Evaporating Asset

Water Scarcity and Innovations for the Future

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SustainAbility

Introduction

The World Economic Forum has identified "water crises" as one of the top ten issues of greatest concern to the global economy in 2014.[1] What is causing these crises and how do we address them? Through research supported by the Rockefeller Foundation in 2014, SustainAbility explored the challenges faced by freshwater and freshwater ecosystems globally due to growing sectoral competition—between agricultural, industrial and municipal users—for limited water. This paper illuminates some of the most innovative approaches to protect, preserve and replenish freshwater ecosystems.

Following several months of research involving a review of over 90 reports, articles and papers, dozens of expert interviews and a convening with a global cohort of water experts, SustainAbility developed a number of observations about the global water crisis and what it means for the private sector.

- Water stress will be a growing problem in the coming years due to population growth, urbanization, climate change and growing demands from agriculture, energy, and industry.
- Critical system failures including siloed decision-making and an undervaluation of ecosystems and freshwater have exacerbated the problem.
- Water issues are gaining momentum with increasing private sector awareness of water risk, a focus on the food/energy/water nexus across sectors, and greater investment in water infrastructure, green infrastructure and wastewater reuse.
- There are several promising and innovative solutions that aim to protect freshwater and freshwater ecosystems, from watershed payments and natural capital management tools to the development of water markets and green bonds.
- Companies can do more by extending beyond conservation and efficiency within normal operations and looking towards how they can engage in water management at the basin level. Of the 563 companies analyzed for the Carbon Disclosure Project's (CDP) 2013 Global Water Report, only 3% of respondents set concrete targets or goals for watershed management.[2]

While the outlook may seem bleak, in principle most countries have the water they need to support growth, but are simply not managing it appropriately.[3] Too often the economic costs and benefits of water use are not accurately incorporated into water allocations, resulting in increasingly water-stressed situations. With a more balanced and systems-level approach to water management, where water allocations are no longer made in isolation from other economic decisions, there is hope that we can successfully navigate the water scarcity challenge.

This report provides an introduction to the context and causes of water scarcity, the growing momentum around addressing water issues and a look at what SustainAbility considers to be some of the more interesting solutions on the horizon.

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The Current Landscape

In order to grasp the ramifications of water scarcity and the urgency with which global stakeholders need to take action, it is important to understand the current state of water. This section provides a snapshot of how and where water is used, what regions are most at risk and what factors are driving and will continue to drive ongoing water stress.

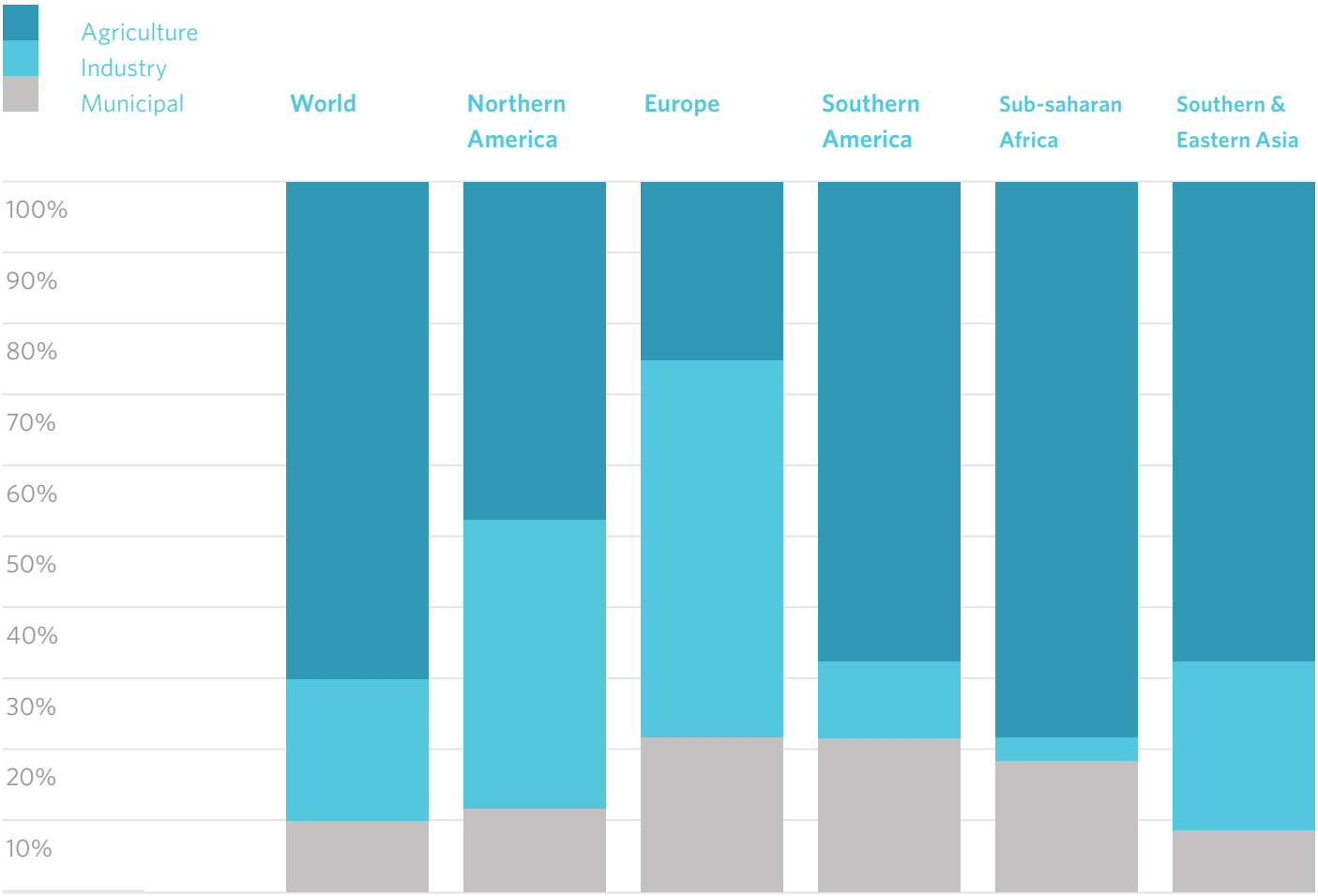
Where is Water Going?

"The greatest demand for water comes from agriculture, which accounts for over 70% of global water use."
2030 Water Resource Group

The greatest demand for water comes from agriculture, which accounts for over 70% of global water use.[4] By 2030, annual water demand for agriculture is expected to increase significantly to meet the needs of a growing population. At the same time, industrial sector water demand is expected to substantially increase in rapidly developing countries.

Figure 1

Global water use by sector in 2012



Source: USGS[5]

Regions at Risk

According to a 2012 study looking at global water scarcity, at least 2.7 billion people are living in water basins that experience severe water scarcity (where water consumption greatly exceeds natural availability) during at least one month of the year (see Figure 2).[6] Areas facing the greatest water scarcity lie in the US, Mexico, Africa (central and southern), Middle East, China, India, Thailand and Australia. Furthermore, of the world's 100 most populous water basins, more than half rank 'medium to high' or 'high' for water stress.[7]

Many of these water-scarce regions are facing unsustainable groundwater depletion, water pollution, increasing salinity levels and critical biodiversity loss. Deterioration, sometimes irreversible, of the delicate ecosystems (forests, wetlands, rivers, lakes) that moderate water flows and filter water further reduces water replenishment. In Mexico City, for example, over-pumping of the aquifer underneath the city has led to severe subsidence as porous ground, which used to be water-filled, collapses. In some areas, this has resulted in the land falling as much as eight meters, the equivalent of a two-and-a-half story building.[8]

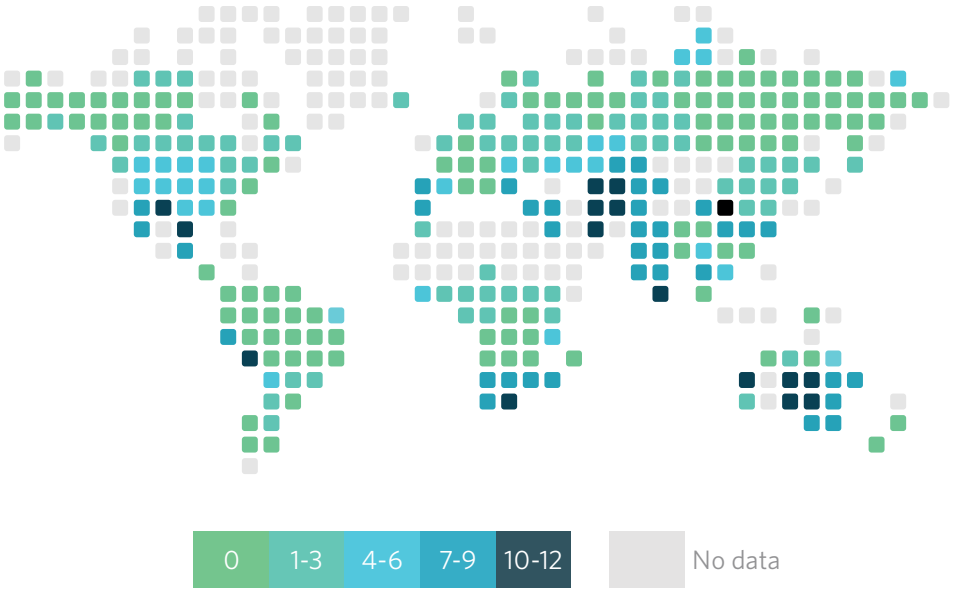
"At least 2.7 billion people are living in water basins that experience severe water scarcity."
WaterFootprint.org

Figure 2

Number of months during the year in which the blue water footprint exceeds blue water availability for the world's major river basins, based on the period of 1996–2005.

Blue water availability refers to natural flows (through rivers and groundwater) minus the presumed environmental flow requirement.

Visual interpretation of original data. Data courtesy of Hoekstra et al. (2012) Global Monthly Water Scarcity: Blue Water Footprints versus Blue Water Availability. doi:10.1371/journal.pone.0032688.g004[9]



Factors Driving Increasing Water Scarcity

In a world of already constrained water resources, demand for freshwater is only expected to intensify in the coming years due to a number of converging factors:

- **Population Growth:** As the global population increases from approximately seven billion today to an expected 9.6 billion by 2050, water stress will only be further exacerbated.[10] Already strained basins and aquifers will be pressured to deliver greater volumes of water to support the livelihoods of at least another 2.6 billion people. And as developing world diets become more animal protein-rich and consumption patterns grow to imitate those of the West, freshwater demand will only increase across all sectors including agriculture, energy production, and manufacturing.
- **Agriculture Needs:** Agricultural production must increase by 60% by 2050 to keep pace with population growth.[11] Cereals, meat and milk products, make up the largest single sources of water consumption and will be in greater demand.[12] Key crops to watch are those that have: (1) high water footprints per ton of product (2) are produced in large quantities globally, and (3) consume significant amounts of water globally. These crops include: sugarcane, corn, wheat, rice, sorghum, millet and cotton.[13]

"Agricultural production must increase by 60% by 2050 to keep pace with population growth."
CCAFS.CGIAR.org

- **Energy and Industry:** The International Energy Agency estimates that by 2035 water consumption for energy production will double, with most growth attributed to coal and biofuels.[14] Water shortages have already led to curtailment of energy production leading to power outages in the U.S., China, France, India, Sri Lanka and Brazil.[15][16] Globally, water demands from industry will also nearly double by 2030.[17]
- **Urbanization:** A larger portion of expected population growth will include people living in cities where water must be pumped from the ground or provided from outside aquifers, which will place additional pressure on already aging infrastructure (pumps and pipes) and the natural ecosystems that provide freshwater. As of 2010, more than half of the global population lived in an urban area and the World Health Organization estimates that by 2050, seven out of every ten people will live in a city.[18]
- **Climate Change:** As weather patterns, rainfall quantities and temperatures change, freshwater ecosystems will be affected and the ability to produce food and energy or use water domestically will be impacted. This year alone, the massive drought in California, the third most severe on record, has cost $1.5 billion in agriculture losses and additional groundwater pumping costs and has pushed 428,000 acres of irrigated cropland out of production.[19]

"The International Energy Agency estimates that by 2035 water consumption for energy production will double, with most growth attributed to coal and biofuels."
ThinkProgress.org

- **Globalization:** The liberalization of trade and free flow of global capital over the last 3 decades has increased GDP growth in developing countries but rapidly depleted natural resources. WWF's 2012 Living Planet Report finds that the global population is already using 50% more resources than the earth can provide and by 2030 even two planets will not be enough to support current consumption patterns.[20]
- **Greater Competition:** Competition for water will intensify due to over-exploitation and rising water demand, causing damage to ecosystems that cannot easily be reversed. An increasing number of water basins are at risk of becoming 'closed,' meaning that water use exceeds availability leaving insufficient water flows for ecosystems. More 'closed' basins results in rivers failing to reach the sea, land subsidence from groundwater overdraft, seawater intrusion into estuaries and coastal aquifers, and degraded wetlands.[21]

System Failures Contributing to Water Scarcity

Two critical and widespread system failures make water scarcity that much more challenging to solve: fractured decision-making and the chronic undervaluation of ecosystems and freshwater.

Fractured decision-making in both the private and public sectors, has continually led to poor water management. Societies, governments, academia and businesses are organized in a way that limits interaction between the groups of stakeholders making, and affected by, water decisions. Beginning at the university level, students of ecology, hydrology and the environment are usually separated from those of business, law and policy, with little crossover. At the corporate or government level, this segregation continues with siloed units dedicated to sustainability, finance, and strategy or distinct ministries/departments for agriculture, commerce, energy and the environment. This lack of communication is magnified by the fact that each group speaks about water in its own way and because local communities and ecosystems affected by water decisions are often not included in the discussion. With no common language and a shortage of opportunities to engage across these groups, it is extremely difficult to align on the system-wide solutions necessary to adequately manage water.

The universal undervaluation of ecosystems and freshwater has resulted in waste, overuse, inefficiencies and water stress. Historically there has been too little value placed upon freshwater itself and the ecosystems that provide it. When making development decisions, governments and companies tend to overestimate the economic benefits and underestimate the environmental costs. Although rising, the price of water varies vastly across the globe and in many areas experts agree that the price is too low to account for the real value. Unless greater value is placed on the ecosystems that deliver freshwater, those ecosystems will continue to be neglected and marginalized. Natural capital valuation, a method for placing an economic value on ecosystems, is starting to take hold, but not fast enough.

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Notable Signs of Momentum

As global water concerns are becoming more widespread, there are notable signals that indicate growing awareness of the challenge, an increasing acknowledgement of shared needs and tradeoffs, and an impetus to work collaboratively to find innovative solutions. The private sector is increasingly taking action to manage its own water risks, while discussion about shared water challenges is occurring across sectors. There has also been a surge in activity that supports the protection and conservation of ecosystems that supply freshwater. The public and private sectors have also shown interest in wastewater reuse, indicating a desire to devote intellectual and financial capital to finding ways to extend the value of water.

Private Sector Water Risk Analysis

"Of the 180 corporate respondents to the Carbon Disclosure Project's (CDP) 2013 Global Water Report, 70% identified water as a substantive business risk while 57% experienced a water- related business impact in the past five years."
Carbon Disclosure Project

Driven in some part by tighter rules and regulations, more companies are engaging in stronger measurement and management of water use throughout the value chain in an effort to secure and protect water supplies. Of the 180 corporate respondents to the Carbon Disclosure Project's (CDP) 2013 Global Water Report, 70% identified water as a substantive business risk while 57% experienced a water-related business impact in the past five years.[22] Beverage companies like Coca-Cola, PepsiCo, Nestlé, SABMiller, and Miller Coors are leading the charge to develop a stronger understanding and management of water risk, even pursuing "water positive" approaches like Coca-Cola's Replenish Initiative. While the risk is clear to beverage companies, other industries are catching on as well. As early as 2000, Ford Motor Co. noticed water was a key supply chain concern and began setting year over year water reduction targets. The private sector is also engaging in cross sector partnerships and using industry initiatives like the 2030 Water Resources Group and the CEO Water Mandate to drive greater discussion, research and analysis of water risk.

Food/Energy/Water Nexus Framing

Although coined 20 years ago, in the past several years the "food/energy/water nexus" has become a widely used concept, which acknowledges challenges shared across sectors and the trade-offs embedded in any choices about resource use. In 2011, the World Economic Forum (WEF) published a book called Water Security, the Water-Food-Energy-Climate Nexus in which the CEOs of Coca-Cola and PepsiCo emphasize the importance of collaboration on water scarcity and call for scaling up efforts.[23] WEF's work catalyzed the business community, providing momentum to those who had already adopted the concept, like NGOs, academics and some government leaders. Since then, the food/energy/water nexus concept has been the focus of numerous papers, articles and global events. This year, Shell has held two large-scale multi-stakeholder nexus events in the Philippines and the Netherlands[24]; the University of North Carolina, Chapel Hill, hosted a conference to provide input to the UN Sustainable Development goals process in an effort to get "nexus" thinking incorporated into the post-2015 goals[25]; and numerous regional "nexus" workshops have been held across Africa, Europe and Asia.[26] CGIAR, a leading consortium of agricultural organizations, also hosted a conference as part of a thematic shift to Water, Land and Ecosystems, demonstrating that challenges associated with water scarcity and food production must first prioritize ecosystems.[27]

Growth in Water-related Investments

Investors have shown greater interest in water-focused investments, recognizing that manufacturing, thermal power generation, and municipalities are highly dependent on water. In March 2014, Blackstone Group, the largest private equity firm in the world, launched a water infrastructure investment fund to create sustainable water facilities and support water development projects globally.[28] Meanwhile, Unilever issued a £250 million ($418 million) green bond to raise money for environmental investments related to waste and water management. Both developments are strong signals of the momentum around and engagement on water scarcity that we have not seen to date.

Growth in Green Infrastructure

Amidst aging built infrastructure and tight budgets, there is increasing interest and investment in 'green' infrastructure approaches to water management that protect, restore, or mimic the natural water cycle.[29] Cities such as Portland[30] and Medford OR in the U.S., along with international cities such as Bogota[31] and Kampala[32] are using trees, streams, wetlands, and permeable pavements to support water management. Companies are experimenting with green infrastructure alternatives as well. In the early 1990s, Dow Chemical invested in a constructed wetland at a subsidiary plastics plant in Seadrift, TX to treat wastewater; the project was implemented in half the expected time of a gray infrastructure alternative, cost approximately $1.4 million versus an expected $40 million for the alternative, and requires no electricity or operational support.[33] These are all promising signs as the OECD (Organization for Economic Cooperation and Development) expects transitioning to a "climate resilient economy" will require investment in green infrastructure of $40 trillion between 2012-30, doubling current levels.[34]

Wastewater Re-Use

As countries and regions face declining water resources, many are looking to wastewater re-use to provide an additional source of water, mainly used for irrigation. In the MENA (Middle East North Africa) region, 51% of treated wastewater is used for irrigation and Saudi Arabia plans to increase wastewater reuse to 65% by 2016.[35] In Spain, $917 million was invested over 10 years to build 97 treatment plants that now return 100 million m^3/year of previously un-usable wastewater flows for irrigation.[36] In 2012, Ford Motor Co. in South Africa invested $2.5 million to upgrade a wastewater treatment plant allowing it to double the amount of water recycled at the plant to 15%.[37] A similar plant in Chennai, India now recycles 100% of its wastewater and other plants in Chonqching, China are now recycling hundreds of thousands of gallons of wastewater each day.[38] At a Google data center in Georgia, treated municipal wastewater is recycled to fuel the data center's evaporative cooling system.[39]

Innovative Solutions

Although the water crisis is global, it is most often driven by local conditions that require local solutions. Rainfall patterns, watershed conditions and land use, which all vary by geographic location, are just some of the factors driving water availability. With these diverse conditions come a variety of innovative solutions.

Several organizations have published useful databases of water management solutions including the Water Resources Group,[40] Coca-Cola's Replenish Watershed Protection Projects,[41] CEO Water Mandate's Water Action Hub,[42] and IUCN's water dialogues.[43] The solutions featured in these databases can come from an array of sources. Many thoughtful, bottom-up approaches originate from organizations like IUCN, IWMI, and CGIAR. An influx of NGOs (such as The Nature Conservancy, WWF, and WRI) which wield a strong understanding of ecosystems are also driving new solutions involving partnerships across sectors. The private sector is contributing solutions as well, providing the ability and capacity to experiment, test and then scale new ideas across supply chains and geographies. Lastly, numerous economists, academics and environmentalists are shaping new and exciting thinking on ecosystem valuation.

Many of the most common water management solutions have focused either on reducing water use through greater efficiency and conservation or finding new ways to secure additional sources of water such as desalination or wastewater recycling. Although there have been great advances in both areas, some of the more innovative approaches go a step further, aiming to drive or inform conservation and water security measures at the basin level or at a larger scale. Out of the many solutions available today, there are several innovative areas that have even greater promise if applied more readily:

1.0 Watershed Payments

Watershed payments are market-based mechanisms where downstream stakeholders incentivize upstream actors to manage water resources in a way that sustains clean and reliable water supplies. Upstream stakeholders (like farmers and other landowners) receive funds, supplies and sometimes training from downstream stakeholders (farmers, cities, companies) so that they can invest in sustainable land management practices. These practices often support groundwater replenishment and water pollution filtration, thus ensuring cleaner and more abundant water flows for the downstream stakeholders. The value of watershed payment transactions in 2011 was $8.17 billion across 29 countries (over $7 billion spent in China alone) and watershed investment programs have nearly doubled from 2009-2014.[44]
Some specific examples include:

1.1 China's Eco-Compensation Model

Across China there has been a surge in watershed payment programs that incentivize watershed management across jurisdictional boundaries by paying landowners and cities for better management of upstream watersheds critical to drinking water. For example, in the Min River Water Resource Eco-compensation Program, the city of Fuzou, which lies downstream, pays about $800 million each to upstream cities Sanming and Nanping for pollution control, source water protection and township waste disposal. In this unique collaboration, the two upstream cities also provide matching funds.

1.2 The Nature Conservancy (TNC) Water Funds

First launched in 2000 with the Quito Water Fund in Ecuador, TNC now has 32 water fund projects spread across most of Latin America with expansion efforts directed at Africa and Asia.[45] These funds involve partnerships between watershed stakeholders (including governments, private businesses, environmental authorities, and communities) to combine funding to invest in water management projects (i.e. watershed protection, environmental education, reforestation, and to incentivize environmentally-friendly farming/cattle ranching practices). These funds currently secure drinking water for nearly 50 million people.

2.0 Natural Capital Management

Data-based land and water management modeling tools are driving better decision-making, ecosystem valuation, and identification of priority areas for both the public and private sector. In order to truly manage long-term water flows at the basin level, companies need to start investing in green infrastructure, such as the forests, wetlands, rivers, and streams, that provide those flows. By analyzing the economic and environmental tradeoffs of potential land and watershed management scenarios, these models can help engage and inform stakeholders on the best course of action to take. More widespread utilization of tools like those mentioned below can help inform the private sector on how to prioritize natural capital investments:

2.1 RIOS (Resource Investment Optimization System)

Developed by the Natural Capital Project, this free and open-source software combines biophysical, social and economic data to help stakeholders identify the locations for restoration or protection that maximize returns.[46] The use of RIOS to inform natural capital investments for TNC water funds in Colombia has improved return on investment (ROI) by up to 600% over previous approaches to watershed investment.[47]

2.2 InVest (Integrated Valuation of Environmental Services and Tradeoffs)

Another Natural Capital Project Tool, InVest allows users to assess tradeoffs associated with alternative management choices for terrestrial, freshwater and marine ecosystems.[48] Companies like bottling plants and water utilities can use InVest, or similar evaluation tools, to understand land and water use planning impacts. Lafarge North America, a subsidiary of one of the largest construction materials companies in the world, used InVest to map and value two ecosystem services: erosion control and water purification, in one of its active quarry sites. The study found that using and maintaining existing natural ecosystems avoided the need for investing an estimated $2 million/year for erosion control and up to $51,000/year for nitrogen and phosphorous nutrient removal. [50]

2.3 WRI Aqueduct[51]

Launched in January 2013, the World Resources Institute's Water Risk Atlas mapping tool helps users analyze water risk in terms of quantity, quality and regulatory/reputational risk. While not detailed enough to provide basin-level guidance, the basic tool provides a useful first step towards identifying potential natural capital investment areas. The Aqueduct tool has been used in a variety of applications from analyzing water risks in the global coal industry[52] to developing a global water stress assessment for Owens Corning as part of a corporate water strategy evaluation.[53]

3.0 Development of Water Markets

New water trading marketplaces like water benefit certificates are developing to support the most economically viable water solutions and the best-positioned actors. Meanwhile,more established concepts like tradable water rights and water quality trading are gaining momentum. While these approaches are still relatively nascent or applied in only a few geographies, they could spark new thinking for companies about how to conserve, protect and value water in the communities in which they operate.

3.1 Water benefit certificates (WBCs) Trading[5]

Water benefit certificates are a new and experimental market mechanism to finance water improvement projects, usually focusing on efficiency or purification. The idea is similar in concept to carbon emissions trading. Credits are created through projects certified to deliver a certain number of units of clean freshwater or to provide some water benefit. A buyer interested in offsetting water use, supporting water management projects or meeting regulatory requirements can then purchase these credits. Water Benefit Partners, a public-private partnership between First Climate Markets AG and Gold Standard and funded by the Swiss Development Cooperation, will launch the Water Benefit Standard and issue its first water benefit certificates at World Water Week in Stockholm in 2014. Companies including Bayer, Nestlé, Carlsberg and Munich Re have supported the development of the certificates since 2011. Credit projects currently being piloted include drip-irrigation, sugarcane agriculture efficiency, and water sanitation and hygiene (WASH)-oriented projects in India.[55]

3.2 Water Rights Trading

Water trading is the process of buying and selling either water rights (permanent water access entitlements) or water allocation entitlements (which are seasonal and temporary). In both instances, water is usually transferred from one agricultural user to another, or from the agricultural sector to other higher valued sectors including industry and municipal use. Establishing water rights can serve as an incentive for all sectors to invest in productive water uses and water saving technologies, as water outside of the rights allocated have to be obtained at a cost.[56] In Australia's Murray Darling Basin, where irrigated agriculture is a significant industry, water trading schemes enable users to redistribute water. The basin is thought to be the most mature water market in the world. [57]

It is important to note that water rights trading has received criticism for adversely affecting indigenous groups dependent on traded water sources.[58] In addition, a successful water trading plan requires a whole basin assessment and a strong central governing body, which are not necessarily common traits in all geographies where businesses operate.

3.3 Water Quality Trading

Water quality trading is a somewhat niche yet promising area within water markets. In areas where legislation establishes water quality requirements (nitrogen or phosphorus nutrient caps or temperature and sediment limits) water users or polluters can purchase water quality credits from certified projects to make up for deficits in meeting water quality standards. Examples of certified projects include: tree planting to deliver water temperature benefits and agriculture management to limit nutrient loading. There are over 50 water quality trading programs in the US, but limited examples elsewhere.[59] Earlier this year, Duke Energy, Hoosier Energy and American Electric Power became the first buyers in an interstate water quality trading program in the Ohio River basin.[60]

4.0 Environmental Impact and Green Bonds

One of the most interesting innovations lies in the potential to access the capital markets through environmental impact bonds (EIB) and green bonds to drive funding towards scaling proven water solutions.

4.1 Environmental Impact Bonds

While EIB's are still only a concept, the potential for leveraging the idea of a social impact bond towards environmental needs is promising. A social impact bond or pay for performance bond is a transaction where investors pay an intermediary to deliver some kind of improved social outcome (reduced rates of recidivism, more students going to college) that result in public sector savings (fewer people in jail, fewer young people on welfare). The first social impact bond was issued in 2010, and several more have been structured and launched across the US and in the UK since then. In an EIB, investors would invest funds in proven environmental impact projects that deliver a reduced or avoided cost to a specific entity, in many cases, a government body. The realized savings would then support the repayment of the bond. Currently there is discussion around developing an EIB supporting Philadelphia's Storm Water Management Plan and active interest from environmental NGOs on how to utilize them more.

4.2 Green Bonds

Although the majority of funds currently raised from green bonds are directed towards energy efficiency and solar projects, some are focused more squarely on enabling water efficiency and reducing water use. Unilever's £250 million ($418 million) green bond released in March 2014 will fund water reduction projects along with GHG emission and waste reduction projects at select facilities. Svenska Cellulosa, a Swedish materials company, issued a $232 million bond with facility waste & water reduction as one of many proceed uses, while the World Bank and the African Development Bank released bonds with proceeds just under $1 billion directed towards irrigation water-use reduction projects or water efficiency.

Conclusion

Water scarcity will continue to be a serious concern in the coming years as rapidly changing global conditions place additional pressure on already weakened ecosystems and water infrastructure. Companies and governments are waking up though, with increasing momentum around innovative and collaborative solutions to confront the water scarcity challenge. Improvements in water risk analysis, with the help of natural capital management and valuation tools, indicate that countries and companies alike have realized the imperative to make smarter water allocation decisions. Creative solutions like watershed payments and environmental impact and green bonds will help to support stronger ecosystem functioning and water flows, while innovations like water benefit certificate trading, if successful, could help finance water improvement projects throughout the globe.

Although many of the solutions outlined above are still in the early days of experimentation, several hold a great deal of promise, but will require both financial and strategic support to take hold. The private sector is in a unique position to leverage its financial capacity and unique ability to test and scale new solutions. By more accurately evaluating the economic costs and benefits of water use and taking a systems-level approach to water management, countries and companies have the ability to successfully navigate the water scarcity challenge.

The private sector is in a unique position to leverage its financial capacity and ability to test and scale new solutions.

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About SustainAbility

SustainAbility is a think tank and strategic advisory firm that for over 25 years has catalyzed and supported business leadership on sustainability. Through our agenda-setting research and advocacy, we chart new territory and help business leaders and their stakeholders understand what's next. Through our advisory services, we help clients anticipate key trends, develop effective strategies and initiatives, and unlock new possibilities via authentic stakeholder engagement and collaboration.

For more information, visit www.sustainability.com.

Appendix

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