach. In E. N. Zalta (Ed.), *The Stanford Encyclopedia of Philosophy* (Summer 2011 ed.). Retrieved from http://plato.stanford.edu/archives/sum2011/entries/capability-approach/
[155] Ingrid, R. (2011). The Capability Approach. In E. N. Zalta (Ed.), *The Stanford Encyclopedia of Philosophy* (Summer 2011 ed.). Retrieved from http://plato.stanford.edu/archives/sum2011/entries/capability-approach/
[156] Ingrid, R. (2011). The Capability Approach. In E. N. Zalta (Ed.), *The Stanford Encyclopedia of Philosophy* (Summer 2011 ed.). Retrieved from http://plato.stanford.edu/archives/sum2011/entries/capability-approach/
[157] *Human Development Index (HDI)*. (n.d.). Retrieved 2015, from United Nations Development Programme: Human Development Reports: http://hdr.undp.org/en/content/human-development-index-hdi
[158] *Aid for Trade*. (2014, Nov 19). Retrieved from European Commission: http://ec.europa.eu/trade/policy/countries-and-regions/development/aid-for-trade/
[159] Davis, J., Kang, A., Vincent, J., & Whittington, D. (2001). How important is improved water infrastructure to microenterprises? Evidence from Uganda. *World Development, 29*(10), 1753-1767. Retrieved from http://stanford.edu/group/jennadavis/cgi-bin/drupal/sites/default/files/Davis%20WD%20SMEs%20Uganda.pdf
[160] OECD International Futures Programme. (2011). *Strategic transport infrastructure needs to 2030: Main findings.* OECD.
[161] *Infrastructure Development*. (2015). Retrieved from Helping hand for relief and development: http://www.hhrd.org/hhrd-infrastructureDev.aspx
[162] *International decade for action 'Water For Life' 2005-2015*. (2015, March 13). Retrieved from United Nations: http://www.un.org/waterforlifedecade/water_and_energy.shtml
[163] United Nations, General Assembly, Second Committee. (2013, October 22). Bridging digital divide critical to economic opportunities delegates say as second committee takes up information and communications technology. New York, NY. Retrieved from http://www.un.org/press/en/2013/gaef3374.doc.htm
[164] United Nations, General Assembly, Second Committee. (2013, October 22). Bridging digital divide critical to economic opportunities delegates say as second committee takes up information and communications technology. New York, NY. Retrieved from http://www.un.org/press/en/2013/gaef3374.doc.htm
[165] African Development Bank. (2013). *The African Infrastructure Development Index (AIDI).*
[166] African Development Bank. (2013). *The African Infrastructure Development Index (AIDI).*
[167] African Development Bank. (2013). *The African Infrastructure Development Index (AIDI).*
[168] African Development Bank. (2013). *The African Infrastructure Development Index (AIDI).*
[169] Daga, G. (2014). *Towards a new development paradigm: Critical analysis of gross national happiness.* Masters thesis, O.P. Jindal Global University, Jindal School of Government and Public Policy. Retrieved from http://www.researchgate.net/profile/Gaurav_Daga2/publication/262419781_Towards_a_New_Development_Paradigm_Critical_Analysis_of_Gross_National_Happiness/links/00b7d537b4254f1755000000.pdf
[170] O.M. Nour, S. S. (2005, September). Science and technology developpment indicators in the Arab region: A comparative study of Arab Gulf and Mediterranean countries. *Science, Technology & Society, 10*(2), 249-274. doi:10.1177/097172180501000204
[171] *Human Development Index (HDI)*. (n.d.). Retrieved 2015, from United Nations Development Programme: Human Development Reports: http://hdr.undp.org/en/content/human-development-index-hdi

[172] UNDP. (2014). *Human Development Report 2014.* New York, NY: United Nations Development Programme. Retrieved 2014, from http://hdr.undp.org/sites/default/files/hdr14-report-en-1.pdf
[173] UNDP. (2014). *Human Development Report 2014.* New York, NY: United Nations Development Programme. Retrieved 2014, from http://hdr.undp.org/sites/default/files/hdr14-report-en-1.pdf
[174] UNDP. (2014). *Human Development Report 2014.* New York, NY: United Nations Development Programme. Retrieved 2014, from http://hdr.undp.org/sites/default/files/hdr14-report-en-1.pdf
[175] UNDP. (2014). *Human Development Report 2014.* New York, NY: United Nations Development Programme. Retrieved 2014, from http://hdr.undp.org/sites/default/files/hdr14-report-en-1.pdf
[176] UNDP. (2014). *Human Development Report 2014.* New York, NY: United Nations Development Programme. Retrieved 2014, from http://hdr.undp.org/sites/default/files/hdr14-report-en-1.pdf
[177] *Human Development Index (HDI)*. (n.d.). Retrieved 2015, from United Nations Development Programme: Human Development Reports: http://hdr.undp.org/en/content/human-development-index-hdi
[178] *Human Development Index (HDI)*. (n.d.). Retrieved 2015, from United Nations Development Programme: Human Development Reports: http://hdr.undp.org/en/content/human-development-index-hdi
[179] UNDP. (2014). *Human Development Report 2014.* New York, NY: United Nations Development Programme. Retrieved 2014, from http://hdr.undp.org/sites/default/files/hdr14-report-en-1.pdf
[180] African Development Bank. (2013). *The African Infrastructure Development Index (AIDI).*
[181] *Gender Inequality Index (GII)*. (n.d.). Retrieved from United Nations Development Programme: Human Development Reports: http://hdr.undp.org/en/content/gender-inequality-index-gii
Goodchild, M. F., & Janelle, D. G. (2004). Thinking spatially in the social sciences. In M. F. Goodchild, & D. G. Janelle (Eds.), *Spatially integrated social science* (pp. 3-22). New York, NY: Oxford University Press.
[182] *Gender Inequality Index (GII)*. (n.d.). Retrieved from United Nations Development Programme: Human Development Reports: http://hdr.undp.org/en/content/gender-inequality-index-gii
Goodchild, M. F., & Janelle, D. G. (2004). Thinking spatially in the social sciences. In M. F. Goodchild, & D. G. Janelle (Eds.), *Spatially integrated social science* (pp. 3-22). New York, NY: Oxford University Press.
[183] *Gender Inequality Index (GII)*. (n.d.). Retrieved from United Nations Development Programme: Human Development Reports: http://hdr.undp.org/en/content/gender-inequality-index-gii
Goodchild, M. F., & Janelle, D. G. (2004). Thinking spatially in the social sciences. In M. F. Goodchild, & D. G. Janelle (Eds.), *Spatially integrated social science* (pp. 3-22). New York, NY: Oxford University Press.
[184] *Gender Inequality Index (GII)*. (n.d.). Retrieved from United Nations Development Programme: Human Development Reports: http://hdr.undp.org/en/content/gender-inequality-index-gii
Goodchild, M. F., & Janelle, D. G. (2004). Thinking spatially in the social sciences. In M. F. Goodchild, & D. G. Janelle (Eds.), *Spatially integrated social science* (pp. 3-22). New York, NY: Oxford University Press.
[185] *Gender Inequality Index (GII)*. (n.d.). Retrieved from United Nations Development Programme: Human Development Reports: http://hdr.undp.org/en/content/gender-inequality-index-gii
Goodchild, M. F., & Janelle, D. G. (2004). Thinking spatially in the social sciences. In M. F. Goodchild, & D. G. Janelle (Eds.), *Spatially integrated social science* (pp. 3-22). New York, NY: Oxford University Press.
[186] *Gender Inequality Index (GII)*. (n.d.). Retrieved from United Nations Development Programme: Human Development Reports: http://hdr.undp.org/en/content/gender-inequality-index-gii
Goodchild, M. F., & Janelle, D. G. (2004). Thinking spatially in the social sciences. In M. F. Goodchild, & D. G. Janelle (Eds.), *Spatially integrated social science* (pp. 3-22). New York, NY: Oxford University Press.
[187] *Ibrahim Index of African Governance*. (2015). Retrieved from Mo Ibrahim Foundation: http://www.moibrahimfoundation.org/iiag/
[188] Hanson, K., Kararach, G., & Shaw, T. M. (2012). *Rethinking development challenges for public policy: Insights from contemporary Africa.* New York, NY: Palgrave MacMillan.
[189] Holling, C. S. (2001). Understanding the complexity of economic, ecological, and social systems. *Ecosystems, 4*, 390-405. doi:10.1007/s10021-00 -0101-5
[190] Gupta, J., Toonen, T., Slinger, J., Hermans, L., van der Zaag, P., Ahlers, R., . . . Hermans, L. (2011). *Principles of good governance at different water governance levels.* Delft, the Netherlands: International

Hydrological Programme of UNESCO. Retrieved 2015, from http://www.unesco.nl/sites/default/files/dossier/water_governance.pdg_.pdf
[191] *Ibrahim Index of African Governance*. (2015). Retrieved from Mo Ibrahim Foundation: http://www.moibrahimfoundation.org/iiag/
[192] (2014). Retrieved 2015, from Mo Ibrahim Foundation: http://www.moibrahimfoundation.org/
[193] *Social Progress Index 2015*. (2015). Retrieved from The Social Progress Imperative: http://www.socialprogressimperative.org/data/spi#data_table/countries/spi/dim1,dim2,dim3
[194] [Cite a major source about the social progress index.]
[195] *Social Progress Index 2015*. (2015). Retrieved from The Social Progress Imperative: http://www.socialprogressimperative.org/data/spi#data_table/countries/spi/dim1,dim2,dim3
[196] *Social Progress Index 2015*. (2015). Retrieved from The Social Progress Imperative: http://www.socialprogressimperative.org/data/spi#data_table/countries/spi/dim1,dim2,dim3
[197] nef (the new economics foundation). (2015, 15 January). *About the HPI*. Retrieved 2015, from Happy Planet Index: http://www.happyplanetindex.org/about/
[198] nef (the new economics foundation). (2015, 15 January). *About the HPI*. Retrieved 2015, from Happy Planet Index: http://www.happyplanetindex.org/about/
[199] nef (the new economics foundation). (2015, 15 January). *About the HPI*. Retrieved 2015, from Happy Planet Index: http://www.happyplanetindex.org/about/
[200] *The World Economic Forum*. (n.d.). Retrieved from The World Economic Forum: http://www.weforum.org/world-economic-forum
[201] Schwab, K. (2014). *The Global Competitiveness Report 2014-2015: Full Data Edition.* Geneva: The World Economic Forum. Retrieved from http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2013-14.pdf
[202] Schwab, K. (2014). *The Global Competitiveness Report 2014-2015: Full Data Edition.* Geneva: The World Economic Forum. Retrieved from http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2013-14.pdf
[203] Schwab, K. (2014). *The Global Competitiveness Report 2014-2015: Full Data Edition.* Geneva: The World Economic Forum. Retrieved from http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2013-14.pdf
[204] Schwab, K. (2014). *The Global Competitiveness Report 2014-2015: Full Data Edition.* Geneva: The World Economic Forum. Retrieved from http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2013-14.pdf
[205] Schwab, K. (2014). *The Global Competitiveness Report 2014-2015: Full Data Edition.* Geneva: The World Economic Forum. Retrieved from http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2013-14.pdf
[206] Schwab, K. (2014). *The Global Competitiveness Report 2014-2015: Full Data Edition.* Geneva: The World Economic Forum. Retrieved from http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2013-14.pdf
[207] Schwab, K. (2014). *The Global Competitiveness Report 2014-2015: Full Data Edition.* Geneva: The World Economic Forum. Retrieved from http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2013-14.pdf
[208] Esri. (2015). Spatial Analysis. Redlands, CA: Environmental Systems Research Institute, Inc. (Esri). Retrieved from http://www.esri.com/
[209] Esri. (2015). Spatial Analysis. Redlands, CA: Environmental Systems Research Institute, Inc. (Esri). Retrieved from http://www.esri.com/
[210] Goodchild, M. F., & Janelle, D. G. (2004). Thinking spatially in the social sciences. In M. F. Goodchild, & D. G. Janelle (Eds.), *Spatially integrated social science* (pp. 3-22). New York, NY: Oxford University Press.
[211] Esri. (2015). ArcGIS for Desktop: Release 10.2. Redlands, CA: Environmental Systems Research Institute, Inc. (Esri). Retrieved from http://www.esri.com/
[212] MacDonald, A., Bonsor, H., Dochartaigh, B., & Taylor, R. (2012). Quantitative maps of groundwater resources in Africa. *Environmental Research Letters, 7*. doi:10.1088/1748-9326/7/2/024009

[213] Esri. (2015). ArcGIS for Desktop: Release 10.2. Redlands, CA: Environmental Systems Research Institute, Inc. (Esri). Retrieved from http://www.esri.com/
[214] Haken, N., Messner, J. J., Hendry, K., Taft, P., Lawrence, K., Brisard, L., & Umana, F. (2014). *The Fragile States Index 2014.* Washington, D.C.: The Fund for Peace. Retrieved from http://library.fundforpeace.org/library/cfsir1423-fragilestatesindex2014-06d.pdf
[215] Haken, N., Messner, J. J., Hendry, K., Taft, P., Lawrence, K., Brisard, L., & Umana, F. (2014). *The Fragile States Index 2014.* Washington, D.C.: The Fund for Peace. Retrieved from http://library.fundforpeace.org/library/cfsir1423-fragilestatesindex2014-06d.pdf
[216] Haken, N., Messner, J. J., Hendry, K., Taft, P., Lawrence, K., Brisard, L., & Umana, F. (2014). *The Fragile States Index 2014.* Washington, D.C.: The Fund for Peace. Retrieved from http://library.fundforpeace.org/library/cfsir1423-fragilestatesindex2014-06d.pdf
[217] Haken, N., Messner, J. J., Hendry, K., Taft, P., Lawrence, K., Brisard, L., & Umana, F. (2014). *The Fragile States Index 2014.* Washington, D.C.: The Fund for Peace. Retrieved from http://library.fundforpeace.org/library/cfsir1423-fragilestatesindex2014-06d.pdf
[218] Haken, N., Messner, J. J., Hendry, K., Taft, P., Lawrence, K., Brisard, L., & Umana, F. (2014). *The Fragile States Index 2014.* Washington, D.C.: The Fund for Peace. Retrieved from http://library.fundforpeace.org/library/cfsir1423-fragilestatesindex2014-06d.pdf
[219] *Fragile States Index*. (2015). Retrieved 15 April, 2015, from Foreign Policy: http://foreignpolicy.com/fragile-states-2014/#rankings
[220] Haken, N., Messner, J. J., Hendry, K., Taft, P., Lawrence, K., Brisard, L., & Umana, F. (2014). *The Fragile States Index 2014.* Washington, D.C.: The Fund for Peace. Retrieved from http://library.fundforpeace.org/library/cfsir1423-fragilestatesindex2014-06d.pdf
[221] Haken, N., Messner, J. J., Hendry, K., Taft, P., Lawrence, K., Brisard, L., & Umana, F. (2014). *The Fragile States Index 2014.* Washington, D.C.: The Fund for Peace. Retrieved from http://library.fundforpeace.org/library/cfsir1423-fragilestatesindex2014-06d.pdf
[222] *Composition of macro geographical (continental) regions, geographic sub-regions, and selected economic and other groupings.* (2013, October 31). Retrieved from United Nations Statistics Division: http://unstats.un.org/unsd/methods/m49/m49regin.htm#africa
[223] *JMP Country Files*. (n.d.). Retrieved from JMP | WHO/UNICEF Joint Monitoring Programme (JMP) for Water Supply and Sanitation: http://www.wssinfo.org/documents/?tx_displaycontroller[type]=country_files
[224] *JMP Country Files*. (n.d.). Retrieved from JMP | WHO/UNICEF Joint Monitoring Programme (JMP) for Water Supply and Sanitation: http://www.wssinfo.org/documents/?tx_displaycontroller[type]=country_files
[225] http://www.blog.kpmgafrica.com/africas-top-10-fastest-growing-economies/
[226] Definition of value in English. (n.d.). Retrieved April 19, 2015, from http://www.oxforddictionaries.com/us/definition/american_english/value
[227] Yang, J. (2013, August 27). Maximizing Shareholder Value: The Goal That Changed Corporate America. *The Washington Post*. Retrieved April 19, 2015, from http://www.washingtonpost.com/business/economy/maximizing-shareholder-value-the-goal-that-changed-corporate-america/2013/08/26/26e9ca8e-ed74-11e2-9008-61e94a7ea20d_story.html
[228] Friedman, M. (1970, September 13). The Social Responsibility of Business is to Increase its Profits. *The New York Times Magazine*.
[229] Lazonick, W. (2014, September). Profits Without Prosperity. Retrieved April 19, 2015, from https://hbr.org/2014/09/profits-without-prosperity
[230] Yang, J. (2013, August 27). Maximizing Shareholder Value: The Goal That Changed Corporate America. *The Washington Post*. Retrieved April 19, 2015, from http://www.washingtonpost.com/business/economy/maximizing-shareholder-value-the-goal-that-changed-corporate-america/2013/08/26/26e9ca8e-ed74-11e2-9008-61e94a7ea20d_story.html
[231] Gomory, R., & Sylla, R. (2013). The American Corporation. *Dædalus*, the Journal of the American Academy of Arts and Sciences, 142(2), 102-118.

[232] About. (n.d.). Retrieved April 19, 2015, from http://businessroundtable.org/about
[233] The Business Roundtable (1981, October). Statement on Corporate Responsibility.
[234] Freeman, R. (1984). *Strategic management: A stakeholder approach*. Cambridge, MA: Pitman
[235] Porter, M., & Kramer, M. (2011, January). Creating Shared Value. *Harvard Business Review*.
[236] Jensen, M. (2001). Value Maximization, Stakeholder Theory, and the Corporate Objective Function. *Business Ethics Quarterly*, 235-235.
[237] Noked, N. (2013, December 28). *The Corporate Social Responsibility Report and Effective Stakeholder Engagement*. Retrieved April 19, 2015, from http://corpgov.law.harvard.edu/2013/12/28/the-corporate-social-responsibility-report-and-effective-stakeholder-engagement/
[238] Clark, Jr., W., & Vranka, L. (2013). *The Need and Rationale for the Benefit Corporation: Why It Is the Legal Form that Best Addresses the Needs of Social Entrepreneurs, Investors, and, Ultimately, the Public*. Retrieved from http://www.benefitcorp.net/storage/documents/Benecit_Corporation_White_Paper_1_18_2013.pdf
[239] Barro, R. (2007, June 19). Bill Gates's Charitable Vistas. *The Wall Street Journal*. Retrieved April 1, 2015, from http://www.wsj.com/articles/SB118222027751440041
[240] Auerswald, P. (2009). Creating Social Value. *Stanford Social Innovation Review*, Spring, 50-55.
[241] Phills Jr., J., Deiglmeier, K., & Miller, D. (2008). Rediscovering Social Innovation. *Stanford Social Innovation Review*, Fall. Retrieved April 1, 2015, from http://www.ssireview.org/articles/entry/rediscovering_social_innovation/
[242] Phills Jr., J., Deiglmeier, K., & Miller, D. (2008). Rediscovering Social Innovation. *Stanford Social Innovation Review*, Fall. Retrieved April 1, 2015, from http://www.ssireview.org/articles/entry/rediscovering_social_innovation/
[243] Karnani, A. (2007). Microfinance Misses Its Mark. *Stanford Social Innovation Review*, Summer. Retrieved April 1, 2015, from http://www.ssireview.org/articles/entry/microfinance_misses_its_mark/.
[244] Auerswald, P. (2009). Creating Social Value. *Stanford Social Innovation Review*, Spring, 50-55.
[245] Robeyns, I. (2011, April 14). *The Capability Approach*. Retrieved April 19, 2015, from http://plato.stanford.edu/entries/capability-approach/
[246] Global Reporting Initiative. (2012). *Integrated Reporting: October to December 2011*. Global Reporting Initiative. Retrieved from https://www.globalreporting.org/SiteCollectionDocuments/Integrated-reporting-monthly-report-October-to-December-2011.pdf
[247] Global Reporting Initiative. (2012). *Integrated Reporting: October to December 2011*. Global Reporting Initiative. Retrieved from https://www.globalreporting.org/SiteCollectionDocuments/Integrated-reporting-monthly-report-October-to-December-2011.pdf
[248] International Integrated Reporting Council. (2013). *The International <IR> Framework*. International Integrated Reporting Council. Retrieved from http://www.theiirc.org/wp-content/uploads/2013/12/13-12-08-THE-INTERNATIONAL-IR-FRAMEWORK-2-1.pdf
[249] Ernst & Young LLP. (2013). *Value Creation: Background Paper for < IR >*. International Integrated Reporting Council. Retrieved from http://www.theiirc.org/wp-content/uploads/2013/07/IR-Background-Paper-Value.pdf
[250] Ernst & Young LLP. (2013). *Value Creation: Background Paper for < IR >*. International Integrated Reporting Council. Retrieved from http://www.theiirc.org/wp-content/uploads/2013/07/IR-Background-Paper-Value.pdf
[251] Ernst & Young LLP. (2013). *Value Creation: Background Paper for < IR >*. International Integrated Reporting Council. Retrieved from http://www.theiirc.org/wp-content/uploads/2013/07/IR-Background-Paper-Value.pdf
[252] International Integrated Reporting Council. (2013). *The International <IR> Framework*. International Integrated Reporting Council. Retrieved from http://www.theiirc.org/wp-content/uploads/2013/12/13-12-08-THE-INTERNATIONAL-IR-FRAMEWORK-2-1.pdf

[253] International Integrated Reporting Council. (2013). *The International <IR> Framework*. International Integrated Reporting Council. Retrieved from http://www.theiirc.org/wp-content/uploads/2013/12/13-12-08-THE-INTERNATIONAL-IR-FRAMEWORK-2-1.pdf
[254] International Integrated Reporting Council. (2013). *The International <IR> Framework*. International Integrated Reporting Council. Retrieved from http://www.theiirc.org/wp-content/uploads/2013/12/13-12-08-THE-INTERNATIONAL-IR-FRAMEWORK-2-1.pdf
[255] International Integrated Reporting Council. (2013). *The International <IR> Framework*. International Integrated Reporting Council. Retrieved from http://www.theiirc.org/wp-content/uploads/2013/12/13-12-08-THE-INTERNATIONAL-IR-FRAMEWORK-2-1.pdf
[256] Meadows, D., & Wright, D. (2008). *Thinking in systems: A primer*. White River Junction, VT: Chelsea Green Pub.
[257] Radzicki, M., & Taylor, R. (2008). Origin of System Dynamics: Jay W. Forrester and the History of System Dynamics. In *U.S. Department of Energy's Introduction to System Dynamics*. Washington, D.C.: U.S. Department of Energy.
[258] Radzicki, M., & Taylor, R. (2008). Origin of System Dynamics: Jay W. Forrester and the History of System Dynamics. In *U.S. Department of Energy's Introduction to System Dynamics*. Washington, D.C.: U.S. Department of Energy.
[259] Sterman, J. (2005). Learning From Evidence In A Complex World. *American Journal of Public Health*, 505-514.
[260] Sterman, J. (2005). Learning From Evidence In A Complex World. *American Journal of Public Health*, 505-514.
[261] Meadows, D., & Wright, D. (2008). *Thinking in systems: A primer*. White River Junction, VT: Chelsea Green Pub.
[262] Meadows, D., & Wright, D. (2008). *Thinking in systems: A primer*. White River Junction, VT: Chelsea Green Pub.
[263] Meadows, D., & Wright, D. (2008). *Thinking in systems: A primer*. White River Junction, VT: Chelsea Green Pub.
[264] Sterman, J. (2005). Learning From Evidence In A Complex World. *American Journal of Public Health*, 505-514.
[265] Forrester, J. (2009). *Some Basic Concepts in System Dynamics*. Massachusetts Institute of Technology.
[266] Sterman, J. (2005). Learning From Evidence In A Complex World. *American Journal of Public Health*, 505-514.
[267] Meadows, D., & Wright, D. (2008). *Thinking in systems: A primer*. White River Junction, VT: Chelsea Green Pub.
[268] Bathtub-Style_Diagram. (2012, December 26). Retrieved April 19, 2015, from http://overthepeak.com/wordpress/archives/10884/bathtub-style_diagram
[269] Meadows, D., & Wright, D. (2008). *Thinking in systems: A primer*. White River Junction, VT: Chelsea Green Pub.
[270] Ormand, C. (n.d.). Introduction to Complex Systems. Retrieved April 19, 2015, from http://serc.carleton.edu/NAGTWorkshops/complexsystems/introduction.html
[271] Meadows, D., & Wright, D. (2008). *Thinking in systems: A primer*. White River Junction, VT: Chelsea Green Pub.
[272] Ormand, C. (n.d.). Introduction to Complex Systems. Retrieved April 19, 2015, from http://serc.carleton.edu/NAGTWorkshops/complexsystems/introduction.html
[273] Meadows, D., & Wright, D. (2008). *Thinking in systems: A primer*. White River Junction, VT: Chelsea Green Pub.
[274] Ormand, C. (n.d.). Introduction to Complex Systems. Retrieved April 19, 2015, from http://serc.carleton.edu/NAGTWorkshops/complexsystems/introduction.html
[275] Meadows, D., & Wright, D. (2008). *Thinking in systems: A primer*. White River Junction, VT: Chelsea Green Pub.
[276] Sterman, J. (2005). Learning From Evidence In A Complex World. *American Journal of Public Health*, 505-514.

---

[277] Sargut, G., & McGrath, R. (2011, September 1). Learning to Live With Complexity. *Harvard Business Review*.
[278] Sterman, J. (2005). Learning From Evidence In A Complex World. *American Journal of Public Health*, 505-514.
[279] Kirkwood, C. (1998). System Behavior and Causal Loop Diagrams. In *System Dynamics Methods: A Quick Introduction*. Arizona State University.
[280] Kirkwood, C. (1998). System Behavior and Causal Loop Diagrams. In *System Dynamics Methods: A Quick Introduction*. Arizona State University.
[281] Meadows, D. (1999). *Leverage Points: Places to Intervene in a System*. The Sustainability Institute.
[282] Meadows, D. (1999). *Leverage Points: Places to Intervene in a System*. The Sustainability Institute.
[283] Wu, G., Li, L., Ahmad, S., Chen, X., & Pan, X. (2013). A Dynamic Model for Vulnerability Assessment of Regional Water Resources in Arid Areas: A Case Study of Bayingolin, China. *Water Resources Management*, 27, 3085-3101.
[284] Fernald, A., Tidwell, V., Rivera, J., Rodríguez, S., Guldan, S., Steele, C., . . . Cibils, A. (2012). Modeling Sustainability of Water, Environment, Livelihood, and Culture in Traditional Irrigation Communities and Their Linked Watersheds. *Sustainability*, 4, 2998-3022.
[285] Hjorth, P., & Bagheri, A. (2006). Navigating towards sustainable development: A system dynamics approach. *Futures*, 38, 74-92.
[286] Madani, K., & Mariño, M. (2009). System Dynamics Analysis For Managing Iran's Zayandeh-Rud River Basin. *Water Resources Management*, 23, 2163-2187.
[287] LimnoTech,. (2013). Quantifying Replenish Benefits in Community Water Partnership Projects. LimnoTech. Retrieved from http://assets.coca-colacompany.com/2f/cb/e5d2ca1e4c58a38adbe8586d06db/final-quanitification-report-water-pdf.pdf
[288]Overview: Social Capital. (2011). Retrieved April 19, 2015, from http://go.worldbank.org/C0QTRW4QF0
[289] Morrison, J., Morikawa, M., Murphy, M., and Shulte, P. 2009, Water Scarcity & Climate Change: Growing Risks for Businesses & Investors, Pacific Institute, Ceres Report
[290] Report – The Sustainability Institute, 1999, Hartland, VT. Leverage Points: Places to Intervene in a System. Donella Meadows.
[291] Report – The Sustainability Institute, 1999, Hartland, VT. Leverage Points: Places to Intervene in a System. Donella Meadows
[292] Environmental Protection Agency. What is a Watershed? (n.d.). Retrieved April 21, 2015, from http://water.epa.gov/type/watersheds/whatis.cfmh
[293] Coca-Cola (n.d.). *RAIN: The Replenish Africa Initiative*. retrieved April 20, 2015 from http://www.coca-colacompany.com/rain-the-replenish-africa-initiative#TCCC
[294] LimnoTech,. (2013). Quantifying Replenish Benefits in Community Water Partnership Projects. LimnoTech. Retrieved from http://assets.coca-colacompany.com/2f/cb/e5d2ca1e4c58a38adbe8586d06db/final-quanitification-report-water-pdf.pdfht
[295] UN. 2012. *The Millennium Development Goals Report*. New York: UN
[296] Estimated with data from WHO/UNICEF Joint Monitoring Programme (JMP) for Water Supply and Sanitation. (2012). Progress on Sanitation and Drinking-Water, 2012 Update
[297] World Health Organization. Health through safe drinking water and basic sanitation. (n.d.). Retrieved April 21, 2015, from http://www.who.int/water_sanitation_health/mdg1/en/
[298] WHO/UNICEF. Improved and unimproved water and sanitation facilities. (n.d.). Retrieved April 21, 2015, from http://www.wssinfo.org/definitions-methods/watsan-categories/
[299] Global Water, Sanitation, & Hygiene (WASH). (2015, February 3). Retrieved April 21, 2015, from http://www.cdc.gov/healthywater/global
[300] Coca-Cola (n.d.). *RAIN: The Replenish Africa Initiative*. retrieved April 20, 2016 from http://www.coca-colacompany.com/rain-the-replenish-africa-initiative#TCCC
[301] Coca-Cola (n.d.). *RAIN: The Replenish Africa Initiative*. retrieved April 20,2015 http://www.coca-colacompany.com/rain-the-replenish-africa-initiative#TCCC

[302] Coca-Cola (n.d.). *RAIN: The Replenish Africa Initiative*. retrieved April 20,2015http://www.coca-colacompany.com/rain-the-replenish-africa-initiative#TCCC
[303] RAIN 2020 Investments Broll. (n.d.). Retrieved April 21, 2015, from http://www.coca-colacompany.com/press-center/a-v-library/rain-2020-investments-broll-bc3714359874001#TCCC
[304] Improved and unimproved water and sanitation facilities. (n.d.). Retrieved April 21, 2015, from
[305]Pathways for increasing agricultural water productivity. (n.d.). Retrieved April 21, 2015, from http://www.iwmi.cgiar.org/assessment/Water for Food Water for Life/Chapt ers/Chapter 7 Water Productivity.pdf
[306] Coca-Cola (n.d.). *RAIN: The Replenish Africa Initiative*. retrieved April 20, 2015from http://www.coca-colacompany.com/rain-the-replenish-africa-initiative
[307]LimnoTech,. (2013). Quantifying Replenish Benefits in Community Water Partnership Projects. LimnoTech. Retrieved from http://assets.coca-colacompany.com/2f/cb/e5d2ca1e4c58a38adbe8586d06db/final-quanitification-report-water-pdf.pdf
[308] Leverage Point. (2014). Retrieved April 20, 2015, from http://www.thwink.org/sustain/glossary/LeveragePoint.htm
[309] Leverage Point. (2014). Retrieved April 20, 2015, from http://www.thwink.org/sustain/glossary/LeveragePoint.htm
[310] Meadows, D., & Wright, D. (2008). *Thinking in systems: A primer*. White River Junction, VT: Chelsea Green Pub.
[311] Meadows, D. (1999). *Leverage Points: Places to Intervene in a System*. The Sustainability Institute.
[312] Meadows, D., & Wright, D. (2008). *Thinking in systems: A primer*. White River Junction, VT: Chelsea Green Pub.
[313] Porter, M., Hills, G., Pfitzer, M., Patscheke, S., & Hawkins, E. (2011). *Measuring shared value: How to unlock value by linking social and business results*. Retrieved from FSG: http://bibliotecadigital.ccb.org.co/bitstream/handle/11520/1416/Measuring_Shared_Value.pdf?sequence=1&isAllowed=y
[314] Meadows, D. (1999). Leverage Points: Places to Intervene in a System. Retrieved April 20, 2015, from http://www.donellameadows.org/archives/leverage-points-places-to-intervene-in-a-system/
[315] Meadows, D. (1999). Leverage Points: Places to Intervene in a System. Retrieved April 20, 2015, from http://www.donellameadows.org/archives/leverage-points-places-to-intervene-in-a-system/
[316] Meadows, D. (1999). Leverage Points: Places to Intervene in a System. Retrieved April 20, 2015, from http://www.donellameadows.org/archives/leverage-points-places-to-intervene-in-a-system/
[317] Meadows, D. (1999). Leverage Points: Places to Intervene in a System. Retrieved April 20, 2015, from http://www.donellameadows.org/archives/leverage-points-places-to-intervene-in-a-system/
[318] Meadows, D. (1999). Leverage Points: Places to Intervene in a System. Retrieved April 20, 2015, from http://www.donellameadows.org/archives/leverage-points-places-to-intervene-in-a-system/
[319] Meadows, D. (1999). Leverage Points: Places to Intervene in a System. Retrieved April 20, 2015, from http://www.donellameadows.org/archives/leverage-points-places-to-intervene-in-a-system/
[320] Meadows, D. (1999). Leverage Points: Places to Intervene in a System. Retrieved April 20, 2015, from http://www.donellameadows.org/archives/leverage-points-places-to-intervene-in-a-system/
[321] Meadows, D. (1999). Leverage Points: Places to Intervene in a System. Retrieved April 20, 2015, from http://www.donellameadows.org/archives/leverage-points-places-to-intervene-in-a-system/
[322] Meadows, D. (1999). Leverage Points: Places to Intervene in a System. Retrieved April 20, 2015, from http://www.donellameadows.org/archives/leverage-points-places-to-intervene-in-a-system/
[323] Meadows, D. (1999). Leverage Points: Places to Intervene in a System. Retrieved April 20, 2015, from http://www.donellameadows.org/archives/leverage-points-places-to-intervene-in-a-system/
[324] Meadows, D. (1999). Leverage Points: Places to Intervene in a System. Retrieved April 20, 2015, from http://www.donellameadows.org/archives/leverage-points-places-to-intervene-in-a-system/
[325] Meadows, D. (1999). Leverage Points: Places to Intervene in a System. Retrieved April 20, 2015, from http://www.donellameadows.org/archives/leverage-points-places-to-intervene-in-a-system/
[326] Meadows, D. (1999). Leverage Points: Places to Intervene in a System. Retrieved April 20, 2015, from http://www.donellameadows.org/archives/leverage-points-places-to-intervene-in-a-system/

[327] Meadows, D. (1999). Leverage Points: Places to Intervene in a System. Retrieved April 20, 2015, from http://www.donellameadows.org/archives/leverage-points-places-to-intervene-in-a-system/
[328] Biocentrism. (2015). In *Encyclopædia Britannica*. Retrieved from http://www.britannica.com/EBchecked/topic/765710/biocentrism
[329] http://reports.weforum.org/global-competitiveness-report-2014-2015/
[330] http://www.blog.kpmgafrica.com/africas-top-10-fastest-growing-economies/
[331] http://www.blog.kpmgafrica.com/africas-top-10-fastest-growing-economies/
[332] http://reports.weforum.org/global-competitiveness-report-2014-2015/
[333] http://www.blog.kpmgafrica.com/africas-top-10-fastest-growing-economies/
[334] Coca-Cola (n.d.). *RAIN: The Replenish Africa Initiative*. retrieved April 20,2015 http://www.coca-colacompany.com/rain-the-replenish-africa-initiative#TCCC
[335] Coca-Cola (n.d.). *RAIN: The Replenish Africa Initiative*. retrieved April 20,2015http://www.coca-colacompany.com/rain-the-replenish-africa-initiative#TCCC
[336] RAIN 2020 Investments Broll. (n.d.). Retrieved April 21, 2015, from http://www.coca-colacompany.com/press-center/a-v-library/rain-2020-investments-broll-bc3714359874001#TCCC
[337] Coca-Cola (n.d.). *RAIN: The Replenish Africa Initiative*. retrieved April 20, 2015 from http://www.coca-colacompany.com/rain-the-replenish-africa-initiative
[338]Africa Water for Schools | The Coca-Cola Africa Foundation. (n.d.). Retrieved April 21, 2015, from http://www.tccaf.org/africa-water-projects-schools.asp
[339] Africa Water for Schools | The Coca-Cola Africa Foundation. (n.d.). Retrieved April 21, 2015, from http://www.tccaf.org/africa-water-projects-schools.asp
[340] Estimated with data from WHO/UNICEF Joint Monitoring Programme (JMP) for Water Supply and Sanitation. (2012). Progress on Sanitation and Drinking-Water, 2012 Update.
[341] United Nations Development Programme (UNDP). (2006). Human Development Report 2006, Beyond Scarcity: Power, poverty and the global water crisis.
[342] Estimated with data from Diarrhea: Why children are still dying and what can be done. UNICEF, WHO 2009
[343] United Nations Development Programme (UNDP). (2006). Human Development Report 2006, Beyond Scarcity: Power, poverty and the global water crisis.
[344] Estimated with data from Diarrhea: Why children are still dying and what can be done. UNICEF, WHO 2009
[345] World Health Organization (WHO). (2002). The World Health Report 2002, Reducing Risks, Promoting Health Life.
[346] Africa Water for Schools | The Coca-Cola Africa Foundation. (n.d.). Retrieved April 21, 2015, from http://www.tccaf.org/africa-water-projects-schools.asp
[347] Global Environment and Technology Foundation, Personal Communication, October 2014
[348] World Health Organization (WHO). (2008). Safer Water, Better Health: Costs, benefits, and sustainability of interventions to protect and promote health; Updated Table 1: WSH deaths by region, 2004.
tivenessReport_2013-14.pdf.
ort_2013-14.pdf.
[352] *JMP Country Files*. (n.d.). Retrieved from JMP | WHO/UNICEF Joint Monitoring Programme (JMP) for Water Supply and Sanitation:
http://www.wssinfo.org/documents/?tx_displaycontroller[type]=country_files
[353] Mitigating Water Risk for Communities and for Our System. (n.d.). Retrieved April 21, 2015, from http://www.coca-colacompany.com/mitigating-water-risk-for-communities-and-for-our-system#TCCC
[354] Hutton, Guy. (2004). *Evaluation of the costs and benefits of water and sanitation improvements at the global level*. Retrieved from Water, Sanitation, and Health, Protection of the Human Environment, World Health Organization website: http://www.who.int/water_sanitation_health/wsh0404.pdf
[355] Cameron, J., & World Health Organization. (2011). Social cost–benefit analysis – summarizing the available global evidence on drinking-water interventions. In *Valuing water, valuing livelihoods: Guidance*

on social cost-benefit analysis of drinking-water interventions, with special reference to small community water supplies (pp. 217-237). London: IWA Pub.
[356] De Groot, R., Brander, L., Van der Ploeg, S., Costanza, R., Bernard, F., Braat, L., . . . Christie, M. (2012). Global estimates of the value of ecosystems and their services in monetary units. *Ecosystem Services*, *1*(1), 50-61. Retrieved from http://www.sciencedirect.com/science/article/pii/S2212041612000101
[357] Esri. (2015, March 9). World Countries. Retrieved from http://www.arcgis.com/homoe/item.html?id=3864c63872d84aec91933618e3815dd2
[358] Esri. (2015). ArcGIS for Desktop: Release 10.2. Redlands, CA: Environmental Systems Research Institute, Inc. (Esri). Retrieved from http://www.esri.com/
[359] Esri. (2015). ArcGIS for Desktop: Release 10.2. Redlands, CA: Environmental Systems Research Institute, Inc. (Esri). Retrieved from http://www.esri.com/
[360] Raskin, P., Gleick, P., Kirshen, P., Pontius, G., & Strzepek, K. (1997). *Water Futures: Assessment of Long-Range Patterns and Prospects.* Stockholm, Sweden: Stockholm Environment Institute.
[361] Raskin, P., Gleick, P., Kirshen, P., Pontius, G., & Strzepek, K. (1997). *Water Futures: Assessment of Long-Range Patterns and Prospects.* Stockholm, Sweden: Stockholm Environment Institute.
[362] Raskin, P., Gleick, P., Kirshen, P., Pontius, G., & Strzepek, K. (1997). *Water Futures: Assessment of Long-Range Patterns and Prospects.* Stockholm, Sweden: Stockholm Environment Institute.
[363] Raskin, P., Gleick, P., Kirshen, P., Pontius, G., & Strzepek, K. (1997). *Water Futures: Assessment of Long-Range Patterns and Prospects.* Stockholm, Sweden: Stockholm Environment Institute.
[364] African Development Bank. (2013). *The African Infrastructure Development Index (AIDI).*
[365] Haken, N., Messner, J. J., Hendry, K., Taft, P., Lawrence, K., Brisard, L., & Umana, F. (2014). *The Fragile States Index 2014.* Washington, D.C.: The Fund for Peace. Retrieved from http://library.fundforpeace.org/library/cfsir1423-fragilestatesindex2014-06d.pdf
[366] Esri. (2015, March 9). World Countries. Retrieved from http://www.arcgis.com/homoe/item.html?id=3864c63872d84aec91933618e3815dd2
[367] MacDonald, A., Bonsor, H., Dochartaigh, B., & Taylor, R. (2012). Quantitative maps of groundwater resources in Africa. *Environmental Research Letters, 7*. doi:10.1088/1748-9326/7/2/024009
[368] Liu, C., Kroeze, C., Hoekstra, A. Y., & Gerbens-Leenes, W. (2012). Past and future trends in grey water footprints of anthropogenic nitrogen and phosphorous inputs to major world rivers. *Ecological Indicators, 18*, 42-49. Retrieved from http://www.waterfootprint.org/Reports/Liu-et-al-2012.pdf
[369] World Bank. (2015). *World Development Indicators*. Retrieved from The World Bank: http://data.worldbank.org/data-catalog/world-development-indicators
[370] FAO. (2015). *AQUASTAT website*. Retrieved January 15, 2015, from Food and Agriculture Organization of the United Nations (FAO): http://www.fao.org/nr/water/aquastat/main/index.stm
[371] Mekonnen, M. M., & Hoekstra, A. Y. (2011). National Water Footprint Accounts: The Green, Blue and Grey Water Footprint of Production and Consumption. *Value of Water Research Report Series, 50*. Delft, The Netherlands: UNESCO-IHE.
[372] Esri. (2015, March 9). World Countries. Retrieved from http://www.arcgis.com/homoe/item.html?id=3864c63872d84aec91933618e3815dd2
[373] MacDonald, A., Bonsor, H., Dochartaigh, B., & Taylor, R. (2012). Quantitative maps of groundwater resources in Africa. *Environmental Research Letters, 7*. doi:10.1088/1748-9326/7/2/024009
[374] Liu, C., Kroeze, C., Hoekstra, A. Y., & Gerbens-Leenes, W. (2012). Past and future trends in grey water footprints of anthropogenic nitrogen and phosphorous inputs to major world rivers. *Ecological Indicators, 18*, 42-49. Retrieved from http://www.waterfootprint.org/Reports/Liu-et-al-2012.pdf
[375] World Bank. (2015). *World Development Indicators*. Retrieved from The World Bank: http://data.worldbank.org/data-catalog/world-development-indicators
[376] FAO. (2015). *AQUASTAT website*. Retrieved January 15, 2015, from Food and Agriculture Organization of the United Nations (FAO): http://www.fao.org/nr/water/aquastat/main/index.stm
[377] Mekonnen, M. M., & Hoekstra, A. Y. (2011). National Water Footprint Accounts: The Green, Blue and Grey Water Footprint of Production and Consumption. *Value of Water Research Report Series, 50*. Delft, The Netherlands: UNESCO-IHE.

[378] Haken, N., Messner, J. J., Hendry, K., Taft, P., Lawrence, K., Brisard, L., & Umana, F. (2014). *The Fragile States Index 2014.* Washington, D.C.: The Fund for Peace. Retrieved from http://library.fundforpeace.org/library/cfsir1423-fragilestatesindex2014-06d.pdf
[379] Kirkwood, C. (1998). System Behavior and Causal Loop Diagrams. In *System Dynamics Methods: A Quick Introduction*. Arizona State University
[380] Overview : Social Capital. (2011). Retrieved April 19, 2015, from http://go.worldbank.org/C0QTRW4QF0
[381] OECD (2011), *Perspectives on Global Development 2012: Social Cohesion in a Shifting World*, OECD Publishing, Paris.
[382] Schulte, P. (2014, February 4). Defining Water Scarcity, Water Stress, and Water Risk: It's Not Just Semantics. Retrieved April 19, 2015, from http://pacinst.org/water-definitions/
[383] Overview Social Capital. (2011). Retrieved April 19, 2015, from http://go.worldbank.org/C0QTRW4QF0
[384] OECD (2011), *Perspectives on Global Development 2012: Social Cohesion in a Shifting World*, OECD Publishing, Paris.
[385] Schulte, P. (2014, February 4). Defining Water Scarcity, Water Stress, and Water Risk: It's Not Just Semantics. Retrieved April 19, 2015, from http://pacinst.org/water-definitions/
[386] International Integrated Reporting Council. (2013). *The International <IR> Framework*. International Integrated Reporting Council. Retrieved from http://www.theiirc.org/wp-content/uploads/2013/12/13-12-08-THE-INTERNATIONAL-IR-FRAMEWORK-2-1.pdf
[387] Sargut, G., & McGrath, R. (2011, September). Learning to Live With Complexity. *Harvard Business Review*.
[388] Gassert, F., Luck, M., Landis, M., Reig, P., & Shiao, T. (2014). *Aqueduct global maps 2.1: Constructing decision-relevant global water risk indicators.* Washington, DC: World Resources Institute. Retrieved from http://www.wri.org/publication/aqueduct-global-maps-21-indicators
[389] Gassert, F., Luck, M., Landis, M., Reig, P., & Shiao, T. (2014). *Aqueduct global maps 2.1: Constructing decision-relevant global water risk indicators.* Washington, DC: World Resources Institute. Retrieved from http://www.wri.org/publication/aqueduct-global-maps-21-indicators
[390] Gassert, F., Luck, M., Landis, M., Reig, P., & Shiao, T. (2014). *Aqueduct global maps 2.1: Constructing decision-relevant global water risk indicators.* Washington, DC: World Resources Institute. Retrieved from http://www.wri.org/publication/aqueduct-global-maps-21-indicators
[391] Gassert, F., Luck, M., Landis, M., Reig, P., & Shiao, T. (2014). *Aqueduct global maps 2.1: Constructing decision-relevant global water risk indicators.* Washington, DC: World Resources Institute. Retrieved from http://www.wri.org/publication/aqueduct-global-maps-21-indicators
[392] Gassert, F., Luck, M., Landis, M., Reig, P., & Shiao, T. (2014). *Aqueduct global maps 2.1: Constructing decision-relevant global water risk indicators.* Washington, DC: World Resources Institute. Retrieved from http://www.wri.org/publication/aqueduct-global-maps-21-indicators
[393] Gassert, F., Luck, M., Landis, M., Reig, P., & Shiao, T. (2014). *Aqueduct global maps 2.1: Constructing decision-relevant global water risk indicators.* Washington, DC: World Resources Institute. Retrieved from http://www.wri.org/publication/aqueduct-global-maps-21-indicators
[394] Gassert, F., Luck, M., Landis, M., Reig, P., & Shiao, T. (2014). *Aqueduct global maps 2.1: Constructing decision-relevant global water risk indicators.* Washington, DC: World Resources Institute. Retrieved from http://www.wri.org/publication/aqueduct-global-maps-21-indicators
[395] Gassert, F., Luck, M., Landis, M., Reig, P., & Shiao, T. (2014). *Aqueduct global maps 2.1: Constructing decision-relevant global water risk indicators.* Washington, DC: World Resources Institute. Retrieved from http://www.wri.org/publication/aqueduct-global-maps-21-indicators
[396] Gassert, F., Luck, M., Landis, M., Reig, P., & Shiao, T. (2014). *Aqueduct global maps 2.1: Constructing decision-relevant global water risk indicators.* Washington, DC: World Resources Institute. Retrieved from http://www.wri.org/publication/aqueduct-global-maps-21-indicators

[397] Gassert, F., Luck, M., Landis, M., Reig, P., & Shiao, T. (2014). *Aqueduct global maps 2.1: Constructing decision-relevant global water risk indicators.* Washington, DC: World Resources Institute. Retrieved from http://www.wri.org/publication/aqueduct-global-maps-21-indicators
[398] Gassert, F., Luck, M., Landis, M., Reig, P., & Shiao, T. (2014). *Aqueduct global maps 2.1: Constructing decision-relevant global water risk indicators.* Washington, DC: World Resources Institute. Retrieved from http://www.wri.org/publication/aqueduct-global-maps-21-indicators
[399] Gassert, F., Luck, M., Landis, M., Reig, P., & Shiao, T. (2014). *Aqueduct global maps 2.1: Constructing decision-relevant global water risk indicators.* Washington, DC: World Resources Institute. Retrieved from http://www.wri.org/publication/aqueduct-global-maps-21-indicators
[400] Gassert, F., Luck, M., Landis, M., Reig, P., & Shiao, T. (2014). *Aqueduct global maps 2.1: Constructing decision-relevant global water risk indicators.* Washington, DC: World Resources Institute. Retrieved from http://www.wri.org/publication/aqueduct-global-maps-21-indicators
[401] Gassert, F., Luck, M., Landis, M., Reig, P., & Shiao, T. (2014). *Aqueduct global maps 2.1: Constructing decision-relevant global water risk indicators.* Washington, DC: World Resources Institute. Retrieved from http://www.wri.org/publication/aqueduct-global-maps-21-indicators
[402] Gassert, F., Luck, M., Landis, M., Reig, P., & Shiao, T. (2014). *Aqueduct global maps 2.1: Constructing decision-relevant global water risk indicators.* Washington, DC: World Resources Institute. Retrieved from http://www.wri.org/publication/aqueduct-global-maps-21-indicators
[403] Gassert, F., Luck, M., Landis, M., Reig, P., & Shiao, T. (2014). *Aqueduct global maps 2.1: Constructing decision-relevant global water risk indicators.* Washington, DC: World Resources Institute. Retrieved from http://www.wri.org/publication/aqueduct-global-maps-21-indicators
[404] Gassert, F., Luck, M., Landis, M., Reig, P., & Shiao, T. (2014). *Aqueduct global maps 2.1: Constructing decision-relevant global water risk indicators.* Washington, DC: World Resources Institute. Retrieved from http://www.wri.org/publication/aqueduct-global-maps-21-indicators
[405] Gassert, F., Luck, M., Landis, M., Reig, P., & Shiao, T. (2014). *Aqueduct global maps 2.1: Constructing decision-relevant global water risk indicators.* Washington, DC: World Resources Institute. Retrieved from http://www.wri.org/publication/aqueduct-global-maps-21-indicators
[406] Baccarini, D. (1999). The logical framework method for defining project success. Project Management Journal, 30(4), 25-32.
[407] Khang, D., & Moe, T. (2008). Success criteria and factors for international development projects: A life-cycle-based framework. Project Management Journal, 39(1), 72-84.
[408] Khang, D., & Moe, T. (2008). Success criteria and factors for international development projects: A life-cycle-based framework. Project Management Journal, 39(1), 72-84.
[409] Khang, D., & Moe, T. (2008). Success criteria and factors for international development projects: A life-cycle-based framework. Project Management Journal, 39(1), 72-84.
[410] Diallo, A., & Thuillier, D. (2004). The success dimensions of international development projects: The perceptions of African project coordinators. *International Journal of Project Management, 22*, 19-31.
[411] Diallo, A., & Thuillier, D. (2004). The success dimensions of international development projects: The perceptions of African project coordinators. *International Journal of Project Management, 22*, 19-31.
[412] Diallo, A., & Thuillier, D. (2004). The success dimensions of international development projects: The perceptions of African project coordinators. *International Journal of Project Management, 22*, 19-31.
[413] A guide to the project management body of knowledge (PMBOK guide) (3rd ed.). (2004). Newtown Square, PA: Project Management Institute.
[414] USAID. (2014). Local Systems: A Framework for Supporting Sustained Development. Washington, D.C.
[415] Publications. (n.d.). Retrieved April 19, 2015, from http://wdi.umich.edu/research/bop/projects/actionable-knowledge/papers
[416] Child Diarrhea. (n.d.). Retrieved April 19, 2015, from http://www.povertyactionlab.org/policy-lessons/health/child-diarrhea?tab=tab-background
[417] UNESCO. (2006). Water: a shared responsibility. 2006. United Nations Educational, Scientific and Cultural Organization. New York: UNESCO.

[418] J Murphy, H., McBean, E., & Farahbakhsh, K. (2009). Appropriate Technology – A Comprehensive Approach For Water And Sanitation In The Developing World. *Technology in Society, 31*, 158-167.
[419] Hall, S., & London, T. (2005). Developing Native Capability. *Stanford Social Innovation Review, 3*(2), 28-33.
[420] The World Bank,. (2002). Reforming Public Institutions and Strengthening Governance. The World Bank. Retrieved from http://www1.worldbank.org/publicsector/Reforming.pdf
[421] Bakker, K., Kooy, M., Shofiani, N., & Martijn, E. (2008). Governance Failure: Rethinking the Institutional Dimensions of Urban Water Supply to Poor Households. World Development, 36(10), 1891-1915.
[422] Rheingans, R., Dreibelbis, R., & Freeman, M. (2006). Beyond The Millennium Development Goals: Public Health Challenges In Water And Sanitation. Global Public Health, 31-48.
[423] Hamdy, A., Abu-Zeid, M., & Lacirignola, C. (1998). Institutional Capacity Building for Water Sector Development. Water International, 23(3), 126-133.
[424] Estache, A., & Kouassi, E. (2002). Sector Organization, Governance, and the Inefficiency of African Water Utilities. The World Bank. Retrieved from https://openknowledge.worldbank.org/bitstream/handle/10986/19274/multi0page.pdf?sequence=1
[425] Khang, D., & Moe, T. (2008). Success criteria and factors for international development projects: A life-cycle-based framework. Project Management Journal, 39(1), 72-84.
[426] Millar, A., Simeone, R., & Carnevale, J. (2001). Logic models: A systems tool for performance management. Evaluation and Program Planning, 24(1), 73-81.
[427] McAllister, K. (1999). Understanding Participation: Monitoring and evaluating process, outputs and outcomes. International Development Research Centre. Retrieved from http://www.academia.edu/5186523/Understanding_Participation_Monitoring_and_evaluating_process_outputs_and_outcomes
[428] McAllister, K. (1999). Understanding Participation: Monitoring and evaluating process, outputs and outcomes. International Development Research Centre. Retrieved from http://www.academia.edu/5186523/Understanding_Participation_Monitoring_and_evaluating_process_outputs_and_outcomes
[429] Engels, J. (2010). Aid project exit strategies: building strong sustainable institutions (Ph.D). School of Philosophy, Anthropology and Social Inquiry, The University of Melbourne.
[430] Engels, J. (2010). Aid project exit strategies: building strong sustainable institutions (Ph.D). School of Philosophy, Anthropology and Social Inquiry, The University of Melbourne.
[431] Engels, J. (2010). Aid project exit strategies: building strong sustainable institutions (Ph.D). School of Philosophy, Anthropology and Social Inquiry, The University of Melbourne.
[432] Engels, J. (2010). Aid project exit strategies: building strong sustainable institutions (Ph.D). School of Philosophy, Anthropology and Social Inquiry, The University of Melbourne.
[433] Rogers, B. & Macias, K. (2004) Program graduation and exit strategies: a focus on Title II food aid development programs, FANTA Technical Note No. 9, Washington, D.C: Food and Nutrition Technical Assistance Project (FANTA).
[434] Levinger, B. & McLeod, J. (2002) Hello, I Must Be Going: Ensuring Quality Services and Sustainable Benefits through Well-Designed Exit Strategies, Newton, MA: Education Development Center, Inc.
[435] Levinger, B. & McLeod, J. (2002) Hello, I Must Be Going: Ensuring Quality Services and Sustainable Benefits through Well-Designed Exit Strategies, Newton, MA: Education Development Center, Inc.
[436] Rogers, B. & Macias, K. (2004) Program graduation and exit strategies: a focus on Title II food aid development programs, FANTA Technical Note No. 9, Washington, D.C: Food and Nutrition Technical Assistance Project (FANTA).
[437] Engels, J. (2010). Aid project exit strategies: building strong sustainable institutions (Ph.D). School of Philosophy, Anthropology and Social Inquiry, The University of Melbourne.
[438] Hall, S., & London, T. (2005). Developing Native Capability. *Stanford Social Innovation Review, 3*(2), 28-33.