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The Case for Green Infrastructure in LAC

Conclusions from Stockholm World Water Week 2018

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Water and Sanitation Division

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SIWI WORLD WATER WEEK | EYE ON LAC

IDB Inter-American Development Bank

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SUMMARY

EXECUTIVE SUMMARY

Sustainable Development Goal 6 (SDG6) establishes ambitious targets that aim to achieve universal access to safe and affordable drinking water, sanitation and hygiene (WASH) services. All countries in the regions of Latin America and the Caribbean (LAC) have committed to achieving SDG6 by 2030, an endeavor which will require innovative approaches to long-standing water challenges. A shift to green infrastructure in combination with gray will be necessary moving forward as conventional approaches to WASH service delivery will not be adequate to meet the challenges of SDG6.

As part of Stockholm World Water Week 2018 (SWWW), the IDB organized, in coordination with several partners, a set of four sessions ("Eye on LAC") in which the necessity, challenges, and opportunities for implementing natural infrastructure in LAC were discussed with respect to meeting SDG6 targets.

Arising from the World Water Week 2018 theme of "Water, Ecosystems and Human Development," Eye on LAC focused primarily on ecological and economic arguments for implementing green infrastructure in LAC. Green infrastructure was discussed in the context of: 1) the water-energy-food nexus; 2) the business case and financing options for green infrastructure projects; 3) barriers and challenges to mainstreaming green infrastructure in the water sector; and 4) how water reserves can be used as an ecological water management model.

This paper summarizes the discussions, findings, and conclusions reached during those SWWW sessions, and provides recommendations on strategies that will help LAC advance green infrastructure in pursuit of meeting SDG6 targets by 2030.

The overarching recommendations for expanding green infrastructure are as follows.

- Understanding the inherent connection between water challenges and the food and energy sectors.
- Developing strong business cases for green infrastructure, which can open the door to investment and unique financing opportunities.
- Educating regarding the multiple purposes and co-benefits of green infrastructure.
- Incorporating green-blue thinking into all aspects of city planning, water strategies, and ecosystem management.
- Exploring nonconventional solutions (i.e. water reserves, as mechanisms for addressing water challenges).

INTRODUCTION

Having previously agreed to meet the United Nation's Sustainable Development Goal #6 by 2030, all countries in Latin America and the Caribbean are now tasked with "ensur(ing) availability and sustainable management of water and sanitation for all" in the coming years. The ambitious SDG6 includes targets that aim to reduce pollution, increase water-use efficiency, implement integrated water resources management, protect and restore water-related ecosystems, and achieve universal and equitable access to drinking water and sanitation[1]. Meeting these targets presents a significant challenge to LAC country governments, and a water revolution has thus been triggered to spur progress toward SDG6. It has become clear that business-as-usual models will not be able to meet the rising challenges. Rather, synergistic approaches, innovative models, active investment, and a green mindset must be embraced throughout government, civil, and private sectors.

Each year, key leaders, practitioners and other representatives from the global water, sanitation and hygiene (WASH) sector convene in Stockholm, Sweden, for World Water Week (SWWW). The overall theme of SWWW 2018 was "Water, Ecosystems and Human Development." The Inter-American Development Bank (IDB) was responsible, together with several partners, for organizing a set of four sessions, in which the challenges of implementing natural infrastructure in the region of Latin America and the Caribbean (LAC) were discussed. These sessions were referred to as "Eye on LAC"[2].

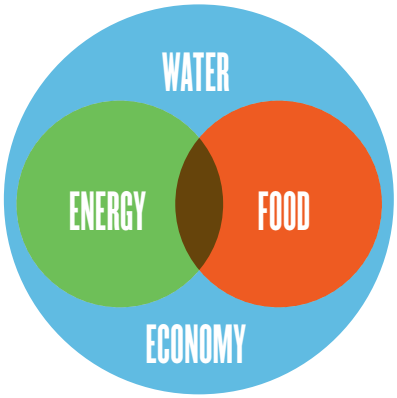
The purpose of this paper is therefore to summarize and synthesize findings, conclusions, and recommendations based on the presentations and discussions held during the aforementioned WWW "Eye on LAC" sessions, with the primary objective being to outline key insights and examples the LAC region can learn from and build on, to move forward. A particular focus will be placed on how investment in green infrastructure will be essential for meeting SDG6 targets. The first section of the report outlines why investment should be made in green infrastructure, describing challenges in the water, energy, and food sectors and how green infrastructure can be used to address challenges at various points within the water-energy-food nexus. Chapter One provides an answer as to why addressing such challenges is necessary to achieve SDG6. Chapter Two makes the business case for investing in green infrastructure, analyzing case studies of successful investments and exploring unique financing sources for green infrastructure development projects. Chapter Three provides insight into the importance of conventionalizing green and hybrid infrastructure, and outlines an avenue for incorporating green infrastructure into mainstream development projects. The final chapter outlines a water reserve model as an innovative approach to addressing water challenges, followed by a concluding section summarizing primary findings and recommendations so that significant progress can be made in the short 12 years remaining to meet SDG6 across the LAC region.

The primary audience for this report is intended to be development practitioners, public and government sector representatives, and/or other stakeholders interested specifically in sanitation sector challenges and opportunities around the achievement of SDG6 in the LAC region, as well as those interested in specific discussions and conclusions reached during LAC-related sessions at SWWW 2018. To analyze findings and establish the conclusions presented in this report, the author used notes and materials from all relevant sessions during SWWW 2018, including a review of any appropriate relevant literature. It is beyond the scope of this paper to suggest specific country-level recommendations for achieving SDG6; the primary objective of this report is to discuss overarching and preliminary recommendations for expanding and sustaining WASH coverage in LAC.

CHAPTER ONE
Natural Infrastructure and the Water-Energy-Food Nexus

The water-energy-food nexus refers to three sectors (water, energy, and food) that are inextricably linked, given that the actions of one are likely to have an impact on one or both of the others. As LAC societies face the increasingly prevalent challenges of environmental degradation, loss of biodiversity, water scarcity, urbanization, and rapidly growing populations, pressure on the water-energy-food nexus is sure to also increase. In addition, quality, reliable water, food, and energy resources are tightly interwoven with human health and well-being and are directly linked to the economy. The various SDG6 targets cannot be met unless issues in all areas of the water-energy-food nexus are addressed. Green infrastructure is one solution that stabilizes the water-energy-food nexus and brings LAC closer to achieving SDG6.

FIGURE 1: THE WATER-ENERGY-FOOD NEXUS



By addressing issues within the individual sectors of the water-energy-food nexus, green infrastructure thereby helps to improve the entire system. For example, developing water retention by means of green infrastructure reduces energy demand by saving future costs for obtaining water and can increase the water available for agriculture, ensuring greater food security. Similarly, green infrastructure that filters wastewater or storm water runoff can save energy during the water treatment process and reduce the amount of pollutants entering lakes, rivers, and oceans, thereby reducing negative influences on fisheries. In the case of "Super Storm" Sandy in the United States, wetlands prevented $625 million in damages, leading to the prevention of tremendous energy expenditures in repairs. As a result, LAC developers should look to nature for solutions, thinking about how they can use ecosystem structure and function to maximize deliverance of services to human society.

Green infrastructures are unlike other conventional, engineered solutions. They have no finite life expectancy, are low cost, and can provide highly effective treatments. Likewise, they can be used for multiple purposes (i.e., a city park can provide storm water catchment, reducing pollution, and at the same time offer improved aesthetics and recreation opportunities, leading to improvements in human health.), can be owned (in some cases) by local communities, and yield products to support local economies.

In addition, the benefits of natural infrastructure increase with time, can be self-maintaining with the potential for self-repair, can (in some coastal examples) grow and keep pace with sea level rise, and pro-

vide 24/7 services. Green and gray infrastructure, however, should not be seen as independent, and focus on the development of one should not outpace the other. Rather, a hybrid approach combining the strengths of green and gray infrastructure should be the focus of development in LAC to move forward. Such an approach is particularly useful when space is limited, as is often the case on island nations.

LAC island nations face numerous water challenges, with the loss of coral reefs being one of them. The Mesoamerican reef is the second largest barrier reef in the world, yet much of it is degraded due to climate change, mega storms, and human influences such as over-fishing and pollution. Coral restoration, as it is conducted by Fragments of Hope in Belize, is a nature-based solution that addresses several aspects of the water-energy-food nexus. Coral reefs act as a buffer to storm surges and provide a habitat for marine life. Therefore, with the return of coral reefs there is flood protection and related reductions in energy required for repairs, increased food security due to healthy, stable fisheries, and stimulation of local economy due to tourism and fishing industries.

Fragments of Hope has demonstrated feasibility, longevity, sustainability (reproduction), scalability, and replicability within their restoration practices. With low-cost, low-tech methods and an effective training program, Fragments of Hope's coral restoration methods are already spreading across the Caribbean and provide a prime example of how green infrastructure in the water sector can not only address water-related challenges, but also provide solutions within the food and energy sectors. Through the oceans, everything is connected, thus, marine-based green infrastructure is one way in which SDG6 can be met and water-energy-food nexus challenges addressed in LAC.

A second example is found in Madrid, Spain, where Canal de Isabel II directs drainage water away from the city. Water in Madrid, however, is not managed in a linear fashion. Rather, its use is circular and wastewater is treated as a resource that is processed and used in a variety of ways. In some of the regions' wastewater treatment plants, biogas is now generated from the city's waste, significantly reducing the carbon footprint of the treatment process. In addition, 95 percent of sludge is processed to extract phosphorous compounds which can then be used as fertilizers in agriculture.[3]

In Madrid, water infrastructure focuses on water regeneration, energy self-sufficiency, sustainable systems, and sludge management, using traditional technologies in green ways. By using wastewater as a resource, water infrastructure in Madrid generates energy, supports food production, and ensures a reliable, quality water supply and treatment system, thereby stabilizing all three aspects of the water-energy-food nexus trilogy. Similar systems could be used in LAC to address local water, food, and energy challenges and meet SDG6.

Developing green infrastructure in LAC means several challenges must be overcome, namely convincing engineers, governments, investment groups, and communities of the added value of nature-based water infrastructure. However, lessons from similar projects, extensive communication, community engagement and ownership, and education on the multiple purposes and benefits of green infrastructure will help to propel green infrastructure forward. Meeting SDG6 and addressing the water-energy-food nexus are inherently connected and, moving forward, developing green infrastructure will be a foundational element to addressing the challenges of both.

CHAPTER TWO
Green-Gray Infrastructure: The Case for Investment

Implementing green infrastructure will be necessary for addressing water-energy-food nexus challenges as well as for meeting SDG6 targets. It is estimated that investments of more than $14 billion USD annually are needed to attain SDG6 by 2030. Advancing green infrastructure development, however, will require strong business cases to express the economic benefits of investing and financing such infrastructure. To secure necessary funds, returns on investment (ROI) for green infrastructure projects must be sufficient to attract the interest of investors. In this chapter, case studies provide examples of successful green infrastructure projects with positive ROIs as well as potential financing mechanisms for green-gray infrastructure.

Looking first at the example of the Cantareira reservoir system, which provides water to 9 million people in São Paulo, Brazil, green infrastructure was developed in response to a 2015 water crisis. A reforestation project was implemented in an attempt to reduce runoff and sedimentation into reservoirs and to provide a natural water retention and release mechanism for rainy and dry periods. The World Resources Institute (WRI) has since used a Green-Gray Assesment tool to evaluate the ROI of natural infrastructure in São Paulo's water system during its first two years of implementation. The assesment was conducted using the following outline.

- Defining investment objectives
- Specifying investment portfolios
- Outlining model outcomes
- Determining ROI
- Comparing costs and benefits
- Analyzing risk and uncertainty

In this example, the WRI compared a business-as-usual case with a project in which 4,000 ha of forest is in the process of being replanted. Findings have shown considerable cost-benefits associated with this natural infrastructure project. Whereas initial investment in reforestation cost US$37M, sedimentation management cost-prevention was more than US$106M and erosion has already been reduced by 36 percent. The study found that costs were reduced in relation to workforce, energy, chemical product usage, sludge removal, anthracite and sand replacement, and machinery. The WRI also emphasized the importance of efficiency in implementation, finding that doubling the rate of implementation could double net present value.

The WRI study of this São Paulo green infrastructure project has outlined the next steps as: strengthening the business case for green infrastructure investment, involving landowners so they enroll in natural infrastructure programs, developing a blended finance model, and developing a broader watershed plan. Moving forward, the São Paulo example, and others, should be used as a platform to stimulate discussion on green infrastructure and support the case for investment in green-gray systems.

A second argument for investment in green infrastructure can be made by looking at the benefits of investments made by the Fund for the Protection of Water (FONAG) in Quito, Ecuador. The water

resources of Quito, the capital of Ecuador, originate in the eastern Andean mountain range. Although much of this headwater region lies in natural reserves, inadequate agricultural, livestock, and forestry practices on unprotected lands threaten the water security of the Quito metropolitan district's 3 million inhabitants.

A FONAG development was therefore enabled to ensure proper funding for management and conservation practices in the water basins that supply Quito's water. FONAG has since carried out programs that aim at building a water culture and achieving integrated water management with the goal of conserving, restoring, and/or effectively managing the remaining unprotected land in Quito's headwater region during the next 62 years. Thus far, FONAG has implemented a variety of interventions and projects including the following.

- Establishing conservation agreements with private and community owned landowners, to preserve sensitive water source areas and promote sustainable productivity.
- Restoring degraded, overgrazed lands in the Andean headwater region. Restoration strategeis are both passive, i.e. effective elimination of threats, and active, i.e. planting native paramo vegetation and wetland restoration.
- Generating relevant information for optimal decision-making by FONAG itself and other stakeholders regarding water catchments. Operating a hydrometeorological network that fills historical gaps, collaborates with the water authority on water uses and authorizations, and generates socioeconomic information regarding intervention areas.
- Running a cutting-edge, environmental education program in rural schools and communities, in coordination with the education authorities.
- Creating an enabling environment for research partners to study relevant processes regarding FONAG interventions.
- Monitoring the impact of its interventions, including water quantity and quality, and quantifying the return on investments made by stake-holders.

As in any development project, without adequate monitoring and analysis, conclusions cannot be made as to the actual effect of a given action or intervention. FONAG therefore carried out impact monitoring to evaluate the benefits of their interventions in terms of water quality and quantity, to understand the key processes related to the performance of water related ecosystem services, and to establish the ROI for their various projects.

Just as in the São Paulo case study, two different scenarios were explored when assessing the success of FONAG's green infrastructure projects: a business-as-usual scenario and a scenario with sustainable ecosystem management (SEM) using green infrastructure intervention. It was found that, by means of FONAG's interventions in the SEM scenario, further degradation of lands in Quito's headwater supply region was prevented and sustainable catchment management was implemented. In addition, not only did FONAG interventions have an ecological benefit and successfully show that water quantity and quality would improve over the next 20 years, but they were also found to have a positive ROI. These findings show once again the benefits of investing in green infrastrucutre.

FINANCING MECHANISMS FOR GREEN-GRAY INFRASTRUCTURE

Despite a growing business case for investment in green infrastructure, challenges still lie in acquiring financing for development projects. New and innovative financing methods have emerged in recent years that can be used to provide critical funds for meeting SDG6 targets. Financing methods include water trading, a market-based solution using the purchase and sale of credits to address pollution and water conservation issues, and climate bonds, which development projects may be eligible for upon meeting certain criteria.

WATER TRADING

Water trading is a market-based solution that can be used to either improve water quality or address water scarcity in a manner that both maximizes economic efficiency and maintains environmental integrity. In water trading, regulation sets a water quality or quantity standard. Polluters and large consumers that are less capable of meeting regulatory requirements may then purchase credits from other sources equating to a load reduction or water conservation unit elsewhere. By using a system of credits, an economic incentive is provided to encourage best management practices and voluntary conservation efforts. Likewise, water trading provides an alternative option for meeting conservation goals to entities that find achieving environmental standards less financially or technologically feasible.

Water quality trading can especially benefit point source pollution sources such as wastewater treatment plants where upgrading machinery and technology or retrofitting stormwater systems is generally very costly. Conversely, nonpoint source reduction practices such as nutrient management or building buffers along stream banks and at the edge of farm fields are considerably cheaper. The difference in costs between point and nonpoint source pollution reduction creates an avenue for water trading where sources with higher pollution control or water conservation costs can purchase reduction credits from sources with lower costs. Likewise, water trading generates a niche for economic growth by allowing those with lower conservation costs to earn new revenue through the sale of credits.[4]

A 2012 study further explored the economic savings water quality trading programs could achieve by shifting towards green infrastructure, estimating millions in potential savings for point source polluters given the option to purchase load reduction credits from agricultural nonpoint sources (CBC, 2012). In addition, co-benefits such as carbon storage, air quality, and recreation opportunities gained from implementing green infrastructure add a potential for both added cost savings and stimulated revenue. When possible, co-benefits should be compensated for and uncertainty regarding green infrastructure performance should be acknowledged but not over-penalized. It should also be noted that additional savings can be made via the use of third-party aggregators and brokers who can effectively lower transaction costs and that self-sustaining practices with internal benefits can reduce verification costs.

Water trading is a viable mechanism for incentivizing and financing green infrastructure projects. Using market forces, water trading encourages voluntary conservation efforts leading to reductions in pollution and water usage, primarily by means of the implementation of green infrastructure in agricultural regions, where conservation projects are often less costly to undertake. The development of water trading programs in LAC could help LAC countries make significant gains toward achieving SDG6 targets. Other financing methods such as acquiring climate bonds would also be beneficial in attaining the funding needed for green infrastructure development projects.

CLIMATE BONDS

Climate bonds, also known as green bonds, are specifically aimed at raising capital for green infrastructure and can also be used as a resource for financing development projects with the goal of attaining SDG6 in LAC by 2030. Governments, multi-national banks, or corporations can issue climate bonds which, like normal bonds, are then repaid over a certain period of time. Climate bonds can be used to finance projects across a variety of sectors, each requiring a given set of criteria be met for an issuance to be made. Water infrastructures that can be covered under climate bonds were identified in two phases.

- Phase 1: Engineered water infrastructure: Infrastructure for water collection, storage, treatment, distribution, or infrastructure for flood protection and drought resilience.
- Phase 2: Nature-based and hybrid water infrastructure: Green and hybrid water infrastructure for water collection, storage, treatment, distribution, or infrastructure for flood protection and drought resilience.

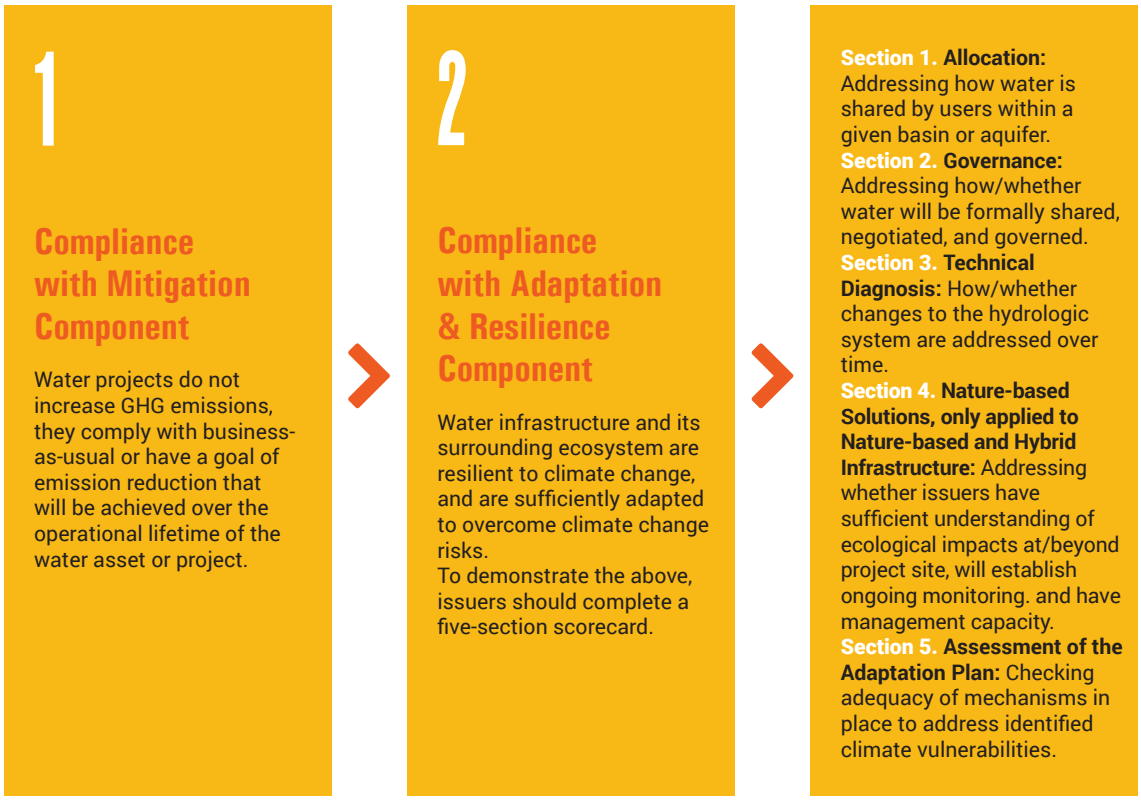
Green and gray-green infrastructure projects falling under the Phase 2 eligibility for climate bonds are further identified as follows.

- Water storage: active snowpack management, park usage, natural areas for storm water management, creating groundwater recharge areas
- Flood defense: restoration of wetlands for flood water storage, creation of delta flood zones to naturally allow for river expansion, altering flow mechanisms to reduce the force of flood stage flows
- Drought defense: use of pumps to transfer water to and from natural aquifers, planting trees and other forms of revegetation
- Water treatment: construction of nature-based wetlands using native plants for water filtration, nutrient management
- Storm water management: creation of wetland retention ponds
- Ecological restoration/management: development of environmental flow regime, sediment transport to reduce and restore downstream deposits

Although climate bonds can provide funding for a variety of types of green infrastructure, to be financed and listed as a climate bond, nature-based development projects must first meet two basic ground rules:

- Must reflect the intentional use of natural and/or nature-based features, processes, and functions as an integral part of addressing a human need and do so in a manner that protects, manages, restores, and/or enhances natural features, processes, and systems in a functioning and sustainable manner.
- Where feasible, the project must prioritize natural features over nature-based features. Such features must include the protection, restoration, expansion, and/or creation of natural systems and processes as an explicit component of the desired project outcomes.

Therefore, to attain a climate bond, water development projects must meet the following criteria[5]:



So long as issuers can supply evidence that their development project with comply with the climate bond initiative's mitigation, adaptation, and resilience components, green and gray-green infrastructure can achieve funding through the issuance of climate bonds. Both China and the European Union (EU) have accepted these criteria and issuance is expected to increase in the coming years.

Addressing climate change is beginning to be recognized not only as an environmental benefit, but a means to lower financial risk. Although climate bonds are a relatively new financing technique for water infrastructure, their market is growing rapidly and gaining popularity in both development and commercial banks. By increasing the finances available for green infrastructure, climate bonds will catalyze the development of green and gray-green infrastructure in the water sector, thereby helping LAC progress toward SDG6.

Achieving SDG6 in LAC by 2030 will require substantial investment in green and gray-green infrastructure. Examples from São Paulo, Brazil and Quito, Ecuador show how investment in green infrastructure can not only provide environmental and social benefits, but also achieve positive ROIs along with both direct and indirect economic benefits. Attaining the necessary funding for development projects, however, remains a challenge. Nevertheless, innovative financing methods such as water trading and the issuance of climate bonds can help to fill the funding gap. As LAC continues to push towards the SDG6 targets and the business case for green infrastructure strengthens, it will become ever clearer that good ecology is good business.

CHAPTER THREE
Mainstreaming Natural Infrastructure in Water Projects

In Latin America and the Caribbean, cities are growing rapidly. As urban development continues and populations expand, the demand for food, water, and energy will also increase. Despite most of LAC being water-rich, much of the region (35 percent) is water-stressed. In addition, 40 percent of the land surrounding water basins in LAC is degraded by deforestation, poor agricultural practices, and new developments. High levels of degradation result in increased treatment costs, reduced aquifer recharge rates, and increased exposure to water-related events such as drought and flooding. Moving forward, it is clear that grey infrastructure can no longer be the only solution to meeting these water challenges. Meeting SDG6 will require working with nature and mainstreaming nature-based water infrastructure.

Mainstreaming green infrastructure must first begin by incorporating green-blue thinking into all aspects of development projects. Solutions to water challenges must be constructed using an environmental mindset. Likewise, development projects should have biomimicry and environmental services as founding principles. Taking green-blue approaches to water infrastructure projects includes the following.

- Working with nature across the water cycle
- Creating, expanding, and adapting green and blue spaces
- Capturing, storing, treating, and releasing water - providing continuity across the water cycle
- Including vegetation in project design

Examples of green infrastructure range from planting bushes, trees, and forests to building meadows and wetlands in rural areas. Likewise, green approaches to urban infrastructure include developing hedgerows, footpaths, fields, planters, bioswales, tree pits, and green roofs. Similarly, blue infrastructure such as ponds, lakes, streams, and ditches can be used in both rural and urban settings to address water challenges. Green-blue thinking and the mainstreaming of green infrastructure can provide natural solutions to storm-water runoff and pollution, water retention and infiltration, erosion, and more. Although green-blue thinking should be emphasized in future development projects, it should not be assumed that natural infrastructure can be the sole solution to meeting water needs in LAC.

Green infrastructure can help to address many of LAC's water challenges in meeting SDG6, but gray infrastructure still has an important role to play. Managing water supply to meet increasing demand and complying with SDG6 targets will require a hybrid green and gray strategy. Mainstreaming green infrastructure alongside gray systems will help complement the strengths and limitations of both development types (Figure 2).

FIGURE 2: COMPLEMENTARY ASPECTS OF GREEN AND GRAY INFRASTRUCTURE.

ASPECTS	GREEN	GRAY
SCALE	River basin	Demand dependent
FUNCTION	Multifunctional w/ co-benefits	Monofunctional
BOUNDARY	Open system	Clear, developed
CONSTRUCTION	Longer, nature dependent	Short
PERFORMANCE	Adaptive, cyclical, resilient	Eroding

Together, green and gray infrastructure can work across a variety of scales, using their combined range of functions to meet the water needs of LAC. In addition, hybrid infrastructures require less investment, build and retain services over time, and accrue natural capital. Mainstreaming hybrid green-gray infrastructure, however, will require interventions at all levels of city, ecosystem, and water infrastructure planning.

As governments, NGOs, development organizations, and others work to meet SDG6 in LAC, the following, general guidelines will likely be followed for strategy development. At each stage of the development planning process, blue-green thinking should be used to explore how the use of green and hybrid infrastructures can meet development needs.

- **Inception**- Focus on objectives and criteria: Utilizing green or hybrid infrastructures, ecosystem services, and meeting SDG6 targets should be listed by developers as primary objectives of any new water infrastructure projects.
- **Situation analysis**-Describing the problem being addressed and identifying reference cases: Ecological degradation should be seen as a primary component of water quality, quantity, and distribution issues. By identifying degradation as a fundamental source of water challenges, the development of green infrastructure and pursuit of nature-based solutions should become a logical solution to such problems.
- **Strategy building**-Identifying alternative and preferred strategies for project implementation: Green and hybrid infrastructure should be considered and identified as preferred strategies when planning water infrastructure projects.
- **Action planning**-Investment planning, feasibility, promotion, design, and EIA: Incorporating green infrastructure into project design can open the door to alternative funding opportunities, make meeting project objectives more feasible, and increase project compatibility with environmental standards.
- **Implementation**-Implementing development project and conduct monitoring and evaluation: A green-blue mindset should be maintained throughout project implementation. Likewise, monitoring and evaluation should explore environmental impacts of project development and the effectiveness of nature-based infrastructure in meeting project objectives.

Incorporating green thinking into watershed management and urban planning can help to mainstream green infrastructure when a green-blue mindset is integrated into every phase of project development. In addition, mainstreaming green infrastructure will require collaboration across sectors. Engineers, financers, and developers will need to work together to close the gap between the need for

development, viable technology, and funding availability. Likewise, multilateral development banks, climate funds, NGOs, and the green infrastructure community are being mobilized to make natural infrastructure more feasible.

FIGURE 3: ROLE OF MDBS, CLIMATE FUNDS, NGOS, AND THE GI COMMUNITY IN MAINSTREAMING GREEN INFRASTRUCTURE.

MDBS AND CLIMATE FUNDS	NGOS AND THE GI COMMUNITY
Financial instruments to cover technology risks	Provide performance evidence including monitoring and modeling
Promote cross-sector infrastructure delivery	Offer risk management
Provide evidence for the "paradigm shifting" potential for GI	Outline industry guidelines
Provide blended finance opportunities	Develop a market for green and hybrid infrastructure service providers

Mainstreaming green infrastructure would not only help LAC towards meeting SDG6, but would reap vast environmental, social, and economic benefits. Studies have shown that urban green can reduce storm water runoff by up to 8%, reduce the urban heat bubble effect, and make urban residents 3.3 times more likely to exercise. Other benefits of green infrastructure include the following.

- **Environmental:** improves aesthetics, enhances microclimate, improves air, water, and soil quality, reduces flood risk, improves water storage and reuse, increases biodiversity and reduces ambient noise
- **Social:** encourages physical activity, improves mental health, improves childhood productivity, faster hospital recovery rates, lowers stress, improves workplace productivity, increases social cohesion, reduces crime
- **Economic:** increases resilience, increases land value, stimulates property sales, encourages inward investment, reduces building energy costs, increases tourist attraction, lowers healthcare costs

Mainstreaming green infrastructure can help LAC to meet SDG6 by 2030 as well as provide additional environmental, social, and economic co-benefits. Incorporating green thinking into city planning, watershed management, and water infrastructure development will be necessary to promote the development of green infrastructure in LAC. Although there is much to learn from the monitoring and evaluation of pilot studies, it is important to remember that solutions to water challenges are context-specific and green infrastructure should be uniquely designed to address issues on a case-by-case basis. With the collaboration of eco-engineers, development banks, NGOs, and others, green and hybrid infrastructure are already on the fast track to becoming a part of conventional water systems in LAC.

CHAPTER FOUR

Water Reserves, an Ecological Water Management Model

Meeting SDG6 will require unique, innovative, and unconventional solutions. Such solutions must not only take the shape of extensive development, but also that of active and expansive preservation. SDG6 target 6.1 in particular calls for "achiev(ing) universal and equitable access to safe and affordable drinking water for all" by 2030. Likewise, target 6.6 calls for "protect(ing) and restor(ing) water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes." Successfully meeting both targets will require an increasing emphasis on natural water resource preservation. Such an undertaking can be achieved through the development of water reserves.

Water reserves are composed of a volume of water existing in an ecosystem that is allocated to and reserved for the specific function of ecological protection. The development of water reserves can be useful for environmental preservation as well as ensuring water security for current and future generations, especially in watersheds where water resources are already threatened by climate change and development pressures. By setting aside an ecological volume of water, water reserves guarantee healthy watersheds and ecosystems and sustained ecosystem services.

As the first nation to pioneer a water reserve model, much can be learned from Mexico's National Water Reserve Program. Recognizing current and impending water challenges, Mexico developed their National Program with the aim of securing water for the conservation of ecosystems and for use by future generations. Potential reservoirs were then identified and put through a project screening procedure before being designated as official water reserves. The elements of the procedure are provided below.

- Update of water availability status
- Technical justification studies
- Water reserve decrees proposed
- Environmental impact assessment
- Project submission
- Signing of the presidential decree

To date, 13 water decrees have been signed by the president of Mexico, establishing water reserves in 295 basins across the country. With 99 percent of the water set aside for environmental protection and just one percent for public use, the reserves will guarantee water supplies to 45 million people for the next 50 years[1]. In total, water reserves in Mexico represent 55 percent of the country's surface water.

The water reserve program in Mexico ensures that current water allocations are unaffected and that protected water will not be sold to the highest bidder. Under the Mexican National Reserve Program, water in designated reserves will not be granted for allocation or privatized, but will remain protected for the sole purpose of water retention. Mexico's water reserves have been revolutionary and provide a prime example of how NGOs, governments, and local communities can come together to meet conservation targets and address water challenges.

Lessons from the development of Mexico's water reserves are already being shared throughout the region, with the Mexican National Reserve Program being used as a model in Guatemala, Peru, Bolivia, Colombia, and Ecuador1. Ecuador in particular has been actively developing water reserves as a means to protect the human right to water, water for irrigation and food sovereignty, and ecological flow. The Protected Areas Natural System (SNAP) in Ecuador has 56 natural reserves thus far, and prioritizes protecting ecosystems where water is produced and water sources are vulnerable.

The examples from Mexico and Ecuador illustrate that water management is shifting towards the development of green infrastructure, with conservation becoming an integral part of management practices. Water reserves can provide solutions for a variety of water challenges including water scarcity, watershed protection, and water availability to future generations. Moving forward, water should be seen as a strategic resource similar to oil and mined materials and it should be protected, sustained, and managed as such. Collaboration between stakeholders, governments, and communities will be necessary for water reserves to be successfully implemented across LAC as a tool for meeting SDG6 targets. Water funds can encourage and finance the conservation, restoration, and management of watersheds, propelling LAC toward achieving SDG6. As countries pursue the development of water reserves, it should be made clear that the benefits of water reserves span different sectors. A variety the various co-benefits that come from water preservation and the term "water reserve" should not be restrictive.

CONCLUSIONS AND RECOMMENDATIONS

It is evident that meeting SDG6 in LAC will require extensive investment in green infrastructure. Gray infrastructure alone has shown to be insufficient in addressing challenges in the WASH sector. Rather, gray and green infrastructure must be used to provide adequate water services and security by 2030. Developers should look to nature and incorporate ecosystem design, protection, and restoration into water management strategies to reduce costs, increase sustainability, and effectively meet SDG6 targets.

This paper discussed four key areas regarding the need for green infrastructure, including various examples and incentives that should be thoroughly considered by LAC in respect to achieving SDG6: (1) the role of green infrastructure in the water-energy-food nexus; (2) investment opportunities; (3) mainstreaming green infrastructure; and (4) the need for innovative, nonconventional water management. These areas should not be the only focus areas, but should be explored in combination with other methodologies, strategies, technologies, and resources in regards to meeting the ambitious SDG6 targets. However, they represent key insights and areas that should be analyzed if LAC is going to overcome its water challenges in the next 12 years.

Although each chapter had its own, specific takeaways, there are general, overarching recommendations that are applicable to and consistent across all four central areas. These are:

- **Addressing Challenges at the Water-Energy-Food Nexus.** Challenges in the water, energy, and food sectors should not be approached independently. These three sectors are inextricably linked and solutions should be designed to simultaneously address multiple aspects of the water-energy-food nexus. Implementing green infrastructure, therefore, may not only propel LAC toward meeting SDG6, but can also ensure food and energy security as well as promote human health and economic development.

- **Establishing Strong Business Cases.** Agreement upon SDG6 has led to the identification of a significant funding gap. Upwards of $14 billion will be needed annually to meet the ambitious SDG6 targets. Active investment in water infrastructure in LAC must be secured. Case studies in Ecuador and Brazil show that green infrastructure projects are worthwhile investments, with conservation/restoration and reforestation projects respectively resulting in positive returns on investment for project financers. In addition, monitoring and evaluation of green infrastructure projects have shown that benefits compound with time and that indirect co-benefits can provide additional cost savings. Strong business cases help attract investment and implementing green or hybrid infrastructure opens the door to selective funding opportunities such as climate bonds. Likewise, water trading, a unique, market-based approach to addressing water challenges, is an increasingly common mechanism for funding and providing incentives for green infrastructure development.

- **Mainstreaming Green Infrastructure and Hybrid Models.** Given the ambitious SDG6 targets and the relatively short period of time left to attain them, it is crucial that green and hybrid infrastructures become a mainstream solution to water challenges. Neither green or gray infrastructure should take precedence over the other; rather, they should attract parallel investments. To mainstream green solutions, green-blue thinking should be incorporated into every aspect of development for urban planning, water infrastructure, and ecosystem management. The many benefits, co-benefits, and multiple purposes must be openly expressed and thoroughly understood

before green infrastructure will be widely accepted by governments and communities. Communication should occur across sectors and nations to share insights and lessons from case studies and successful development projects.

- **Investing in Nonconventional Water Management.** There is not, however, a one-size-fits-all green infrastructure solution. Solutions must be context-specific and a variety of strategies must be implemented to meet the SDG6 targets by 2030. Nonconventional water management strategies such as water reserves, water recycling, and ecosystem restoration in addition to green urban design and green infrastructure in agriculture should be explored as solutions to water scarcity and quality challenges. Water reserves in Mexico and Ecuador have gained popularity and been successful at promoting sustainable water usage and preserving water resources for future generations. Wastewater treatment plants in Madrid have installed technologies to generate biogas and extract phosphorous to be used as fertilizers from agricultural and municipal wastewater. In addition, restoration can be used to protect coastlines from storm surges, prevent erosion, promote healthy ecosystems and wild food sources, and allow for the natural retention and release of water. Overall, decision-makers and investors will need to pursue new and unique development options to achieve SDG6.

It is now 2018, with just 12 years to go, the time for mainstreaming and investing in green infrastructure is now. Simply channeling more investment towards conventional approaches will not be sufficient; the region needs to address issues at the heart of the water-energy-food nexus, actively finance green and hybrid infrastructure, incorporate green-blue thinking into all aspects of city planning and ecosystem management, and explore innovative, nonconventional water management strategies. Without this focus, and with growing populations, increasing degradation, and climate change, challenges will only become increasingly complex and conventional solutions even less able to resolve them effectively and efficiently, let alone meet the SDG6 targets. LAC must continue actively implementing and investing in green infrastructure.

ANNEX 1

Sustainable Development Goal 6, Associated Targets and Indicators Ensure Availability and Sustainable Management of Water and Sanitation for All.[6]

6.1 By 2030, achieve universal and equitable access to safe and affordable drinking water for all

6.1.1 Proportion of population using safely managed drinking water services

6.2 By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations

6.2.1 Proportion of population using safely managed sanitation services, including a hand-washing facility with soap and water

6.3 By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally

6.3.1 Proportion of wastewater safely treated

6.3.2 Proportion of bodies of water with good ambient water quality

6.4 By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity

6.4.1 Change in water-use efficiency over time

6.4.2 Level of water stress: freshwater withdrawal as a proportion of available freshwater resources

6.5 By 2030, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate

6.5.1 Degree of integrated water resources management implementation (0-100)

6.5.2 Proportion of transboundary basin area with an operational arrangement for water cooperation

6.6 By 2030, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes

6.6.1 Change in the extent of water-related ecosystems over time

6.A By 2030, expand international cooperation and capacity-building support for developing countries in water- and sanitation-related activities and programs, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies

6.A.1 Amount of water- and sanitation-related official development assistance that is part of a government-coordinated spending plan

6.B Support and strengthen the participation of local communities in improving water and sanitation management

6.B.1 Proportion of local administrative units with established and operational policies and procedures for participation of local communities in water and sanitation management

ANNEX 2

LAC Sessions Convened by IDB During Stockholm World Water Week 2018

SESSION 1:

Mainstreaming Natural Infrastructure in Water Projects

Description: In Latin America and the Caribbean (LAC), cities are growing at an incredible pace. Along with that growth comes the need for more water to address food, sanitation, and energy requirements. In LAC, 40% of the land area around water sources is degraded by deforestation, poor agricultural practices and new developments. The effects of this degradation is becoming visible: increased treatment costs, reduced aquifer recharge, increased exposure to water-related events such as droughts and floods. Nature can secure water supplies while adding several benefits that address the challenges LAC faces. In most cases, water and sanitation projects do not consider natural or green components in their design, even when the economic case is clear. Grey infrastructure typically prevails as a technical solution. The sector needs a shift towards greener projects.

SESSION 2:

Green-Gray Infrastructure: The Case for Investment

Description: Green infrastructure is an approach to water management that protects, restores and mimics the natural water cycle. It entails restoring wetlands or other nature-based solutions, rather than building costly new grey infrastructure. Rivers, streams, wetlands, floodplains, and forests provide critical services such as clean water and flood protection and should be viewed as essential components of our water infrastructure. In LAC, many forward-looking cities are already embracing this green infrastructure approach, including Santiago, Lima and Medellin. Traditional infrastructure isn't designed to handle the increased floods and droughts that come with global warming. Green solutions give communities the security and flexibility they need. They create jobs in different sectors, including engineering and architectural design, construction and landscaping. Green infrastructure also supports supply chains and the jobs connected to them. We are at a crossroads in how we manage our water. Traditional water infrastructure will continue to play a role but solves only a single problem and requires a huge amount of resources to build and maintain. LAC must move towards a wiser combination of green and traditional infrastructure to meet the needs of the 21st Century.

SESSION 3

Natural Infrastructure and the Water-Energy-Food Nexus

Description: Agriculture is the prime engine of economic growth for many Latin American and Caribbean (LAC) countries. The region continues to be the breadbasket of the world with 23% of the arable land, 31% of the water, and 23% of the globe's forests. Fueled by China's and India's demand for natural resources and agricultural products, most countries in LAC are expanding their water, land, and energy footprint. These investments are putting pressure on a wide variety of ecosystems and the services they provide to cities and beyond. Sustainable development for LAC is a question mark. Looming large in the background is another challenge: climate change. Climatologists predict that 90% of the land could be distressed by extreme weather events that affect water availability for food and energy production. Thinking innovatively about the water, energy and food nexus is critical at this point. But not all is hopeless. New investments provide an opportunity to develop solutions

that balance economic growth and sustainability. Natural infrastructure projects that maximize the benefits of ecosystem services must be at the core of that innovation.

SESSION 4

Water Reserves, an Ecological Water Management Model

Description: Water reserves are defined as the volume of water allocated to a specific function: ecological protection. Allocating water to this environmental function contributes to water security, especially in watersheds threatened by climate-induced scarcity and development pressures. By setting aside an ecological volume of water (following the notion of environmental flows), water reserves guarantee healthy watersheds and ecosystems. Mexico was the first country to pioneer the model. The Mexican case, which is now a National Program, represents a fruitful collaboration between governments, NGOs, and academic institutions that combines technical and policy aspects. More than two years into implementation, the Program has succeeded as an effective water management and biodiversity conservation strategy that has reduced climate change vulnerability in several strategic watersheds.

ANNEX 3
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PLEASE SEE

https://programme.worldwaterweek.org/ for further details on the 2018 WWW.

ENDNOTES

1. See Annex 1 for complete details of targets falling under SDG6.
2. See Annex 2 for details and abstracts for each “Eye on LAC” session.
3.https://www.veoliawatertechnologies.com/sites/g/files/dvc471/f/assets/documents/2017/10/170324_VWT_NA_WAVE_Sludge_web_1_0.pdf
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