EcoDecisión
inversión en la naturaleza

Green Infrastructure in the Drinking Water Sector in Latin America and the Caribbean: Trends, Challenges, and Opportunities

December 2015

FOREST TRENDS

The Nature Conservancy
Protecting nature. Preserving life.

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Agency for Development and Cooperation SDC

Collaborating Institutions

EcoDecisión is a social enterprise that develops financial alternatives for conserving nature. EcoDecisión is a pioneer in the emerging field of environmental services markets for climate change mitigation, protection of water resources, and biodiversity conservation.

Established in 1998, and based in Quito, Ecuador, EcoDecisión works in Latin America with a broad spectrum of clients and partners, including non-governmental organizations and local, national, and international governments and companies. EcoDecisión also promotes ProAcqua, a multi-disciplinary group of water specialists committed to implementing and monitoring green infrastructure investments in Latin America.

Forest Trends is a Washington, DC-based international non-profit organization whose mission is to maintain, restore, and enhance forests and connected natural ecosystems, which provide life-sustaining processes, by promoting incentives stemming from a broad range of ecosystem services and products. Specifically, Forest Trends seeks to catalyze the development of integrated carbon, water, and biodiversity incentives that deliver real conservation outcomes and benefits to local communities and other stewards of our natural resources.

Forest Trends analyzes strategic market and policy issues, catalyzes connections between producers, communities, and investors, and develops new financial tools to help markets work for conservation and people.

The Nature Conservancy is the leading conservation organization working around the world to protect ecologically important lands and waters for nature and people. TNC works all over the world focused on the global challenges that impact lands, water, oceans, city, and climate. TNC seeks solutions to these challenges, using all tools available.

TNC is committed to expanding conservation efforts worldwide, this includes: protecting and restoring landscapes, rivers, and oceans on an unprecedented scale; transform the way natural resources are used in the world, influence policy and practices at local and global scales; and inspire global action by people who value nature and its role in ensuring dynamic economies and prosperous communities.

Acknowledgements

We thank Fernando Momiy, Ivan Lucich, and Luis Acosta of SUNASS for their support and contributions to this process; Gena Gammie of Forest Trends for her multiple suggestions and recommendations; and Jeffrey Cowan and The Nature Conservancy country teams of for their collaboration.

The Nature Conservancy gratefully acknowledges the generous support provided by the Tinker Foundation on public policy work throughout Latin America and for the publication of this study.

Graphic Design by Eszter Szöcs Bodnar of Visilio Design (www.visilio.com). Translation and editing by Claudia Lechuga and Gabriela Pigmore of Green Plus Consultoría Ambiental. Final English edition by EcoDecision.

Cover photo credits, clockwise from the top left: EcoDecisión, CONDESAN, Morley Read, Sanit Fuangnakhon, EcoDecisión, Ammit Jack.

Prepared for:

ASOCIACIÓN DE ENTES REGULADORES DE AGUA Y SANEAMIENTO DE LAS AMERICAS

Green Infrastructure in the Drinking Water Sector in Latin America and the Caribbean: Trends, Challenges, and Opportunities

Authors:

Marta Echavarria, Paola Zavala, Lorena Coronel,
Tamara Montalvo and Luz Maria Aguirre

December 2015

Prologue

For many years in Latin America and the Caribbean, the solution to deteriorating or insufficient water resources – due to contamination, waste, natural disasters, city growth, or other factors – was investment in built or gray infrastructure.

However, recently the tendency to invest in the conservation and protection of natural ecosystems, also called green infrastructure, has increased among diverse water users. Guaranteeing water availability is fundamental for drinking water operators and so investment in conservation measures, restoration, or protection of ecosystems that provide water is a priority.

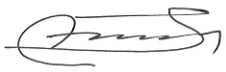
Regulators and drinking water operators are learning that protecting water sources can be more efficient than investing in gray infrastructure; that it is more important to keep water sources free of contamination than to invest in water treatment plants; and that in some cases there is no other solution other than to conserve, given there may be no other available water source to obtain this resource.

In this context, the Association of Regulating Entities of Drinking Water and Sanitation ((ADERASA – for its acronym in Spanish) created a Green Infrastructure Working Group, with the mission of collecting and analyzing experiences in the region on green infrastructure investment and the roles that water regulators and operators can play. Under the understanding that not all the experiences in the region would be gathered by this Working Group, the National Sanitation Services Superintendency of Peru (SUNASS – for its acronym in Spanish), currently presiding ADERASA, invited Forest Trends as a key partner to develop this work. Forest Trends, in turn, hired EcoDecisión with the support of The Nature Conservancy (TNC) to prepare this study, *Green Infrastructure in the Drinking Water Sector in Latin America and the Caribbean: Trends, Challenges, and Opportunities*.

ADERASA´s main interest is to try to gather the greatest amount of experiences that will contribute to the development of a baseline of green infrastructure in Latin America and the Caribbean. This would help understand the state of investments in green infrastructure, and to analyze regional trends so that collaborated support can be provided to isolated efforts among operators, regulators, NGOs, and different countries.

The study was designed to document the state of initiatives and investment in green infrastructure by water regulators, drinking water operators, and project developers in Latin American and Caribbean countries, beyond just the experiences of the members of Green Infrastructure Working Group and ADERASA. This study includes activities such as: payment for ecosystem services projects, water funds, promotion of investment plans for climate change adaptation in watersheds, recuperation of vegetative cover, water governance strengthening, and environmental education.

Finally, an acknowledgement to the water regulators and the drinking water operators that responded to the survey and who understand that, without a shared account of current experiences, it would be difficult to advance on the right path. A special thanks to Forest Trends for its steadfast support of the Green Infrastructure Working Group and SUNASS, to EcoDecisión for its professionalism in the development of the study, and to The Nature Conservancy, without whose support this study would not have been possible.



Fernando Momiy
President
Association of Regulating Entities of Drinking Water and Sanitation (ADERASA)

Executive Summary

Green Infrastructure includes a group of measures with the objective of improving nature's capacity to generate ecosystem goods and services, such as water flow, regulation, and water quality. This is why protecting supplying watersheds is a critical factor for water security.

Investment in green infrastructure can generate economic and environmental returns by avoiding operating and maintenance costs, by preventing interruption in the functioning of water systems, and by delaying the need for capital investments. Investment in green infrastructure can be viewed as an effective complement for protecting investments in built or gray infrastructure.

In recent years, interest in green infrastructure by the drinking water sector has increased; however, investment is still incipient.

This study seeks to determine the state of initiatives and investments in green infrastructure by water regulators, drinking water operators, and project developers in Latin America and the Caribbean. The study's objective is to analyze the role of water regulators and operators, the amount of investment directed to green infrastructure, the actions involved in green infrastructure investments, monitoring measures of these investments, the financial mechanisms that are used, and lastly the barriers and challenges of these initiatives.

The study collected the opinions of 34 water operators, regulators, and water protection project developers from 11 countries, as well as relevant information available green infrastructure investment with the goal of sketching out a trend in the region and identifying the next implementation steps in the future.

Investment in green infrastructure includes a variety of activities such as reforestation, forest protection, watersheds, wetlands, and other activities. In general terms, water operators and regulators in the region are just starting to implement such activities and developing experience in this sense.

In general terms, operators in Latin America and the Caribbean are not investing significantly in green infrastructure. Respondents, representing a group of leaders in this field, indicate an investment in green infrastructure of less than five percent of their annual budget. The exceptions are some cities in Peru where investment is greater than the aforementioned percentage because of recent regulatory reform that demand investment in environmental compensation.

Of the diverse financial mechanisms used by stakeholders, the main ones are water funds. Of the 28 initiatives identified with the participation of drinking water operators, 14 are identified as water funds. It is worth remembering that the region pioneered the creation and operation of water funds and that today there are more than 20 in place. In Latin America and the Caribbean, the majority of green infrastructure investment has been channeled through national environmental programs, financed by the central government, that reward private and community landowners for protecting natural ecosystems on their lands. These programs present a great opportunity for the participation of drinking water operators thus allowing the articulation of public policies on water management and territorial planning.

EcoDecisión estimates that water operators invest approximately US$13.9 million annually in green infrastructure. This information comes from secondary information collected from different studies and sources. In contrast, the estimated annual investment for water protection in 2013 in Latin America reached US$86 million (Bennett & Carroll, 2014).

The investment in green infrastructure contrasts with the great threats present in the region, especially the loss of natural vegetative cover and the growth of urban populations in forest zones rich in water such as the Amazon, adding to this the impact of climate change and mining in Andean landscapes and ecosystems.The main concerns of the sector are related to the competition for use of water resources, financial challenges, climatic risks, and the lack of clarity of sector policies. From the experiences in the region it is important to note the role of the regulating entity as a facilitator and promoter of green infrastructure investment and how the adequacy of the legal framework promotes the crystallization of these initiatives.

Operators can collect resources to finance green infrastructure actions and in some cases, they can execute actions directly or through third parties. Nevertheless, there are institutional weaknesses such as lack of financing, personnel, hydrologic knowledge, monitoring systems, and training, that limit their capacity to invest in green infrastructure.

Project developers that were surveyed, for the most part non-governmental organizations, take on roles such as promoters and implementers of green infrastructure activities and have the human and technical resources that complement operators´ capabilities.

The task of documenting the evidence of green infrastructure impact is still pending. The weakness of monitoring and evaluation systems limits the availability of information to document impacts and to measure the cost-effectiveness of investments. It is necessary to develop methodologies and to strengthen the capacity of actors in this area and to generate a culture of adaptive management. It is expected that, in the long term, evidence from the region will show that investment in green infrastructure is a cost-effective way to guarantee water security in terms of water quality and quantity.

Table of Contents

Introduction

This study was designed to document the trend of investment in green infrastructure by water regulators, drinking water operators, and project developers in Latin American and Caribbean countries, beyond the experiences of the Green Infrastructure Working Group members and ADERASA.

The study´s objective was to document and analyze the role of regulating entities and water operators, the amount of investment directed to green infrastructure, the actions involved in implementing green infrastructure, the monitoring measures for these investments, the financial mechanisms that are used, and finally the barriers and challenges of these initiatives. The study includes activities such as: projects for payment for environmental services, water funds, promoting investment plans for climate change adaptation in watersheds, recovery of vegetative coverage, strengthening water resource governance, and environmental education, among others (Map 1).

Map 1. Survey Respondents by Country and Sector

To this end, surveys were sent out in Spanish, English, and Portuguese to more than 200 organizations in the entire region through ADERASA, the Latin American Association of Water and Sanitation Operators (ALOAS – for its acronym in Spanish), and The Nature Conservancy (TNC). The survey

received 34 responses from 11 countries including 7 regulators, 14 water operators and 13 project developers

The survey's response rate (17 percent) shows how green infrastructure concept is new to the sector. In addition, the entities that responded tended to be those with the greatest experience and knowledge on the subject, which can mean a bias in the answers.

The participation of ADERASA´s Green Infrastructure Working Group, review of existing literature, and interviews of specialists complemented the information in the survey in order to understand the history of green infrastructure investment that the region is experiencing. From isolated cases in some pioneer countries such as Costa Rica and Ecuador, there replicas of water protection initiatives in countries such as Mexico and Brazil. There is a new period of articulation among different water users on green infrastructure. In this case it is important for water regulators and operators to learn from the regional experience in green infrastructure so that they can make informed decisions.

Regional Problems

On a first glance, Latin America and the Caribbean is one of the richest regions in the world in terms of water resources. The region has 30 percent of the world surface runoff, but this contrasts with indicators that demonstrate that a good part of the countries in the region experience water scarcity. (Mahlknecht & Pastén, 2013)

According to the Economic Commission for Latin America and the Caribbean (ECLAC), access to water in Latin America is very heterogeneous, and problems related to water quality and sanitation have increased notably over the last 30 years. This follows the important industrial and agricultural development of the region, which was not accompanied by water quality and sanitation policies. Latin American and Caribbean countries have made significant efforts to improve management and increase coverage of their drinking water and sanitation services. Regardless of the advances achieved over the last decades, the sector's situation still represents a challenge for the region. The problems are due to the unequal distribution of water supply and demand, and also to other causes such as: population growth, urbanization, lack of infrastructure, reduced capacity of institutions to meet demand, and the impacts of extreme meteorological events. (Mahlknecht & Pastén, 2013)

Water scarcity in the region is not only physical – it is exacerbated by the lack of investment in appropriate infrastructure. This can lead to poor quality of service as well as water quality control due to partial or intermittent supply, obsolete distribution channels, a low rate of metering, and other factors. These impacts, in turn, have other consequences such as a high cost to the public health system and greater vulnerability to natural disasters. In general, when compared to other developing regions in the world, the level of coverage of drinking water is good. Nevertheless, the rural sector shows service coverage indicators that are generally much lower than the urban sector (Mahlknecht & Pastén, 2013).

According to The Nature Conservancy's study "Natural Infrastructure: An opportunity for Water Security in 25 Latin American Cities" (2015), water source for Latin American cities are covered by forests (40 percent); agricultural lands (30 percent); and native prairies and grasslands (20 percent). As the transformation of forests into agricultural or grazing land increases, the regulation, infiltration, and quality of water diminishes. This problem is particularly serious in Latin America. The region registered 64 percent of global deforestation between 2000 and 2005.

Water sources in the region face great pressures due to the aforementioned challenges; mining and the excessive use of fertilizers for agriculture produce contamination in rivers and lakes, which, in turn, affect water quality. These problems will surely increase with the growing need to produce food and generate other sources of income.

The survey shows that water operators' primarily extract water from superficial sources. Nevertheless, in some countries there is great dependency on groundwater, as was indicated by the National Association of Water and Sanitation Companies of Mexico (ANEAS by its acronym in Spanish) and the National Federation of Cooperatives and Sanitary Services of Chile. In years of great water stress, groundwater is extracted at greater rates to complement surface water sources, as is the case of the Waters of Siguatepeque, Honduras, where 80 percent of the water comes from groundwater sources.

According to the survey, regulators and operators agree that the main problem they face for ensuring water supply is competition with other water users (Figure 1). This situation is linked to demographic growth and the region's urbanization, highlighting the importance of protecting water sources.

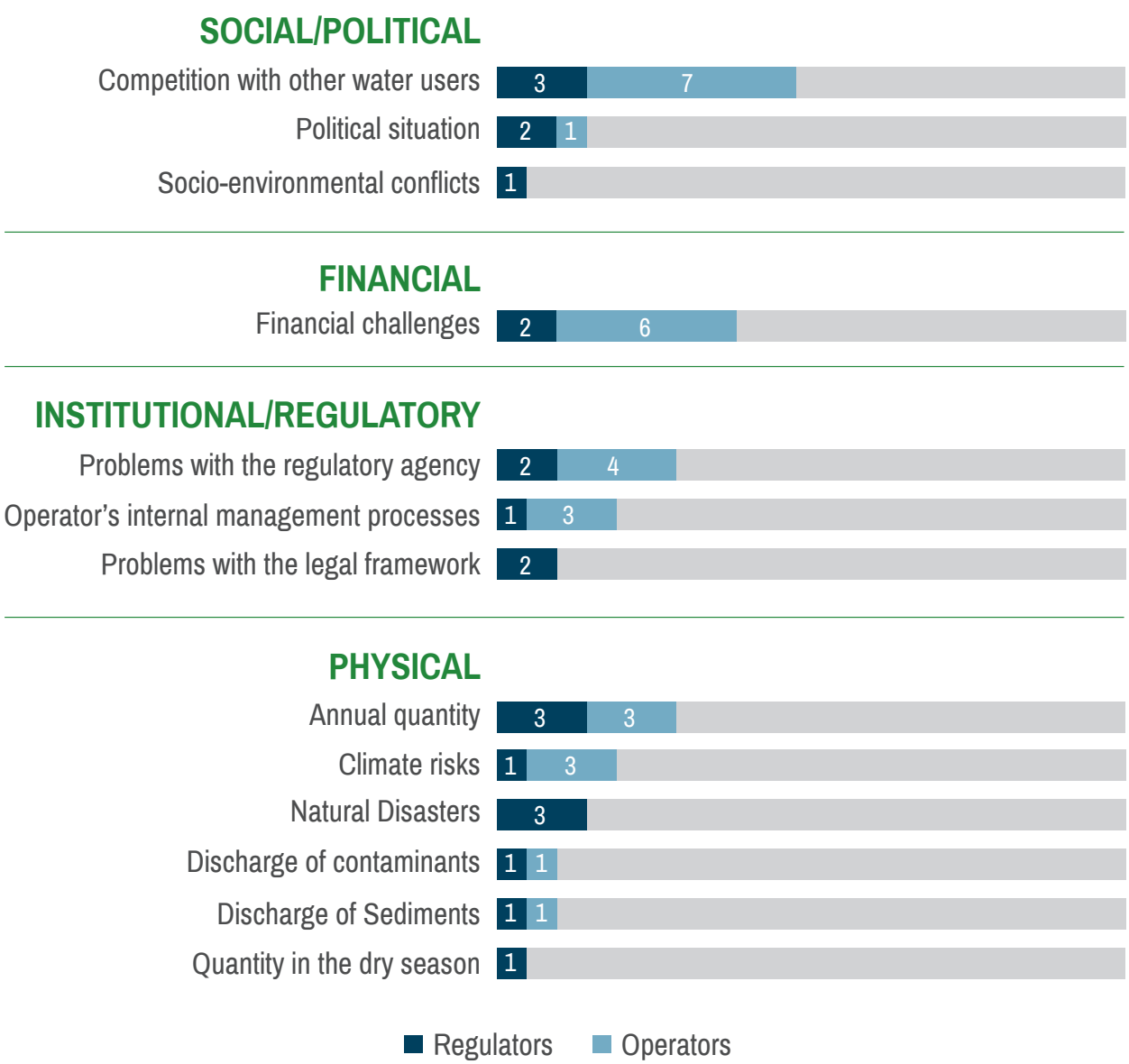
Drinking water supply is one of the basic services that cities must offer and its stability requires securing water sources that are not affected by third parties.

Other problems that were identified included: financial challenges, problems with the regulating entity, quantity in the annual availability of the resource, waste water treatment, high per capita consumption, and water that is not accounted for ("non-revenue water") due to physical and commercial loss. Several of these considerations point to the need for having good measurement and evaluation systems, a basic condition for the good functioning of the drinking water service.

The survey included a list of options related to the control of activities that affect the drinking water supply. Even though 50 percent of operators and regulators responded that competition for water is a problem, only 21 percent of respondents indicated that they collaborate with national government agencies and civil society. Thirteen percent report that there is multi-sector work and recognize that the protection of sources is a group effort

.

Figure 1: Principal Challenges for the Provision of Water



While recognizing that those who responded to the survey are among the leaders in the region on green infrastructure, it is interesting to note that more than 80 percent of operators and project developers affirm that watersheds that supply the resources are in some state of conservation. This is a meaningful number that indicates the importance of watershed conservation. The conservation or protection frameworks most widely used are: private conservation areas, municipal conservation areas, and conservation agreements.

Green Infrastructure

Concept and Justification

Green infrastructure is a concept under development that includes investment measures to protect, restore, and maintain natural landscapes such as reforestation, forest conservation, restoration of riverbanks, wetlands, natural landscapes, and other activities that contribute to protecting and/or restoring ecosystem functions.

According to the United Nations Environment Program (UNEP) Green Infrastructure Guide, green infrastructure is defined as a strategically planned network of natural and semi-natural zones of high quality with other environmental elements, designed and managed to provide a wide range of ecosystem services, and to protect biodiversity in rural and urban settlements. In addition, the guide emphasizes that the objective of green infrastructure is to increase nature's capacity to generate goods and multiple ecosystem services with value in a sustainable way (UNEP, 2014).

Green infrastructure has shown that it can be a more cost-effective way to guarantee water supply. A robust scientific foundation already exists which indicates how green infrastructure can be more efficient than gray infrastructure, for example through reducing operations and maintenance costs and deferring the need for capital investment outlays. There are concrete and documented experiences in several locations throughout the United States (see, for example, Gartner et al., 2013).

Conceptualization of the Latin American Drinking Water Sector

In reference to water, green infrastructure is the protection of natural or semi-natural ecosystems that provide water services that complement, increase, or replace those provided by gray infrastructure. It is understood for this study that investments in green infrastructure protect and/or optimize the functioning of water ecosystems for the purpose of increasing nature's ability to capture, regulate, filter, and/or deliver water to users in a secure way.

This investment in water source protection counters the great threats that are present in the region, particularly the loss of natural vegetative coverage due to the land use change promoted by intensive agriculture, population growth in urban areas, climatic change impacts, and mining – especially in Andean ecosystems.

The current study adjusts the recommended list in the UNEP (2014) guide and includes the following green infrastructure actions[1]:

- Reforestation/Afforestation
- Forest conservation
- Reconnection of rivers with floodplains
- Water harvesting[2]
- Riparian protection
- Wetlands construction

[1] The concept used in the the survey didn´t incorporate actions in urban areas nor actions for the maintenance and protection of groundwater.

[2] Refers to capturing humidity with mesh placed in strategic locations. This concept is used in Peru for a government program of the Ministry of Agriculture for building small reservoirs in high areas. These could generate environmental impact if not properly built.

- Conservation/restoration of grasslands and/or prairies
- Wetland conservation/restoration
- Optimization of ancestral technologies (*amunas*, infiltration strips)

A last element was added to recognize experience in countries such as Colombia, Ecuador, Mexico, and Peru where there is potential for technology built by pre-Colombian cultures that can increase water use efficiency, such as *andenes* or *terrazas*.

Box 1: Green Infrastructure Investment by water companies in Ecuador

Ecuador has led the involvement of water companies in green infrastructure investment for more than 15 years. ETAPA, the water company from the city of Cuenca, pioneered its environmental commitment by being the first company to purchase a private reserve, the Mazar Forest, of more than 2,000 hectares. This first purchase motivated ETAPA to develop an important land purchase program to protect its water sources. In addition to being the first company in the country to treat urban wastewater, it also regulated other sources of water pollution, such as used oils and batteries. ETAPA took over the management of Cajas National Park, a protected area. ETAPA invests important sums of money for monitoring, control, and management of the park, which represents the largest investment in a protected area in the country. In addition, Cajas is an emblematic tourist destination near the city of Cuenca. ETAPA in Cuenca led the creation of the Fund for the Protection of the Paute Watershed (FONAPA – for its acronym in Spanish).

The Loja Municipality, through its Drinking Water and Sewage System Unit, is a founding member and main financer of the Regional Water Fund (FORAGUA – for its acronym in Spanish) conformed by five municipalities.

In 2000 Quito´s water company, EPMAPS, created the first water fund in the world: Quito Water Protection Fund (FONAG – for its acronym in Spanish). This example inspired the creation of many funds in different countries. In Ecuador it promoted the participation of other water companies to be involved in the creation of new funds. For example, that was the case for the Fund for the Management of Paramos and the Fight Against Poverty in Tungurahua, where the provincial government convened several authorities, including the Ambato water company and the energy company.

In addition to the work through water funds, water companies in Ecuador have led other investment activities in green infrastructure. EPMAPS in Quito has historically committed to the conservation of important areas such as the three national parks where its catchments are located. To date EPMAPS owns more than 14,000 hectares of private land for the protection of its water sources. The total investment in water funds in Ecuador for activities to protect its sources surpasses US$20 million over the last 15 years.

Source: Pablo Lloret, personal communication, October 14, 2015.

Wastewater treatment plants could be included as part of green infrastructure. Although they represent physical construction, and so could be considered “gray infrastructure,” the opinion of Latin American specialists and of members of ADERASA´s Green Infrastructure Group is inclined to consider the treatment of residual waters as part of green infrastructure activities that already contribute to the purification of water, a health priority in the region. In addition, the functioning of river ecosystems is optimized which complements other actions for watershed protection.

Regarding additional green infrastructure activities, respondents provided the following answers: environmental education, purchase of lands, best agricultural practices, and creation of water protection areas, green terraces, eco-agriculture, and hydrogeological studies, among others. Some of these activities are non-structural methods that are strategies or prerequisites to achieve

biophysical intervention; for example, to achieve ecological changes it may be necessary to implement complementary measures such as: environmental education, improving governance, and implementing social or economic interventions.

In summary, ADERASA´s Green Infrastructure Working Group proposes, rather than one strict definition of green infrastructure, a broader concept that defines the actions to those "works and activities that protect and/or recover the better functioning of natural water ecosystems", including activities and statements such as: urban forests, riparian corridors, headwaters, green roofs, actions to recharge aquifers, Sustainable Urban Drainage Systems (SUDS)[3], areas to capture water and contaminants in urban or rural areas, investment in decontaminating natural channels, and interception of residual water.

The ADERASA´s Green Infrastructure Working Group experts suggest that investment in green infrastructure should cause neither environmental nor social damage. For example, cases have been identified such as reforestation with introduced species, or the construction of reservoirs in protection zones, which must be assessed to ensure that they do not generate environmental problems. There are also situations where investment in green infrastructure must be adequately designed to avoid social conflict, which in turn could affect water supply.

The concept of green infrastructure is new to the region. It is understood that it will continue to develop as more experience in this type of investment is advanced.

[3] Sustainable Urban Drainage Systems were designed to diminish the quantity of contaminants that runoff water while reducing the circulating flow on the surface.

Green Infrastructure by Numbers

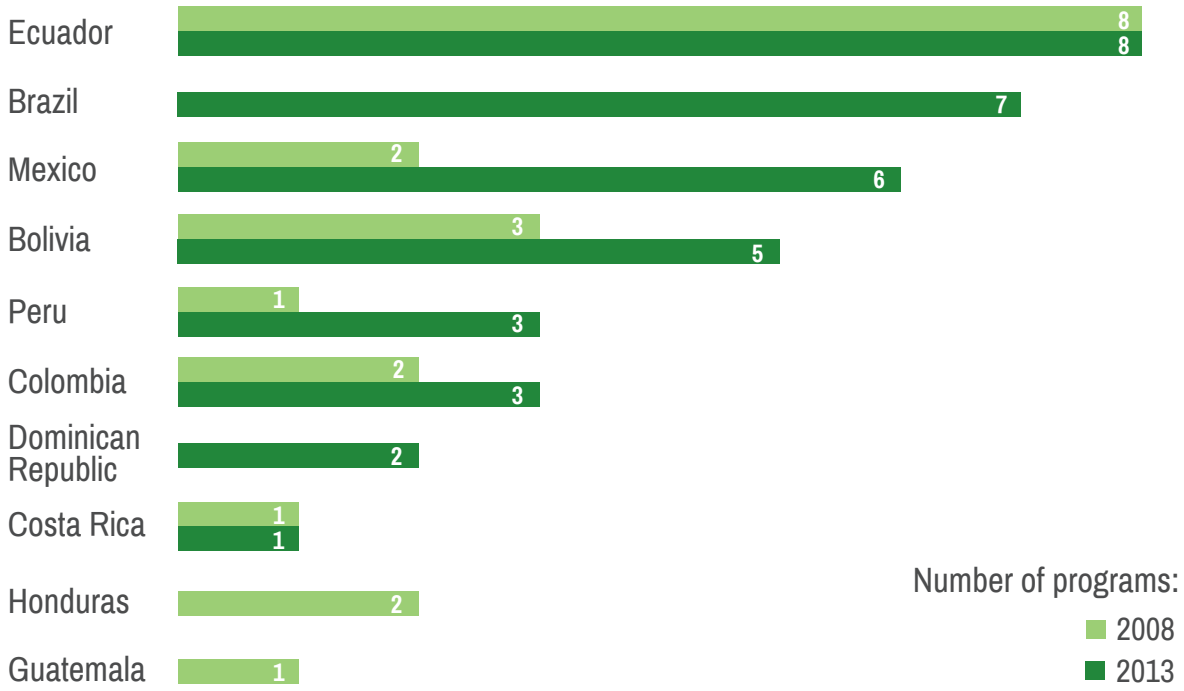
Level and Amount of Investment

Considering the limited information available and the survey's response rate, it is difficult to quantify the evolution of investment in green infrastructure from the drinking water sector in detail. The study aims to describe trends in green infrastructure in recent years and to highlight indicative data from available sources to differentiate those investments that involve drinking water operators.

The global study The State of Watershed Investment quantified the investment on a global level of transactions focused on water protection measures, such as payments for ecosystem services, subsidies, incentives, and water funds – a scope which captures green infrastructure investments by many stakeholders, not just those from the drinking water sector. Watershed investment through these types of mechanisms in Latin America was at least US$84.9 million in 2013 (Bennett & Carroll, 2014). This value is mainly made up of the investment outlay by the national programs of Mexico, Costa Rica, and Ecuador, as well as investments by Brazil´s national programs. This investment resulted in the protection of more than 6.1 million hectares in Latin America and the Caribbean, an area larger than Costa Rica (Bennett & Carroll, 2014).

There is a growing interest in the region on green infrastructure investment, as evidenced by the growth of these initiatives from 28 in 2011 to 69 in 2013 (Bennett & Carroll, 2014).

Figure 2: Number of Watershed Investment Programs



Source: Bennett & Carroll 2014

While Ecuador gradually increased the budget for its Socio Paramo program at a national scale, the large national programs of Costa Rica and Mexico both showed a slight reduction of funds

in 2013, which resulted in the reduction of aggregate transactions in Latin America, compared to 2011. Nevertheless, these programs achieved an annual growth rate of five percent in regard to the coverage area between 2011 and 2013, with more than 300,000 hectares of new land under management in 2013 (Bennett & Carroll, 2014). In Latin America practically all transaction's growth between 2012 and 2013 was driven by medium-scale programs (defined as programs between US$500,000 and US$1 million per year); this group was led by the water producer programs in Brazil and water funds throughout the region.

Regarding the investment trend specifically within the Latin American drinking water sector, there are indications of a growing interest from the sector in these types of initiatives. According to EcoDecisión´s databases, water operators increased their participation in water protection investment between 2008 and 2013.

Beginning in 2008, an interesting investment trend by multiple actors, including water operators, has been observed through water funds, a model that has arisen in the region. In Colombia and Ecuador, the water companies of Bogota and Cuenca, respectively, led the creation of water funds. FORAGUA in Ecuador was founded with the participation of five municipalities assigning resources from the water tariff for the protection of their supplying watersheds. The fund currently has the participation of 11 municipalities and 13 additional municipalities are expected to join in the near future.

Based on information collected by EcoDecisión from the last three years, the annual investment made by water operators is estimated to be approximately US $13.9 million. Table 1 summarizes the investments in which there is an operator participation and estimates a total annual investment, thus aiming to outline the specific investment of water operators.

Table 1: Watershed Investment Programs With Resources from Water Operators

	MECHANISM OR INITIATIVE	CITY	DRINKING WATER OPERATOR	ANNUAL CONTRIBUTION US$
BOLIVIA				
1	Reciprocal Water Agreements	Santa Cruz	28 local water cooperatives	$35,670
			Subtotal	**$35,670**
BRAZIL				
1	PCJ and Alto Tete Water Fund	Joanopolis		n.d.*
2	Payments for Ecosystem Services Camboriu	Camboriu	Municipal Water Treatment Company EMASA	$100,000
3	Water Producer of Bacia do ribeirão João Leite	Goias	SANEAGO	$6,000,000
4	Oásis Apucarana-PR	Apucarana	SANEPAR	$100,000
5	Water Production Program Guaratingueta	Guarantigueta	SAEG	$10,000
6	Water Producer – Pipiripau Project	Distrito Federal	CAESB	$85,000

MECHANISM OR INITIATIVE		CITY	DRINKING WATER OPERATOR	ANNUAL CONTRIBUTION US$
7	Water Producer – Taquarussu Project	Taquarussu	Tocatinense Sanitation Agency	n.d.
			Subtotal	**$6,295,000**
COLOMBIA				
1	Agua Somos – Bogota Water Fund	Bogota	Aqueduct and Sewage System Companies of Bogota ESP	$100,000
2	CuencaVerde – Medellin Water Fund	Medellin	Medellin Public Companies	$200,000
			Subtotal	**$300,000**
COSTA RICA				
1	Heredia Public Services Company (Empresa de Servicios Publicos de Heredia (ESPH))	Heredia	Heredia Public Services Company (Empresa de Servicios Publicos de Heredia (ESPH))	$500,000
			Subtotal	**$500,000**
DOMINICAN REPUBLIC				
1	Santo Domingo Water Fund	Santo Domingo	Aqueduct and Sewage System Corporation (Corporación del Acueducto y Alcantarillado (CAASD))	n.d.
2	Yaque del Norte Water Fund	Santiago	COORASAN	$16,000
			Subtotal	**$16,000**
ECUADOR				
1	Quito Water Fund (Fondo de Agua de Quito (FONAG))	Quito	Drinking Water Municipal Company (Empresa Municipal de Agua Potable EPMAPS)	$2,200,000
2	Paute River Water Fund (Fondo de Agua del Río Paute (FONAPA))	Cuenca	Cuenca Drinking Water Company (Empresa de Agua Potable Cuenca (ETAPA))	$300,000
3	Riobamba Water Fund (Fondo de Agua Riobamba (FOPAR))	Riobamba	INTERJUNTAS	n.d.
4	Tungurahua Badlands Fund and Fight Against Poverty	Ambato	Ambato Water Company (Empresa de Agua de Ambato (EMAPA))	$50,000

	MECHANISM OR INITIATIVE	CITY	DRINKING WATER OPERATOR	ANNUAL CONTRIBUTION US$
5	Regional Water Fund (Fondo Regional del Agua (FORAGUA))	Loja	Drinking Water Municipal Units	$550,000
6	Guayaquil Water Protection Fund	Guayaquil	Interagua	$30,000
7	Payment for the Protection and Conservation of Native Forests and Badlands in New America	Pimampiro	EMAPA-P	$20,000
			Subtotal	**$3,150,000**
	MEXICO			
1	Monterrey Metropolitan Water Fund (Fondo de Agua Metropolitano de Monterrey (FAMM))	Monterrey	Monterrey Water and Drainage Services (Servicios de Agua y Drenaje Monterrey (SADM))	n.d.
2	Environmental Service Local Payment Mechanisms through matching funds (Mecanismos locales de Pago por Servicios Ambientales a traves de fondos concurrentes (MLPSA))	National		$3,100,000
3	Pixquiac River sub-watershed Environmental Program for Environmental Service Compensation (Programa de compensacion de servicios ambientales de la subcuenca del rio Pixquiac (PROSAPIX))	Xalapa		n.d.
			Subtotal	**$3,100,000**
	PERU			
1	Lima Water Fund – Aquafondo	Lima	SEDAPAL	t.b.d.
2	Regional Water Fund (Fondo Regional del Agua (FORASAN))	Piura	EPS -Grau	t.b.d.
3	Alto Mayo Environmental Service Compensation	Moyobamba	EPS Moyobamba	$42,000
4	Microcuenca Quanda Pride Campaign	San Jose de Lourdes	EPS Marañon	$16,667
5	Piuray Lake	Cusco	SEDACUSCO	$500,000
			Subtotal	**$558,667**
			TOTAL = 28 initiatives	**$13,955,337**

Channeled through Water Funds

Analysis: EcoDecisión / n.d. No data.

Regarding the current study, 60 percent of surveyed operators and regulators stated that investment is increasing. In addition, 78 percent of respondents described contributions as annual, an indicator of investment stability.

According to the survey, the level of investment in green infrastructure of all surveyed actors falls between zero to five percent of annual budgets, with the exception of Peru, where cases exceed these amounts; these cases, which are set to begin investments in 2016, are described later in the document. Operators invest up to three percent of their annual budget in green infrastructure through expenditures in human resources (33 percent), financial expenditures (33 percent), and technical expenditures (34 percent). Only three operators indicated that they do not invest in green infrastructure; however, there is likely a bias in answers in this regard from our sample, since most respondents likely favor green infrastructure more than their peers.

The amount of annual investment is variable and depends on each case. In Brazil the Pipiripau and Descoberto Coberto projects are directed to improve watershed's environmental health with the purpose of improving water quality and quantity. The Water, Energy and Sanitation Regulatory Agency of the Federal District of Brasilia (ADASA – for its acronym in Portuguese) is part of the Pipiripau project and has a large range of participants, including the Water Company of Brasilia (CAESB – for its acronym in Portuguese). ADASA estimates that water operators that it regulates spent US$4,000,000 on green infrastructure over the last 10 years.

In Colombia, investment in green infrastructure is channeled through environmental authorities--Regional Corporations – with funds allocated from water and sanitation user fees. Therefore, the Colombian Drinking Water and Basic Sanitation Regulating Committee (CRA – for its acronym in Spanish) does not have the competence of investing in green infrastructure. This indicates that the tariff methodology provided by this Commission considers mechanisms that allow water operators to include investment needs in the definition of their tariffs. Colombia Manizales Water Company shows a contribution of more than 5 percent, which is equivalent to US$1 million for 2013. This contribution increased to US$1.5 million in 2014.

In Costa Rica, the Public Services Regulating Authority (ARESEP – for its acronym in Spanish) highlighted the only green infrastructure investment case in the country, the Heredia Public Services Company with an annual investment of approximately three percent of its budget or US$500,000. In Ecuador, the Guayaquil Water Company (ECAPAG – for its acronym in Spanish) reported that it made an investment of US$1.8 million in 2013 for the construction of a wastewater treatment plant, which the company considers to be an investment in green infrastructure.

Only Peru has a legal framework for green infrastructure investment by the drinking water and sanitation sector. SUNASS highlights two emblematic operator cases. Starting in 2009, the water operator for the city of Moyobamba developed a framework to charge one Nuevo Sol per month (approximately US$0.30 cents) for each drinking water connection. These resources were assigned to watershed conservation, with direct work from the owners that live in the upper watershed. In Cusco, the water operator SEDACUSCO assigns 9.6 percent of its income to projects for the conservation of Lake Piuray in the Piuray-Corimarca community, which provides 40 percent of Cusco's drinking water.

These cases inspired the development of the recently approved regulation by SUNASS, which clearly directs water operators in Peru to include "environmental compensation" in their tariffs in the form of "compensation mechanisms for ecosystem services" (Modernization of Sanitation Services Law, 2012).

There are currently six operators that have this new tariff approved by SUNASS, together representing an estimated investment of US$28 million for green infrastructure over the next five years. The companies of Cusco, Moyobamba, Amazonas, Apurimac, Junin, and Lima are currently designing studies and proposals for public investment projects to execute these assigned resources for green infrastructure. Therefore, while investment commitments have significantly increased, actual expenditures have not yet taken place because they are still in the process of collecting resources and planning investments. SUNASS has fulfilled its role of promoting, supporting, and guiding the design and implementation of green infrastructure initiatives in the country.

Box 2: Promotion of Green Infrastructure by Peru´s Water Regulator

Since 2007, Peru lead has given rise to various regulatory initiative for the protection of ecosystem services. This exercise permitted the Peruvian Government to formally and coherently incorporate mechanisms for payments for ecosystem services in national laws. The starting point was the approval of an environmental compensation project in Moyobamba in 2007. In 2012, SUNASS, using this model, recommended to the Ministry of Housing, Construction, and Sanitation to include a public policy for managing water sources through payment mechanisms for ecosystem services financed by tariffs on water users, called the Modernization of Sanitation Services Act (Law 30045) approved in 2013. Consequently, there now exists a secure source of funding for green infrastructure, which is summarized in this table presented by SUNASS:

Water Service Providers	Contributors to Payment Mechanisms	Amount US$*
EPS MOYOBAMBA S.R.Ltda.-IQ	EPS Moyobamba (Drinking Water Users)	453,191
	Total	**453,191**
EPS MOYOBAMBA S.R.L.- IIQ	EPS Moyobamba (Drinking Water Users)	677,283
	Regional Government	818,284
	Total	**1,495,567**
SEDACUSCO S.A.	EPS Sedacusco (Usuários de Agua Potável)	7,979,224
	Empresa Privada – Work for Municipal Taxes for Chincero District	9,967,039
	Total	**17,946,263**
EMUSAP ABANCAY S.A.C.	EPS Emusap Abancay (Drinking Water Users)	1,200,000
	Apurímac Regional Government	2,636,500
	Abancay Provincial Municipality	3,488,500
	Water Users for Irrigation	210,000
	Prodesarrollo Apurímac Implementation Unit	156,800
	Total	**7,691,800**
EMUSAP Amazonas S.R.L	EPS Emusap Amazonas (Drinking Water Users)	503,320
	APECO (Peruvian Assocation for the Conservation of Nature)	255,300
	Chachapoyas Provincial Municipality	150,000
	Total	908,620
SEDAPAL	SEDAPAL (Drinking Water Users)	89,068,056
	Total	**89,068,056**
SEDAM Huancayo S.A.	EPS Emusap Huancayo (Drinking Water Users)	2,925,305
	Total	**2,925,305**
EPSASA Ayacucho	EPSASA (Drinking Water Users)	1,153,120
	Total	**1,153,120**
GRAND TOTAL		**121,641,922**

Exchange Rate: US$=3.2 soles

In parallel with this initiative, with the creation of the Ministry of the Environment in 2008, interest in promoting payment for ecosystem services mechanisms increased in the Peruvian environmental community. In 2011, a "project incubator" was created with the goal of scaling up payments for ecosystem services in the country. In 2014, the Compensation Mechanisms for Ecosystem Services Law was finally approved, which promoted the protection and voluntary restoration of environmental services in Peru by public and private users, regional, and municipal governments. Finally, as part of this law, monitoring and compliance measures were created to prioritize investments and evaluate impact over time. This process makes Peru a leader in the region—local actions contribute to the discussion of national policy. The catalyzing factors for this process were: political leadership, coordination at various levels, and technical teams committed to contributing with guides, tools, trainings, and technical support throughout the process. This combination of factors allows investments in green infrastructure to become a reality.

Source: EcoDecisión

It is interesting to consider that there are specific voluntary cases by water operators, where the contribution to green infrastructure is calculated through tariffs. In Ecuador, for example, the Quito Public Drinking Water and Sanitation Metropolitan Company (EPMAPS – for its acronym in Spanish) defines its contribution through FONAG, which reaches two percent of drinking water and sanitation sales. The fund currently has US$13.2 million in its endowment. These resources are in addition to the resources that the company invests directly through its environmental program and other land purchasing measures, as discussed in Box 1. The Guayas Municipal Drinking Water Company (EMAPAG – for its acronym in Spanish) reports that it will assign US$30,000 as seed capital beginning in 2016 through the Guayaquil Water Fund for the Daule river watershed. The municipal drinking water units in Southern Ecuador participate in FORAGUA, and on average contribute more than US$500,000 annually from their tariffs.[4]

Green Infrastructure and Gray Infrastructure

The priorities of water operators are still focused mainly on gray infrastructure. The 34 organizations that responded to the survey indicated the following investment priorities: repairing the existing water network, expanding the network, improving drinking water treatment, and improving wastewater treatment (all gray infrastructure).

Forty-two percent of operators surveyed identified green infrastructure as a priority. For the Honduras Water Company of Siguatepeque, investment in green infrastructure is considered a first priority for the coming years. Respondents are aware that watershed protection is a priority. Nevertheless, watershed conservation still does not occupy a priority spot in operator planning.

Finally, it is important to highlight that the investment in built infrastructure that the drinking water and sanitation sector requires is significant and resources are limited. SUNASS estimated that in Peru in 2010 the infrastructure gap to guarantee universal access was US$3.5 billion (Salazar 2010).

Green Infrastructure Regulatory Framework

The regulatory framework can either facilitate or impede investment in green infrastructure by the drinking water sector. Drinking Water Regulators and operators in Latin America and the Caribbean come from diverse social and political realities, and they have different competencies according to the laws governing the specific country in which they operate. Conditions vary from country to country; therefore, it is not possible to generalize actions and results throughout the region.

The regulatory framework defines institutional architecture. There are countries where there is one operator and one regulator, and in these cases the presence of just one institution allows more specific administrative and public policies. In other countries that have a federal political structure, such as Brazil, more autonomy is given to the states and so there is a wider range of criteria to establish water and sanitation policies. For this reason, Brazil has a National Association of Water Regulators (ABAR – for its acronym in Portuguese) which is comprised of 52 associated agencies, 17 municipal agencies, 28 state agencies, and 17 federal agencies.

In all cases the legal ordinances establish that it must be the state government, federal government, provincial government, and/or municipal government that executes the administration of drinking water, sanitation, and collection services in their territory. It gives them the option to provide service in various ways: through public companies, mixed companies, companies with a majority of state capital, whether through private societies or through participation agreements.

In many cases regulators and water operators are dependent on higher level entities such as the Presidency[5], Ministries, or Sub-Secretariats. By being dependent they are limited by the existence or non-existence of public policies for managing, administering, and supplying water and sanitation.

[4] The amount is collected per cubic meter of consumption and in other cases according to the area of land to be protected.

[5] Peru has an autonomous regulating entity that is independent from the drinking water and sanitation sector that is assigned by, but is not dependent on the President's Council of Ministers.

As mentioned previously, only Peru has defined a specific regulatory framework that requires drinking water companies to contribute to mechanisms for the of ecosystem services through their drinking water tariffs, which are summarized in the following table. This decision is possible given SUNASS is in charge of approving drinking water tariffs that are revised every five years.

The investment in protecting ecosystems and watersheds in the regions responds to national environmental conservation programs, transfers, and voluntary contributions that are summarized in Table 2:

Table 2: Protection Programs for Supplying Watersheds

TYPE	PROGRAM	COUNTRY	FORM OF TRANSFERENCE
National Programs	Forest Conservation Programs	Costa Rica	Subsidios
	Payments for Hydrological Services Program	Mexico	Subsidies
	Socio Paramo	Ecuador	Subsidies
Decentralization	Socio Paramo	Ecuador	Subsidies
Tariffs	Environmental Corporations	Colombia	Direct Investment
	Water Producers	Brazil	Competitive Funds
Voluntary Water Funds	Tariff Resolutions for drinking water utilities	Peru	Direct Investment,
	Water Funds, Agreements	Bolivia Jaén/San Ignacio-Perú	Convenios tripartitos

Source: EcoDecisión

In general, there is a growing tendency in the region to promote public and private investment in protecting water sources. Eleven percent of respondents point out incentive payments to land owners and managers as one of the activities their organization undertakes to protect water sources.

National programs have been established in countries such as Costa Rica, Mexico, and Ecuador. The central government finance these programs by paying private and community owners to protect forests or natural ecosystems. These programs recognize ecosystem services for water protection and assign specific resources to make payments or provide subsidies to owners. In the case of Mexico, national resources are channeled through a forest fund as authorized by law and can be matched with the support of local governments. Costa Rica has several economic instruments for water resources management. It initially created a tax on fossil fuels as a main source of the program and pays for forest protection for the benefits of mitigating climate change, water protection, biodiversity, and landscape beauty. Additionally, there is the Heredia Public Services Company program, through which the water operator collects funds for green infrastructure from water users. Ecuador created the Socio Bosque program with a subprogram called Socio Paramo (high grassland), which recognizes the important role of the high Andean grassland ecosystem in providing water for the country. Overall, in the region resources are mostly channeled through trust funds as listed in Table 2.

In the case of Colombia, the law that created the environmental ministry is unique because it establishes its own financing sources. It defines allocation percentages that must be transferred to decentralized entities – Regional Autonomous Corporations – that are the environmental authorities. In particular, it requires that a percentage of electricity, water and sanitation tariffs must be invested in protecting water sources.

Peru[6] and Colombia[7] approved innovative environmental laws that support watershed investments in 2013, the effects of which will be felt in the coming years. In Peru, the Ministry of Environment created a legal framework that promotes "Compensation Mechanisms for Ecosystem Services" (MRSE – for its acronym in Spanish), in addition to the actions performed by the drinking water and sanitation sector regulating entity and the Housing Ministry.

In order for water operators to participate in green infrastructure, the legal and political feasibility must be considered.

The water tariff is a key aspect for investment. Initiatives that have set contributions through the tariff, such as the cases in Moyobamba, Cusco, Abancay, and Lima in Peru and FONAG and FORAGUA funds in Ecuador, have – and will continue to have – a stable source of income. In addition, the tariff assures the sustainability of investment over time and is a way to directly link consumption to environmental impact.

The regulatory framework defines the regulator's role, and in countries where the regulator is responsible for setting the drinking water tariff, represents a great opportunity to support green infrastructure. Drinking water regulators are national or sub-national entities with greater political power and ample institutional authority and thus have the competence to provide key information for decision making, as in Peru, Costa Rica, Chile, Colombia, and Bolivia. Decisions are more complex in Brazil where there is a federal system and more than one regulator.

It is important to highlight the political dimension of any decision regarding water prices. As water is a public good and its access is often recognized as a human right, affecting the price of water can have great political consequences (Salazar, 2015).

Financial Mechanisms

The financial mechanisms used to channel investments in green infrastructure in the region are mainly endowments and investment funds. The national budget expenditures of Costa Rica, Mexico, and Ecuador are channeled through specific funds created by the law with a specific function. A public, mixed, or private financial entity can manage these resources.

Water users show a growing interest in the creation of water funds. These voluntary frameworks define the contribution of their members based on local negotiations. The first of them, FONAG, created in Quito, Ecuador in 2000, established from the very beginning that its primary contributor, the Qutio Water Company - EPMAPS, would assign a monthly percentage from drinking water and sanitation revenues. Through a municipal ordinance the value was initially set at one percent with an increase to reach a maximum of two percent (currently used). A similar framework was established for member municipalities of the Regional Water Fund - FORAGUA in Southern Ecuador, where a specific contribution for each locality is defined through a municipal ordinance. In contrast, there are water funds that negotiate their contributions every year depending on each member, as is the case for the Paute Water Fund – FONAPA in Ecuador.

It is important to highlight that the water fund model proposes the use of fiduciary trusts that operate under the financial laws of each country, taking advantage of the benefits that they offer. Because they are financial mechanisms under the investment laws of each country, they are managed for the purpose of achieving a specific goal under an independent financial entity. This allows the use of investment yields with transparency and accountability in the use of resources. The financial entity must oversee that resources are not used for purposes other than those defined in the contract. In addition, they offer the option of long-term establishment, in accordance with the laws of each place. In Ecuador, for example, trusts can be constituted for up to 80 years, 25 years in Colombia, and 30 years in Peru.

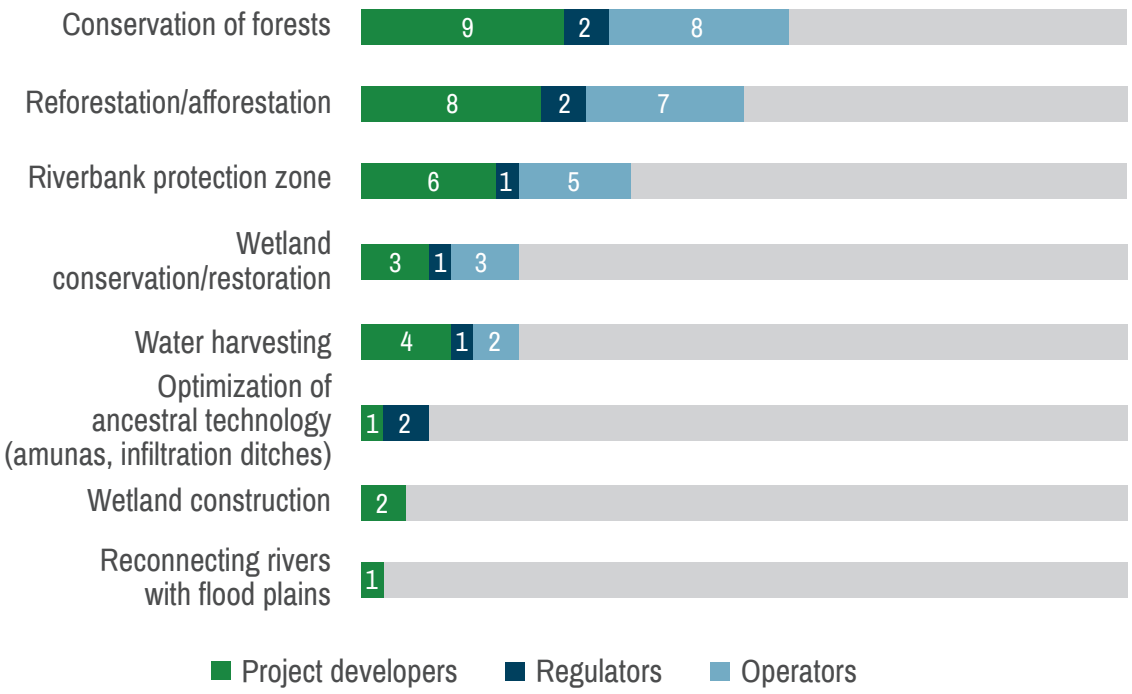
[6] Environmental Ministry of Peru, Supreme Decree 30215, Compensation Mechanisms for Ecosystem Services Law. 2013.

[7] Environmental Ministry of Colombia. Decree 0953 - 2013.

Green Infrastructure Actions

According to the survey, water operators, regulators, and project developers implement the following **green infrastructure actions**: forest conservation, reforestation, riparian protection, wetland conservation/restoration, and water harvesting.

Figure 3: Green Infrastructure Actions



Source: EcoDecisión

Respondents also mentioned the following additional green infrastructure activities:

- Environmental education
- Organic farming, terracing, conservation agriculture and alternative agricultural practices (conservation of agro-forest coffee systems for example), to improve yields and reduce environmental impact of local production systems
- Protection of water recharge areas
- Restoration of slopes, ravines, and reservoirs
- Water and land conservation works
- Control and management of areas with active erosion (embankments, stake fences, re-vegetation, etc.)
- Construction and/or installation of domestic and/or industrial residual water treatment systems
- Implementation of productive activities that are forest friendly, such as beekeeping and crafts
- Micro reservoirs

- Payment to landowners for ecosystem services
- Partial or complete exclusion of agricultural activities
- Monitoring activities to prevent and combat fires and to prevent illegal use of natural resources
- Forest management in areas affected by plagues and diseases

Box 3: Pipiripao, a multisector alliance in Brazil

In the state of Brasilia, actors from diverse sectors have formed an alliance for water protection. This alliance includes the federal government, the local government, NGOs, and private companies.

Under the *Pipiripau – Water Producer* Project, 18 members from different institutions work together to improve land and water management in this watershed. The final goal is to increase water availability, improve water quality, and improve water regulation regimens in rivers. The project promotes conservation practices.

In addition, there is a payment mechanism in place for environmental services through the Water Producer Program. The "polluter pays" principle is promoted through voluntary membership: if someone harms the environment, that person is obligated to pay for those actions. Under this new vision, producers are convinced to take care of the environment thus avoiding actions that degrade natural resources.

Source: Jose Bento da Rocha, ADASA

Impact of Green Infrastructure

The task of determining the impact of green infrastructure is complex. The expectation is that green infrastructure measures will improve water resources, for example in improving water flow generally or particularly during dry seasons. It is expected that if lands are well managed and there is adequate natural cover, water quality will be adequate and with low sediment loads. Good agricultural practices reduce discharge of contaminants. In order to measure these processes it is necessary to have monitoring and evaluation programs in place; currently not common to all water operators and regulators. Thus, it is important to use science to make the right management decisions. (Naeem et al., 2015)

In the case of regulating entities, Peru's regulator (SUNASS) in coordination with the Compensation Mechanisms Incubator of the Ministry of Environment (MINAM – for its acronym in Spanish) and CONDESAN developed a Rapid Hydrological Assessment tool that is a good starting point to measure impacts. CONDESAN´s Initiative for Hydrological Monitoring of Andean Ecosystems (iMHEA – for its acronym in Spanish) has also developed a methodology for hydrological monitoring focusing on the bare minimum needed to insure implementation. Both documents are available at the following link: http://imhea.condesan.org/. The Nature Conservancy also has a guide for monitoring water funds.

In addition to physical measurements, there are a series of social and political advantages to green infrastructure that can result in economic benefits for water operators. For example, having good relationship and governance with surrounding communities will facilitate operations. This is the case of the Medellin Water Company, (EPM – for its acronym in Spanish), which created the Cuenca Verde water fund and has developed an integrated monitoring system. (See Box 4). This kind of socio-economic assessments use some of the indicators that the drinking water sector has been recommended to use to improve its efficiency and cost effectiveness by ECLAC (2014).

Box 4: Monitoring by Public Companies in Medellin, Colombia: A pPowerful Tool for Decision-Making

In Antioquia, Colombia, the Cuenca Verde water fund monitors water quality and quantity in the supplying watersheds of the Rigorande II and La Fe reservoirs, in the interest areas where the water fund actions are implemented. The fund was established by the Medellin Public Companies - EPM and has the participation of private companies, multilateral institutions, and other key actors.

Technical teams perform spatial analysis of intervention areas and select monitoring and sampling points for monitoring actions. Through BACI methodology (Before After Control Impact), information is collected before and after the intervention. An evaluation of the behavior of the specific parameter is performed throughout the intervention zone.

Sample points or control points correspond to points where there are no fund activities but are similar to the impact points and thus allow the measurement of fund activities. Reference points correspond to sites with optimal conservation conditions and therefore provide reference to the desired optimal state. The project identified 206 monitoring points that allow the evaluation of approximately 62 water sources in the five municipalities of influence of the Riogrande II reservoir. The measurements taken in the field include the following: environmental quality index, organic matter pollution index, suspended solids pollution, trophic pollution, and mineralization pollution.

Samples are taken upriver and downriver, as is the case with the establishment of forests on the riverbanks of the Cisquiarca ravine in the municipality of Belmira, to model de impact of the intervention. Colanta, a milk producers cooperative, is a strategic ally of the water fund that support analyzing field parameters.

All respondents recognize the importance of monitoring; nevertheless, there is a great diversity of indicators. Some are very generic while others are very specific. Indicators provided by respondents are listed in Table 3 and they present a wide range of options.

Table 3: Indicators Used for Monitoring

WATER OPERATOR INDICATORS	WATER REGULATOR INDICATORS	PROJECT DEVELOPER INDICATORS
√ Surveyed and monitored area of intervention (ha) √ Percentage of hydrologically significant catchment area with interventions √ Water resource – land use √ State water resources √ Biodiversity √ Ecological Connectivity √ Population wellbeing √ Good governance	√ Goals of the Municipal Plan for Basic Sanitation √ Base flow (l/s), minimum flow in drought season √ Turbidity in raw water (NTU) √ Hours of plant stoppage to clean filters √ Continuity: hours per day without service due to low flow √ Hydrographic units that comply with quality patterns established by ADASA.	√ Improvement of the physical, chemical, and bacteriological quality of water (using water quality indexes) √ Decrease of the contribution of sediment to water sources √ Ecosystem monitoring processes of passive and/or active restoration √ Water monitoring (water regulation) √ Socioeconomic monitoring actions of water funds

Table 3: Indicators Used for Monitoring (Cont.)

INDICADORES OAP	INDICADORES REGULADORES	INDICADORES PROYECTOS
	√ Hydrographic units that comply with minimum values of water availability. √ River monitoring √ Index of service requests provided √ Index programmed audits of water resources √ Protected areas (In the future, quality and quantity of water) √ Sedimentation	√ Governability √ User expectations √ Forest regeneration √ Water quality and quantity √ Biodiversity √ Monitoring progress of forest regeneration/ restoration √ Measurement of water flow and superficial river bodies √ Volume of retained sediment √ Infiltration capacity in plots √ Crop productivity indexes √ Solid retention √ Forest coverage

Source: EcoDecisión

Regarding cost-effectiveness measures, the regulating entity of Brasilia (ADASA) has performed cost-benefit studies, as have Colombia and Costa Rica. SUNASS in Peru is currently developing the methodology for assessing cost-effectiveness.

According to a recent study on the investment in watersheds by water companies that are members of ALOAS, 25 percent of operators in the region performed a cost-benefit analysis of their activities related to watershed protection (Moss, 2015).

Forest Trends, with the support of the global project "Scaling Up Investments in Watershed Services," funded by the Swiss Agency for Development and Cooperation, has created a cost curve comparing the cost-effectiveness of different types of interventions in Lima´s watersheds (Gammie & De Bievre, 2014).

The Natural Capital Project has a model called RIOS that measures the benefit generated through investment in ecosystem protection. (http://www.naturalcapitalproject.org/software/)

Global studies by Forest Trends show that proponents of water protection programs are introducing new tools to measure the effectiveness of investment in watersheds (Bennett & Carroll, 2014). These efforts have a reach beyond the program's specific jurisdictions and may quantify additional benefits for the surrounding populations, such as sustainable livelihoods and biodiversity protection.

On the other hand, by having monitoring systems in place it is possible to integrate complementary studies that help the decision-making process. Studies of paired watersheds by iMHEA-CONDESAN in Bolivia and Peru that compare overgrazed zones to areas that have measures in place to exclude livestock, demonstrate that areas in good conditions can generate significant additional water flow. In this case an additional 43,000 cubic meters of water per square kilometer were measured, which highlight the effectiveness of excluding livestock from hydrologically important areas.

Considering that water operators often have water quality monitoring systems in place, it is important that these results inform operation decisions. For example, turbidity is a measure regularly taken by water operators but is not correlated to deforestation processes in the watershed. Loss of vegetation cover in the upper watershed can lead to erosion and affect the drinking water service due to higher treatment costs (decrease in the use of flocculants or chemicals) or even the need to close treatment plants (stoppages) (CONDESAN, 2015). By linking key environmental and operational indicators water operators can insure users a stable, uninterrupted service due to land stability. This is why it is necessary to assign a budget for green infrastructure implementation and also for monitoring and evaluation to be able to determine the effectiveness and cost-effectiveness of the investment.

.

Motivations and Roles for Green Infrastructure Investment

The analysis of survey responses, the input of water experts, and existing literature showed that green infrastructure investment requires clarity on the roles of the various actors in the sector, including water regulators, water operators, and project developers. It is also necessary to understand each actor's motivations.

Statements were included in the survey to allow evaluate the opinion of regulators, operators, and project developers regarding various aspects of green infrastructure investment.

Regulators, operators, and project developers generally agree on the benefits of green infrastructure:

- Investment in green infrastructure contributes to climate change mitigation
- Investment in green infrastructure is a cost-effective strategy for water management
- Green infrastructure helps reduce disaster risk
- Green infrastructure helps create alliances with other entities and promotes good relationships among multiple actors
- There are positive experiences in the region regarding green infrastructure
- Upstream communities will favorably accept green infrastructure projects and interests with these communities can be aligned

The main divergences in opinions revolved around the following:

- Clarity of the legal and regulatory framework to use resources for green infrastructure
- Planning for the effective management of watersheds
- Scope and meaning of the term green infrastructure
- Technical capacity of operators and project developers to design effective green infrastructure projects
- The effectiveness of monitoring plans and indicators for green infrastructure projects
- Short-term vs. long-term nature of green infrastructure benefits.

The different opinions regarding these statements indicate that corrective actions must be taken otherwise they could become barriers for the investment of green infrastructure. For some operators from Colombia, Ecuador, and Mexico, the definition, scope, and legal framework of green infrastructure is still not clear. It is necessary to better articulate watershed management and land use/planning activities and to monitor effectiveness. For some operators, there are still doubts as to whether interventions in green infrastructure prove to be beneficial in the short term.

Operators, regulators, and project developers agree on the importance of having a regulatory framework that promotes green infrastructure, as well as, operators with the technical capacity to implement the necessary interventions.

In order to clarify the legal framework, it is important to analyze the different stages of investment: resource generation, mechanisms for transferring resources, the execution of activities, and where

intervention is needed. All these stages offer varying opportunities and challenges according to the regulatory context of each country.

Table 4 summarizes the current resource allocation process and their linkages with water operators:

Table 4: Summary of the Regulatory Framework for Investment in Green Infrastructure Relevant for Drinking Water Operators

COUNTRY	SOURCE	HOW RESOURCES ARE TRANSFERED	IMPLEMENTOR	WHERE
Brazil	Water and agriculture use rates	Watershed councils	Contractors with co-financing	Private and community land
Colombia	Water use and discharge rates	Environmental entities	Environmental entities and contractors	Within their jurisdiction
Costa Rica	Drinking water rates	Company and through FONAFIFO	Contractors, private and community owners	Their property
Ecuador	Voluntary allocation	Companies/ municipalities can transfer to water funds	Contractors, private and community owners	Their property
Mexico	National budget and water tariffs	Matching Funds Program	Private and community owners	Their property
Peru	Water tariffs	Companies, lenders, contractors, and funds	Companies, contractors, and water funds	Within their jurisdiction

Source: EcoDecisión

There are countries that have resources that can be allocated to the conservation of drinking water sources but where the resources are not collected by operators but by the water or environmental authorities, as are the cases of Brazil and Colombia. Costa Rica is currently revising its water tariff rulings in order to include environmental investment. This revision uses the work performed by the Heredia Public Services Company as a reference. In Ecuador there was no national regulator before 2014 and so the municipalities set their own water tariffs. Tariffs were established at the local level to protect watersheds through ordinances that channeled resources towards water funds. Also, Mexico does not have a drinking water regulating entity, but operators can participate through co-financing frameworks through the Matching Funds Program with the National Program for Payments for Hydrological Services. The allocation of funds must be analyzed in order to promote investment in green infrastructure measures such as the ones mentioned in this document. In order to clarify the role of each player it is necessary to analyze financing and how it is channeled and spent to promote effective interventions according to each country's context.

Major Findings

The key findings of the current study are summarized as:

- Green infrastructure is a concept that is new to the region, especially to the drinking water and sanitation sector. It is important to define the scope and concept of green infrastructure, which should be broad enough to incorporate the range of contexts in the region, while not losing its essence.
- Results from the study show that operators invest up to three percent of their budget in green infrastructure and affirm that this allocation is increasing. An early estimate of EcoDecision from the last three years indicates an annual investment of approximately $13.9 million by operators.
- Results show that there is a perception amongst operators and regulators that investment in green infrastructure is cost-effective, that it provides a favorable image for operators, and that it promotes good relationships with upstream communities
- Water funds are among the most widely used financial mechanisms for investment in water protection. The study identified a total of 28 initiatives that include the participation of drinking water operators, of which half are water funds. Operators also make investments in green infrastructure through direct execution, co-financing, or through third parties.
- In some countries, unclear regulatory frameworks limit operator investment in green infrastructure; aspects that lack clarity include the source of resources, the mechanism for transferring resources, and where to effectively execute green infrastructure activities.
- Drinking water operators have found institutional and financial weaknesses, which affect decisions related to investment in green infrastructure.
- The water tariff is a key element to channel resources towards green infrastructure in watersheds, and it contributes to the sustainability of the operator's actions.
- Monitoring of green infrastructure actions is incipient; indicators are very diverse. The different systems for monitoring and evaluation limit the availability of information to measure the impact and cost-effectiveness of investments. In addition, it is difficult to consistently compare between watersheds.
- Regulators generally fill the role of promoter and facilitator of investments in green infrastructure.
- Operators' main role is assigning resources and in some cases can also be the executor of green infrastructure actions or can implement through third parties.

Recommendations

- It is necessary to **agree on the scope and concept of green infrastructure** so that it is simple but broad enough to be adapted to the different realities and experiences of each location without losing its essence. For this reason, ADERASA´s Green Infrastructure Working Group proposes the following definition::

"Set of activities, actions, and/or measures implemented in hydrological important ecosystems (for drinking water operators), with the goal of **restoring and/or optimizing ecosystem's** *hydrological functions and guaranteeing the availability of drinking water for users".*

- It is evident that **greater alignment between environmental programs and drinking water operators** is required. This will leverage economic and technical resources. In addition, specialists highlight the benefits of having greater horizontal alignment and coordination among entities of the same hierarchy (ministries, and central government agencies), as well as vertical alignment between regional and central governments.

- **Technical capacity** for designing and implementing green infrastructure among water operators and other actors must be **strengthened**. Existing networks, such as WOP-LAC and ALOAS, should also be strengthened and taken advantage of in order to leverage resources and increase effectiveness.

- **Policy guideline proposals** should be developed to promote the protection of water resources and the ecosystems that source them. It is necessary to have a clear regulatory framework that facilitates and motivates water operator investment in green infrastructure. We recommend promoting a greater connection between green infrastructure and other issues on government agendas (environmental programs, land ordinances, climate change, development, governance).

- It is necessary to promote a greater connection between green infrastructure and other issues on government agendas in a more integrated manner (environmental programs, land ordinances, climate change, development, governance).

- The concept of adaptive management should be developed where monitoring and evaluation systems allow measuring performance of green infrastructure investments, and thus improve its impact and cost-effectiveness. Monitoring must be considered more than just a cost—it should be an investment for decision-making.

- It is necessary to take advantage of **different methodologies and tools for the design, implementation, and evaluation of green infrastructure.** These methodologies must be shared within ADERASA's Green Infrastructure Working Group. For example, by defining the time-span and scale of interventions as part of the cost-benefit analysis. It is also recommended to establish monitoring systems with a focus on paired watersheds using iMHEA and agreeing on a group of minimum indicators for monitoring and using simple measuring methodologies.

- With the support of specialized member entities, it is possible to **develop guidelines and tools** that can help water operators and other actors guide green infrastructure investments. This allows the establishment of certain minimum standards for monitoring or developing methodologies and basic indicators to measure the long-term impact of green infrastructure.

- More in-depth knowledge on those **financial schemes that are currently working is recommended, in order to strengthen their management capacity with a special emphasis on monitoring its investments**. Learning from these experiences will benefit new initiatives. Strengthening monitoring actions on the state of aquifers in the region is also suggested. Documenting its status, relationship with land use, and vegetative cover management, will help link green infrastructure investment.Outreach and training **actions are recommended for operators and other key watershed actors** on the importance of green infrastructure for different water uses.

- Outreach and **training actions are recommended for operators and other key watershed actors** on the importance of green infrastructure for different water uses.

- Based on the systematization of certain experiences, promoting **exchanges between operators and financial mechanisms for green infrastructure is suggested**. This can strengthen networks and scale-up models related to critical themes such as: regulations, actions, monitoring, and relationships with other stakeholders.

References

ADERASA. (2015). Informe de Relatoría de la Primera Reunión del Grupo de Infraestructura Verde de ADERASA. Lima, Perú.

Bennett, G. & Carroll, N. (2014). Gaining Depth: State of Watershed Investment 2014. Disponible en: www.ecosystemmarketplace.com/reports/sowi2014.

CEPAL & GIZ. (2010). Seminario Internacional Rol del regulador de agua potable y saneamiento en el siglo XXI: retos y oportunidades.

CEPAL. (2014) Políticas Tarifarias y Regulatorias en el Marco de los Objetivos de Desarrollo del Milenio y el Derecho Humano al Agua y el Saneamiento. Serie Recursos Naturales e Infraestructura 164. Emilio J. Lentini y Gustavo Ferro

Comunidad Andina de Naciones (2012). Estrategia Andina para la Gestión Integrada de Recursos Hídricos. Lima, Perú.

CONDESAN (2014), Diagnóstico Hidrológico Rápido. Disponible en: www.condesan.org

Cuenca Verde (2015), Formulación del Programa de Monitoreo de la Calidad y Cantidad del Recurso Hídrico de la Corporación Cuenca Verde para el Seguimiento de las condiciones ambientales en las cuencas abastecedoras de los embalses Ríogrande II y La Fe producto de las acciones del Fondo de Agua.

Gammie, G. & De Bievre, B. (2014). Assessing Green Interventions for the Water Supply of Lima. Washington, DC: Forest Trends Association.

Gartner, T., Mulligan, J., Schmidt, R., Gunn., J. (Eds.). (2013). Natural Infrastructure: investing in Forested Landscapes for Source Water Protection in the United States. Washington, DC: World Resources Institute. Disponible en: http://www.wri.org/sites/default/files/wri13_report_4c_naturalinfrastructure_v2.pdf

Kieser & Associates. (2012). Phase 1- Technical Report.

Mahlknecht, J. & Pastén, E.,(2013). Diagnóstico de los Recursos Hídricos en América Latina. Monterrey: FEMSA, Tecnológico de Monterrey, México: Pearson.

McDonald, R.I. & Shemie, D. (2014). Urban Water Blueprint: Mapping conservation solutions to the global water challenge. Arlington, VA: The Nature Conservancy.

Moss, D. (2015a). Building a climate resilient water sector in the Caribbean: Strategies for Water Utilities.

Moss, D. (2015b). Strategies of Latin American and Caribbean Water Operators to Protect Source Water and Watersheds: Findings from an Emerging Learning Community Supported by the Inter-American Development Bank.

Naeem, S., Ingram, J.C., Agardy, T., Barten, P., Bennett, G., Bloomgarden, E., Bremer, L.L., Burkill, P., Cattau, M., Ching, C., Colby, M., Cook, D.C., Costanza, C., DeClerck, F., Freund, C., Gartner, T., Goldman-Benner, R., Gunderson, J., Jarret, D., Kinzig, A.P., Kiss, A., Koontz, A., Kumer, P., Lasky, J.R., Masozera, M., Meyers, D., Milano, F., Naughton-Treves., L., Nichols, E., Olander, L., Olmsted, P., Perge, E., Perrings, C., Polasky., S., Potent, J., Prager, C., Quetier, F., Redford, K., Saterson, K., Thoumi, G., Vargas, M.T., Vickerman, S., Weisser, W., Wilkie, D., Wunder, S. (2015). Environment

and Development, Get the Science right when paying for nature's services. Science, 346(6227), 1206-1207.

Ochoa, B. (2015). Estudio sobre pastoreo en Cuencas Pareadas en Bolivia y Perú, – resultados preliminares. Documento no publicado. Presentado en taller macroregional de mecanismos de retribución por servicios ecosistémicos: Tarapoto.

Salazar, José. (2010) "El Modelo Regulatorio Peruano para la Gestión de los Servicios de Agua Potable y Saneamiento". I Encuentro Iberoaqua sobre Innovación de la Gestión del Agua en Iberoamérica.

Solanes, M. (2015). Gobernanza y finanzas para la Sostenibilidad, VII Foro Mundial del Agua-Corea.

The Nature Conservancy (2015), "Infraestructura Natural, una oportunidad para la seguridad hídrica en 25 ciudades de Latinoamérica."

United Nations Environment Programme (2014). Green Infrastructure Guide for Water Management: Ecosystem-based management approaches for water-related infrastructure projects. Disponible en: http://cmsdata.iucn.org/downloads/green_infrastructure_guide.pdf

INTERVIEWS AND PERSONAL CONSULTATIONS

Bassani, M., Especialista Agua Potable Ecuador, Banco Interamericano de Desarrollo. 6 de noviembre, 2015), Entrevista personal.

Jouravlev, A., Oficial para Asuntos Económicos, División de Recursos Naturales e Infraestructura Comisión Económica para América Latina y el Caribe (CEPAL), (26 de octubre, 2015). Entrevista personal.

Lloret. P., Gerente Ambiental, Empresa Municipal Pública de Agua Potable de Quito (EMAPS), Ecuador. (14 de Octubre, 2015). Entrevista personal.

Salazar, J. Consultor Independiente, Ex-Presidente SUNASS, Perú. (29 de Octubre, 2015). Entrevista personal.

Annex 1 – Research Methodology

The study was concentrated in Latin American and Caribbean countries, excluding Canada and the United States. It covers all initiatives that promote the improvement of ecosystems linked to guaranteeing the supply of water. The scope does not include initiatives for improving green infrastructure within cities (with green roofs or urban parks for example), nor initiatives for marine/coastal infrastructure, although examples of these types of initiatives could be presented if adequate to achieve the study's objectives. Despite the fact that groundwater is a fundamental of any hydrological analysis at the watershed level, it was not considered within the scope of the investigation.

For purposes of the report, the category of "drinking water operators" was widely defined, including drinking water cooperatives and private and public companies. The scope for the operators' survey focused on the largest operators and on members of the Latin American Association of Water and Sanitation Operators (Asociación Latinoamericana de Operadores de Agua y Saneamiento (ALOAS)).

The study focused on four main themes:

1. Investment trends in green infrastructure in the region
2. Factors that influence green infrastructure investment decisions by operators
3. Impacts of green infrastructure investment
4. The roles of operators and regulating entities regarding green infrastructure investment

Information was gathered through online surveys (SurveyMonkey)[8] and interviews with international experts in the drinking water and sanitation sector knowledgeable of the national and regional reality. Information was also gathered from secondary sources.

The surveys were distributed to representatives of drinking water operators, regulators, and project implementers with the support of SUNASS, as the entity currently presiding ADERASA, the secretary of ALOAS and TNC and their network of funds for water through their national representatives. Organizations and individuals that participated in the global report on Latin American investment for water protection prepared by EcoDecisión were also invited to participate in the survey.

The responses that were received and validated include the following:

[8] Some surveys were received in Excel format. The surveys were written in Spanish, English and Portuguese. Both formats are available at: http://forest-trends.org/encuesta-infraestructura-verde.php

Table 1 Summary of Surveys

TYPE OF ACTOR				
COUNTRY	**WATER OPERATORS**	**REGULATOR**	**PROJECT DEVELOPERS**	**TOTAL**
Bolivia	Cochabamba Federation of Cooperatives of Drinking Water and Sewage (Federación de Cooperativas de Agua Potable y Alcantarillado de Cochabamba (FECOAPAC))			1
Brazil	Pernambucana Sanitation Company	Federal District Water, Energy and Basic Sanitation Regulating Agency (Agência Reguladora de Águas, Energia e Saneamiento Básico do Distrito Federal (ADASA-DF))	Iniciativa Verde	5
	Jataí	Inter-Municipal Sanitation Regulating Agency (Agencia reguladora intermunicpal de saneamiento (ARIS))		
Chile	National Federation of Service Cooperatives			1
Colombia	Manizales Waters (Aguas de Manizales S.A.E.S.P.)	Drinking Water and Basic Sanitation Regulation Commission (Comisión de regulción de agua potable y saneamiento básico)	Cuenca Verde Corporation	4
	Pasto Company of Sanitation Works (Empresa de Obras Sanitarias de Pasto S.A.E.S.P)			
Costa Rica	Heredia Public Services Company (Empresa de Servicios Públicos de Heredia S.A. (ESPH))	Public Services Regulating Authority (Autoridad reguladora de los Servicios Públicos)	Nectandra Institute	3
Ecuador	EMAPA-P	Guayaquil Drinking Water and Sanitation Municipal Company, Public Company (Empresa Municipal de Agua Potable y Alcantarillado de Guayaquil, Empresa Pública)	Water fund for the conservation of the Paute River watershed	6
	Public Metropolitan Drinking Water and Sanitation Company (Empresa Pública Metropolitana de Agua Potable y Saneamiento (EPMAPS))		Regional Water Fund	
			Fund for Water Protection (Fondo para la Protección del Agua (FONAG))	

TYPE OF ACTOR				
COUNTRY	**WATER OPERATORS**	**REGULATOR**	**PROJECT DEVELOPERS**	**TOTAL**
Honduras	Siguatepeque Waters			1
Mexico	Xalapa Water and Sanitation Municipal Commission (Comisión Municipal de Agua y Saneamiento de Xalapa)		Triunfo Conservation Fund Monterrey Metropolitan Water Fund.	5
	ANEAS		National Forest Committee	
Paraguay		Sanitation Services Regulating Agency (Ente Regulador de Servicios Sanitarios (ERSSAN))		1
Peru	EPS Marañón	National Superintendent of Sanitation Service (Superintendencia Nacional de Servicio de Saneamiento (SUNASS))	Moyobamba Management Committee	5
	Drinking Water and Sanitation Services Company (Empresa Prestadora de Servicio de Agua Potable y Saneamiento S.A.(SEDAPAR)).		"Partnering for Adaptation and Resilience" Water Project	
Dominican Republic			Environmental and Natural Resources Ministry	2
			Santo Domingo Aqueduct and Sewage System Corporation (Corporación del Acueducto y Alcantarillado de Santo Domingo (CAASD))	
TOTAL	**14**	**7**	**13**	**34**