Rural Water Sustainability in Latin America and the Caribbean

The Sanitation Boards in Paraguay

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I want to dedicate these pages – and all that they mean – to my mama, the greatest example of effort, love, and commitment, and to my brother, a good man.

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Abstract

Water is an essential resource and a fundamental vector in sustainable development. The lack of access to improved water resources has important impacts on health, economy, and education, especially for the most vulnerable populations. However, access does not guarantee an appropriate level of service that is affordable, equitable, and universal. Significant efforts in the international arena have pushed the agenda to improve access, especially in rural areas where levels of access have been historically lower and unevenly distributed. Several models of water management, embracing both public and private sector participation, have been promoted in countries in Latin America and the Caribbean. Traditionally, community-based management has been the most common approach in rural areas, supported by governments and international aid institutions, although results have been mixed.

In Latin American and the Caribbean levels of access to improved water resources have improved significantly in recent decades, achieving and surpassing the Millennium Development Goals. However, challenges are still enormous. Sustainability is a target that must be hit in order to ensure an optimal level of service in the long-term, with strategies that guarantee the environmental, institutional, management, financial, technical, and social dimensions of a system's sustainability.

This research is based on an extensive review of literature on rural water, the current situation related to access in Latin America and the Caribbean, and the evolution of water sector management under different models. A probing assessment on sustainability in the rural water sector, on measurement tools, and on international experiences in water management has also been conducted. The analysis of more than 1,100 indicators shows that institutional, management, technical, and financial dimensions are associated with between 21 and 23 percent of the indicators defined in the 29 tools assessed. Environmental aspects, at a mere 4 percent, are the least common.

The case study of 100 rural communities in Paraguay aims to combine theories on sustainability tools and indicators with a practical approach. Existing information was rounded out with a follow-up survey administered to a sample of users and 100 sanitation boards that manage the water systems, together with a water system assessment in each of the communities. Results show a high level of service in almost all of the 100 communities, with a high likelihood of long-term sustainability, which is due in large part to the high levels of management and social capital

of the communities. The main challenges identified to ensure water sustainability were related with the quality of the source – negatively impacted by climate change effects and the lack of standards for controlling source use – and the lack of financial capacity to expand systems. The cultural value of water is a key aspect affecting user willingness to both pay and responsibly manage the system. The constant support of the Paraguayan government in the rural water sector through the Ministry of Health's autonomous institution (SENASA) also plays a positive role.

The study confirms that the challenges in measuring sustainability in rural water systems and in developing a common framework are enormous. Official data regarding access does not reflect sustainability problems, which can jeopardize significant investments in new and rehabilitated infrastructure. Community participation in addressing these challenges in the rural areas is strategic, but other conditions also require governmental support. Availability of data and appropriate indicators for measuring sustainability are the first steps to understanding the whys, the hows, and the whos involved. From there, national and sub-national governments should prioritize strategies for ultimately improving population welfare.

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Resumen

El agua es un recurso esencial y un vector fundamental para el desarrollo sostenible. La falta de acceso a agua mejorada tiene un impacto importante en la salud, la economía y la educación, especialmente para las poblaciones más vulnerables. Sin embargo, el acceso no garantiza un nivel adecuado de servicio, asequible, equitativo y universal. Importantes esfuerzos en el ámbito internacional han impulsado la agenda para mejorar el acceso a agua mejorada, especialmente en las zonas rurales, donde históricamente los niveles de acceso han sido más bajos y su distribución más desigual. Varios modelos de gestión del agua, implicando tanto al sector público como al privado, se han promovido en los países de América Latina y el Caribe. Tradicionalmente la gestión comunitaria ha sido el enfoque más común en las zonas rurales con apoyo de los gobiernos y las instituciones de ayuda internacional, aunque los resultados han sido mixtos.

El acceso a agua mejorada en América Latina y el Caribe ha mejorado significativamente en las últimas décadas, alcanzando los Objetivos de Desarrollo del Milenio. Sin embargo, los retos siguen siendo enormes. La sostenibilidad es una tarea pendiente para garantizar un nivel óptimo de servicio en el largo plazo, con estrategias que garanticen las dimensiones ambiental, institucional, de gestión, financiera, técnica y social de la sostenibilidad de los sistemas.

Este estudio se basa en una extensa revisión de la literatura sobre agua rural, la situación actual en relación al acceso en América Latina y el Caribe y la evolución de la gestión del sector bajo varios modelos. También se ha llevado a cabo un análisis exhaustivo sobre la sostenibilidad en el sector agua en zonas rurales, sobre las herramientas para su medición y sobre experiencias internacionales en la gestión del agua. El análisis de más de 1.100 indicadores muestra que las dimensiones institucional, de gestión, técnica y financiera reúnen entre el 21 y 23 por ciento de los indicadores definidos en los 29 instrumentos de medida de la sostenibilidad evaluados. Los aspectos ambientales son los menos reconocidos, con aproximadamente un 4 por ciento.

El estudio de caso en 100 comunidades rurales de Paraguay tiene como objetivo combinar la teoría sobre los instrumentos e indicadores para medir la sostenibilidad con un enfoque práctico. La información disponible se completó con una encuesta de seguimiento a una muestra de usuarios y 100 juntas de saneamiento que gestionan los sistemas de agua, junto con la evaluación de los sistemas de agua en todas las comunidades. Los resultados muestran un alto nivel de servicio en casi las 100 comunidades, con una alta probabilidad de sostenibilidad en el largo plazo debido

sobretodo a los altos niveles de gestión y el capital social de las comunidades. Los principales desafíos para la sostenibilidad de los sistemas de agua están relacionados con la calidad de la fuente – afectada negativamente por los efectos del cambio climático y la falta de normativa para controlar su uso – y la falta de capacidad para ampliar los sistemas de agua, principalmente a nivel financiero. El valor cultural del agua es un aspecto clave en la disposición a pagar y en la gestión responsable del sistema, así como el apoyo constante del gobierno paraguayo al sector del agua rural a cargo del Ministerio de Salud a través de una institución autónoma específica (SENASA).

El estudio confirma que los desafíos en la medición de la sostenibilidad en los sistemas rurales de agua y en el desarrollo de un marco común son enormes. Los datos oficiales relativos al acceso a agua mejorada no reflejan los problemas de sostenibilidad que pueden poner en peligro las importantes inversiones en infraestructura nueva y rehabilitada. La participación de la comunidad para hacer frente a estos desafíos en el área rural es clave, pero otras condiciones deben ser también apoyadas por parte del Estado. La disponibilidad de datos e indicadores apropiados para medir la sostenibilidad son los primeros pasos para entender los porqués, los cómos y los quiénes son los responsables involucrados en asegurar la sostenibilidad de los sistemas. A partir de ahí, los gobiernos nacionales y sub-nacionales deben priorizar estrategias para mejorar en última instancia el bienestar de la población.

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Acronyms

CBM	Community-Based Management
CEPAL	*Centro Económico para América Latina y el Caribe* (Economic Center for Latin America and the Caribbean)
CNA	*Comisión Nacional de Agua* (National Water Commission)
COHA	Council of Hemispheric Affairs
CONAGUA	*Comisión Nacional del Agua* (National Water Commission)
CONPES	*Consejo Nacional de Política Económica y Social* (National Council for Economic and Social Policy)
CORPOSANA	*Corporación Paraguaya de Saneamiento Ambiental* (Environmental Sanitation Corporation of Paraguay)
CUPPS	Check Up Program for Small Systems
DAPSAN	*Dirección de Agua Potable y Saneamiento* (Water and Sanitation Direction)
DFID	Department for International Development
DGEEC	*Dirección Nacional de Estadística, Encuestas y Censos* (National Direction of Statistics, Surveys and Census)
ENACAL	*Empresa Nicaragüense de Acueductos y Alcantarillado Sanitario* (Nicaraguan Water and Sewerage Enterprise)
EPA	United States Environmental Protection Agency
ERSSAN	*Entidad de Regulación de los Servicios de Saneamiento de Paraguay* (Regulatory Agency for Sanitation of Paraguay)
ESSAP	*Empresa de Servicios de Saneamiento y Agua Potable* (Sanitation Services and Water Company)
FEASIBLE	Financing for Environmental, Affordable and Strategic Investments that Bring on Large-scale Expenditure
FEPAJUS	*Federación Paraguaya de Juntas de Saneamiento* (Federation of Sanitation Boards of Paraguay)
GAS	Gender Analysis Snapshot
GDP	Gross Domestic Product
GiFT	Governance into Functionality Tool
GNI	Gross National Income

Gs	Guarani [US$1 = Gs.4,500. July 2015]
GWI	Global Water Initiative
HIV/AIDS	Human Immunodeficiency Virus / Acquired Immunodeficiency Syndrome
IDB	Interamerican Development Bank
IFIC	Institute for International Cooperation
IISD	International Institute for Sustainable Development
IOB	Policy and Operations Evaluation Department
IPCC	Intergovernmental Panel on Climate Change
IRC	International Water and Sanitation Centre
IUCN	International Union for Conservation of Nature
IWRM	Integrated Water Resource Management
JICA	Japanese International Cooperation Agency
JMP	Joint Monitoring Program
LAC	Latin America and the Caribbean
MDGs	Millennium Development Goals
MPA	Methodology for Participatory Assessment
NGOs	Non Governmental Organizations
ODA	Official Development Assistance
OECD	Organization for Economic Cooperation and Development
OPS	*Organización Panamericana de la Salud* (Pan-American Health Organization)
PCA	Principal Component Analysis
PEP	Poverty-Environment Partnership
POSAF	Planning-Oriented Sustainability Assessment
PPP	Public Private Partnership
PROWWESS	Promotion of the Role of Women in Water and Environmental Sanitation Services
SAT	Sustainability Assessment Tool
SC	Sustainability Check
SDA	Service Delivery Approach
SDGs	Sustainable Development Goals
SEAM	*Secretaría de Ambiente* (Secretary of Environment)
SEMARNAT	*Secretaría de Medio Ambiente y Recursos Naturales* (Secretary of Environment and Natural Resources)
SENASA	*Servicio Nacional de Saneamiento Ambiental* (National Service of Environmental Sanitation)

SIASAR	*Sistema de Información sobre Agua y Saneamiento Rural* (Information System about Rural Water and Sanitation)
SIT	Sustainability Index Tool
SWIFT	Sector Wide Investment and Financing Tool
TAF	Technology Applicability Framework
TIP	Technology Introduction Process
TOM	*Técnico en Operación y Mantenimiento* (Technician in Operation and Maintenance)
ToPPES	Tool for Planning, Predicting and Evaluating Sustainability
Triple-S	Sustainable Service at Scale initiative
UCA	*Universidad Católica de Asunción* (Catholic University of Asuncion)
UN	United Nations
UNCDF	United Nations Capital Development Fund
UNCTAD	United Nation Conference on Trade and Development
UNDP	United Nations Development Programme
UNEP	United Nations Environmental Program
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
WASH-BAT	Water, Sanitation and Hygiene Bottleneck Analysis Tool
WHO	World Heath Organization
WMO	World Meteorological Organization
WSP	Water and Sanitation Program
WSSCC	Water Supply and Sanitation Collaborative Council
WWAP	World Water Assessment Programme
WWC	World Water Council

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Chapter one
INTRODUCTION

A. Background

Since 1990, over 2.6 billion people have acquired access to improved sources of drinking water. To date more than half the world's population, almost 4 billion people, enjoy the highest level of water access: an in-home piped water connection [WHO/UNICEF, 2015]. However, almost 665 million people, 80 percent of whom live in rural areas, still lack access to improved sources of drinking water. Furthermore, access does not guarantee the overall service level quality regarding water quantity, quality, availability and reliability, or its affordability in terms of equality [Kabeer, 2010; Kayser *et al.*, 2013; Bartram *et al.*, 2014].

In Latin America and the Caribbean (LAC), the percentage of the population with access to improved sources of drinking water hit 94 percent in 2015. However differences between rural and urban areas and among economic and social groups remain significant.

Since the 1970s, several international conferences have defined strategies and targets with the ultimate goal of achieving universal access to safe drinking water. Vagueness in the definition of indicators has limited this success. Furthermore, financial resources have been insufficient especially for dispersed rural areas. Other factors constraining the achievement of targets are the lack of political commitment, inadequate institutional arrangements, and insufficient information to fulfill the minimum data requirements to assess sector evolution and gaps [WHO/UNICEF, 2012; Bartram *et al.*, 2014].

During recent decades, different water sector management models have been developed. In 1992, the Dublin Conference introduced the economic value of water as a core issue in the management of the resource. Thereafter, the economic dimension of water management took precedence over the social and environmental dimensions. This new approach eased the way for the private sector to participate in the water sector [Savenije *et al.*, 2002]. In LAC, the processes of privatization in the 1990s caused social conflict due to various problems, including inequitable access, tariff increases, and reduction of water quality [Bakker, 2010; Lentini, 2011]. Some countries, such as Bolivia and Nicaragua, nationalized the majority of their services in the 2000s. Meanwhile, some studies showed higher levels of access and efficiency in countries with privatized services [Budds *et al.*, 2003; Chong *et al.*, 2003; McKenzie *et al.*, 2012; Andres *et al.*, 2013]. In either case, the discussion has focused mainly on urban contexts, overlooking rural areas.

Community participation in the management of rural water systems has been fundamental to increasing access. However, some studies have highlighted limitations, including lack of institutional capacity of user organizations and limited financing to operate and maintain systems [Peltz, 2008; Barakzai *et al.*, 2014].

The development of the Millennium Development Goals (MDGs) in 2000 helped countries in prioritizing and establishing targets for the water sector. The declaration of water as a Human Right in 2010 and the definition of the Sustainable Development Goals (SDGs) in 2015 reinforced the importance of achieving universal access to improved water sources, and of targeting vulnerable populations.

One of the main problems in the rural water sector is the lack of system sustainability. Several studies have shown low levels of system functionality, with average failure rates approaching 40 percent in recent decades [Kleemeier, 2000; Harvey, 2009; Adank *et al.*, 2014; Ryan, 2014]. Measuring sustainability is challenging. Many studies have analyzed the primary dimensions of sustainability and identified the main factors affecting each. Environmental and social dimensions are in general overlooked, as programs tend to focus on economic, technical, and institutional dimensions. The definition of indicators differs depending on the context and the financial resources available.

Globally, Paraguay has had the highest increases in access to improved water sources since 1990 [WHO/UNICEF, 2015]. In 2015, the percentage of the population with access to improved sources reached 95 in rural areas, up from 0 percent in 1990 when rural inhabitants relied on water from unimproved water sources. The operation and maintenance of the service in rural areas has been managed mainly through community-based organizations called sanitation boards. Study results reveal high service levels, and positive results falling under institutional and social factors reveal a positive impact on system sustainability.

Few quantitative assessments on sustainability have been developed in LAC, and those that exist have mainly concentrated in urban areas. Moreover the studies are generally under a specific project with high levels of technical assistance and financial subsidies. This limits the applicability of lessons learned to other projects. This dearth in analyses may conceal important inequalities in access, especially for the most vulnerable. Studies like the research presented here could help governments to prioritize policies and strategies, by focusing on the main factors affecting sustainability in rural areas and defining appropriate indicators to monitor and evaluate the evolution of the sector.

B. Objectives

The overall objective of this research is to contribute to available knowledge about sustainability in rural water systems. The specific objectives are:

- To examine access to improved water systems in LAC and the main gaps in achieving universal access.
- To identify the different models of rural water management in LAC and analyze the main challenges.
- To analyze the dimensions affecting sustainability in rural water systems and the main indicators for measuring sustainability.
- To assess sustainability, qualitatively and quantitatively, in a Paraguayan case study in order to understand the main factors affecting sustainability.

In order to achieve the objectives described above, four research questions have been developed:

- What are the main limitations to achieving universal access to sustainable improved water systems in rural areas?
- How do environmental, institutional, managerial, technical, financial, and social dimensions impact the sustainability of rural water systems?
- What is the role of community participation in the operation and management of rural water systems through sanitation boards?
- What makes Paraguay a successful case study in terms of increasing access to piped water services in rural areas?

C. Methodology

The analysis uses a combination of quantitative and qualitative methods to address the objectives and research questions. Each chapter is based on an extensive literature compilation and review with special focus on more recently published papers and studies. The information analysis allows for identification of the main approaches to water supply in rural LAC and identification of the main gaps that hinder access and sustainability.

Presented in the second chapter is a review on conferences on water and sustainable development organized by the UN and other international organizations. In order to assess the management models of water supply in different countries in LAC, some semi-structured interviews were held with specialists on the subject, who shared specific governmental documents, and an in-depth literature search was conducted.

The research examines 29 tools for measuring water sustainability in order to identify the most common indicators for each sustainability dimension: environmental, institutional, managerial, technical, financial, and social. The analysis also reviews over a hundred case studies to assess the indicators used and the main results. Each tool and case study was scrutinized to identify the indicators used to measure sustainability. A total of 1,128 indicators were identified and classified across the six dimensions of sustainability. The most frequently used indicators in each dimension were then used in the case study assessment to measure sustainability.

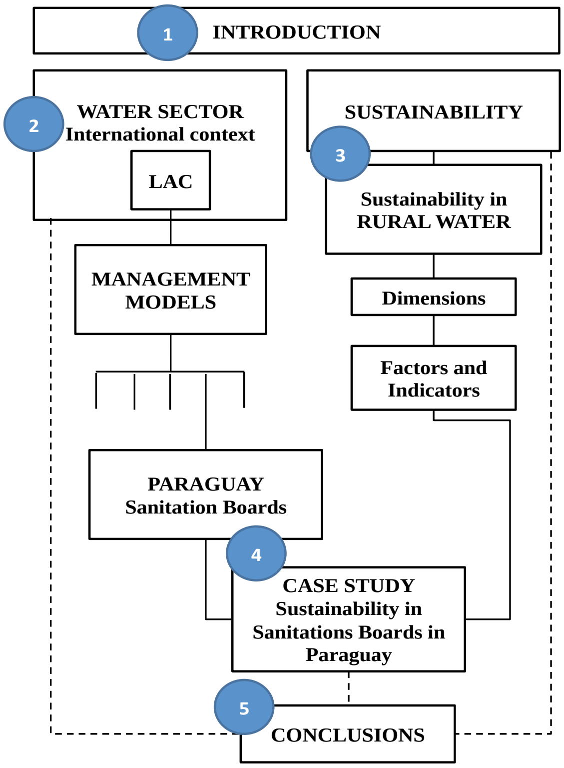
The research selected the 'Drinking Water Supply and Sanitation in Small Communities Program in Paraguay' as a case study for several reasons. First, Paraguay is the country in LAC with a higher increase in access to improved water sources since 1990. Second, the project finished in 2010 and presented data (baseline, midterm and final evaluations) that allowed the follow-up of the water service evolution and the design of a survey to gather new data regarding the sustainability of the project four years after the completion year. Third, the researcher had the opportunity to coordinate the follow-up survey with funds from the Interamerican Development Bank (IDB), and have access to water specialists around the Region to conduct interviews for the research. Finally, some other characteristics of the water sector in Paraguay – water availability, fragmentation of the providers, role of the private sector, the public entity responsible of the rural water sector established within the Ministry of Health – make the country an interesting case study in the Region.

Fieldwork was conducted in Paraguay between 2013 and 2014 in order to gather information about the case study. The case study analyzes 100 rural communities participating in the Drinking Water Supply and Sanitation in Small Communities Program in Paraguay. The objective of the case study is to assess the sustainability of the 100 water systems built under the project and the main factors that may affect the sustainability of the systems. Initial visits were organized in September and October of 2013 to compile available information about the case study and to conduct the first semi-structured interviews with water specialists from the government and other Paraguayan institutions. During 2014, the follow-up survey was designed, tested in 5 communities, and finally administered in all 100 communities between May and July. The resulting data was incorporated into the case study. Finally, the chapter four includes specific information about methodology used for the case study, including survey content and statistical methods for analyzing the data.

D. Structure of the thesis

This thesis is organized into five chapters, including this **Introduction** (Figure 1). **Chapter two** outlines the context of the rural water sector in LAC. The chapter begins with an introduction of the topic, reviewing the international background of conferences and agreements in the water sector, from the Conference of Mar del Plata in 1997 to the declaration of the Sustainable Development Goals in 2015. An explanation of the specific context of the LAC water sector follows, with illustrative examples of water management in the different countries of the Region. Finally, the chapter reviews the latest data on access to improved water sources for LAC, examining population characteristics such as income, education and gender.

Figure 1. Structure of the thesis by chapter (in circles).



Source: author, 2015.

Chapter three explores the evolution of the concept of sustainability in the literature and specifically, in the water sector. The chapter analyzes the different views over time and the dimensions considered by several authors on the concepts of functionality, level of service, and sustainability. The chapter then elaborates on the factors and indicators in the literature – which fall under the six dimensions defined for this research (environmental, institutional, management, technical, financial, and social) and are used to measure sustainability.

Chapter four presents the case study, wherein a theoretical analysis unfolds into a practical study. The Drinking Water Supply and Sanitation in Small Communities Program in Paraguay financed the construction of 100 water systems in 100 rural communities and promoted the creation of sanitation boards to operate and maintain these systems. The chapter analyzes the available data from different surveys and interviews to assess the level of service. Furthermore, the chapter discusses the main results regarding identification of the primary factors affecting the sustainability of water systems.

The research closes with **chapter five**, which presents study conclusions and recommendations for future studies.

Chapter two
RURAL WATER IN LATIN AMERICA AND THE CARIBBEAN

A. Introduction

Water is an essential and irreplaceable resource for life, critical to meet basic human needs and a fundamental vector in sustainable development. As a basic and public service, water performs a variety of economic, social, cultural, and environmental roles [Savenije, 2002]. Access to safe water is the keystone for healthy communities and their economic and social progress [Hutton *et al.*, 2007; Montgomery *et al.*, 2007; World Bank, 2013].

According to the World Health Organization (WHO) [2013] access to safe drinking water is defined according to the proportion of people using improved drinking water sources, such as household connections, public standpipes, boreholes, protected dug wells, protected springs, and rainwater. Furthermore:

- Drinking water is water used for domestic purposes such as drinking, cooking, and personal hygiene.
- Access to drinking water means that the source is less than one kilometer away from its place of use and that it is possible to reliably obtain at least 20 liters per member of a household per day.
- Safe drinking water is water with microbial, chemical, and physical characteristics that meet WHO guidelines or national standards on drinking water quality.

The lack of access to safe water supply exerts a heavy toll on household economies, mainly those with lower incomes, particularly through negative effects in health and education [Gonzalez, 2011; UN, 2012; Kamruzzaman *et al.*, 2013]. Globally, around 10 percent of total diseases are related to unsafe water, sanitation and hygiene, causing almost 3.6 million deaths annually [Prüss-Üstün *et al.*, 2008]. However, non-health effects are also important. The economic benefits of water access are linked to savings for health improvements and gains of productive time due to the reduction of disease. The value of benefits – including access to sanitation – has been estimated at US$260 billion/year [UN, 2012]. Globally the economic return on universal access to improved drinking-water sources is US$2 per dollar invested [WHO, 2012]. Time saved is by far the primary contributor, accounting for up to 70 percent of these economic benefits [Kayser *et al.*, 2013].

Water resources are limited and negative impacts of climate change are adding complexity to resource access and quality assurance. According to WHO [2013], by 2025 half of the world population will be living in water-stressed areas. In addition, water scarcity in some arid and semi-arid areas will displace between 24 million and 700 million people [WWAP, 2012]. The Intergovernmental Panel on Climate Change (IPCC) reports that changes in water availability, demand, and quality due to climate change will affect water management and allocation decisions [IPCC, 2014]. In this burgeoning context, the sustainable use of the resource has become a priority in public policies.

Rural areas are more vulnerable to decreased availability of safe drinking water due to climate change impacts. Globally, 75 percent of the world's poor are concentrated in rural areas, and five out of six of those who do not have access to a safe water supply live in these areas [World Bank, 2012]. In addition, conflicts over water rights are more common in rural areas, disrupting access to safe water, especially for the most vulnerable [Pearce-Oroz, 2011]. While water access has improved in rural areas in the last years, progress is still uneven compared with urban areas. Furthermore, during the last decades rural water policies have focused on coverage – due to specific characteristics of rural areas (low population density, remote areas, fragmentation of the territory) – overlooking quality and sustainability issues.

The international community has undertaken efforts to set common objectives for the universal access to safe water, in order to reduce poverty and increase welfare.[1] In 2000 the United Nations (UN) set out the MDGs as an unprecedented effort to meet the needs of the world's poorest, including access to safe drinking water and sanitation facilities. Target 7C called to *halve, by 2015, the proportion of the population without sustainable access to safe drinking water and basic sanitation* [UN, 2012]. In order to build upon the MDGs and converge with the post-2015 development agenda, in 2012 the UN launched a process to develop a set of Sustainable Development Goals, to be adopted in September 2015. The objective of the SDGs was to contribute to the achievement of sustainable development addressing and focusing on priority areas and development challenges. These challenges include the water and sanitation sector.

During the last decade, countries in LAC have made a large effort to increase and improve access to safe and quality water services. The Region has already met the MDGs water target for 2015 (93 percent), but progress in sanitation has been slower [WHO/UNICEF, 2015].[2] In all, more than 34 million people in the Region do not have access to safe drinking water and 110 million

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1 Taken to account in the concept of 'universal' access to basic water is that 3 to 5 percent of the population is likely to be hard to reach [Howard *et al.*, 2003].

2 The percentage of the population using improved sanitation facilities reached 82 percent in the Region, slightly below the 84 percent set as the MDGs target [WHO/UNICEF, 2015].

people lack improved sanitation facilities. Furthermore, differences between countries, within countries, and among social and economic groups are still significant [Soulier *et al.*, 2013].

B. The international context addressing rural water issues

Since the UN Water Conference held in Mar del Plata (Argentina) in 1977, water has been part of the development agenda. The Action Plan derived from this conference recognized water as a right for the first time, declaring that *all peoples, whatever their stage of development and social and economic conditions have the right to have access to drinking water in quantities and of a quality equal to their basic needs* [UN, 1977]. The Action Plan recommended that *governments develop national plans and programmes for community water supply and sanitation, and identify intermediate milestones within the context of the socio-economic development planning periods and objectives giving priority attention to the segments of the population in greatest need* [UN, 1977]. This conference set up the first International Drinking Water Supply and Sanitation Decade (1981-1990), promoted by the UN to bring attention to challenges in the water and sanitation sector globally. The first International Decade aimed to contribute to health for all through the following principles [UN, 1981]:

- Complementarity of sanitation and water supply development.
- Focus on both rural and urban underserved populations in policies and programs.
- Achievement of full coverage through replicable, self-reliant and self-sustaining programs.
- Use of socially relevant systems applying an appropriate technology.
- Association of the community with all stages of programs and projects.
- Close relation of water supply and sanitation programs with those in other sectors.
- Association of water supply and sanitation with other health programs.

The resolution signed in 1981 recommended that Member States adopt relevant policies to accelerate the pace of their programs for drinking water supply and sanitation for the total population, specifically focusing on health programs to reduce preventable water- and sanitation-related diseases. It also *invited* the multilateral and bilateral agencies to support national plans and develop programs consistent with principles defined in the resolution [UN, 1981]. However milestones or targets were not set and recommendations were followed individually by country without a common framework.

The Decade brought a new approach to water sector development, underlining the role of communities to achieve and sustain the objective of universal water and sanitation coverage. According to United Nations Development Program (UNDP) [1980], *members of local communities are to be involved in all aspects of water/sanitation, from planning constructions and* *financing, to training, operation and maintenance*. Several specialists and institutions supported this paradigm shift from top-down to bottom-up development, where beneficiary communities could participate in the planning and management of the sector [IRC, 2003]. This new approach gained acceptance especially in rural areas, not only in the water and sanitation sector but also for natural resources management [Chambers, 1983 in Manjula, 2009].

In 1992, the UN Conference on Environment and Development was held in Rio de Janeiro (the Rio Summit). The same year, in Dublin, the International Conference on Water and the Environment (the Dublin Conference) recognized the economic value of water. Principle Four of the Dublin Conference stated that *it is vital to recognize first the basic right of all human beings to have access to clean water and sanitation at an affordable price* [WMO, 1992]. The perspective on water resources turned from environmental during the 1970s to social in the 1980s and, finally, to an economic perspective in the 1990s. This new approach led the way for the private sector to participate in water and sanitation sector development [Savenije *et al.*, 2002]. During the 1990s, numerous processes of privatization of water services were developed in LAC with different results. Almost all countries enacted reforms at the national and/or subnational level to facilitate the participation of the private sector in water management. In some cases, such as in Argentina and Bolivia, contracts with private companies were cancelled after social and financial conflicts and only a few continue to have their water supplies under private management [Antunez *et al.*, 2003].

In 1999, the UN General Assembly Resolution 'The Right to Development' (A/Res/54/175), stated that clean water was a fundamental human right and that national governments and the international community had a moral imperative to its promotion. The following decade saw a development of the approach of the Human Right to Water, and in 2010 a UN Resolution (A/Res/64/292) for the first time recognized the Right to Water and Sanitation and acknowledged that *clean drinking water and sanitation are essential to the realization of all human rights* [UN, 2010]. This approach partially reverted the existing paradigm, charging governments with the responsibility of universal access as a "right", and not merely an economic or environmental good.

In 2000, the Hague Declaration on Water Security in the 21st Century also recognized the economic value of water – together with its social, environmental, and cultural values. The Declaration proposed *pricing water services to reflect the cost of their provision* [WWC, 2000]. However, some key aspects for the sustainability of the system (technical, financial, institutional, environmental, and social) were not addressed in this declaration. Furthermore, some critics highlighted that this vision of water from a strict economic approach would impact the most vulnerable population without capacity to pay for the service [Budd *et al.*, 2003].

The Dublin Conference also promoted community participation for managing and sustaining water and sanitation services. Principle Two emphasized the need to develop and manage water resources using participatory approaches involving all stakeholders [WMO, 1992]. Furthermore Principle Three underlined the role of women in the provision, management, and safeguarding of the resource, requiring specific public policies to address this topic.

Starting in the 1990s, and within the framework of participatory processes, the demand-based approach was developed. This approach emphasized community willingness to contribute to the implementation of the project in key aspects, such as planning, execution, and management. This approach was strongly followed by international institutions, such as the World Bank, which developed programs relying on community-based management and demand-responsive methodologies. Evidence from various studies suggests contradictory results about community participation in reaching sustainable access, especially in rural areas. Some authors highlight the benefits of demand-based programs, as they better reflect the reality of a community and its needs, preferences, and expectations [Klugman, 2002; Pearce-Oroz, 2011; Welle *et al.*, 2014]. This approach facilitates achievement of results, ownership of the program, and its sustainability. However, other authors highlight limitations, questioning the impact of participatory approaches without the development of national and local capacities or infrastructure networks [O'Rourke, 1992]. Some programs based on the demand-based approach have failed in identifying the genuine demand of the community, and have been misrepresented or conditioned for specific groups within the community. The payment culture is also a key factor for sustaining water systems (maintenance, repairs, and replacement), together with the analysis of economic context, pre-existing conditions, the role of the private sector, and alternative sources of water [Mansuri *et al.*, 2004; Lockwood *et al.*, 2011]. The Hague Declaration in 2000 also recognized the importance of public participation in decision-making in water management [Mostert, 2003].

As stated previously, in 2000 the UN adopted the UN Millennium Declaration, setting out a series of time-bound targets known as the MDGs. The UN Millennium Declaration committed member nations to a global partnership in achieving eight goals, comprising several targets by 2015 [UN, 2000] (Table 1).

Table 1. Millennium Development Goals.

Goal	Target
Goal 1. Eradicate extreme poverty and hunger.	Target 1.A. Halve, between 1990 and 2015, the proportion of people whose income is less than $1.25 a day.
	Target 1.B. Achieve full and productive employment and decent work for all, including women and young people.
	Target 1.C. Halve, between 1990 and 2015, the proportion of people who suffer from hunger.
Goal 2. Achieve universal primary education.	Target 2.A. Ensure that, by 2015, children everywhere, boys and girls alike, will be able to complete a full course of primary schooling.
Goal 3. Promote gender equality and empower women.	Target 3.A. Eliminate gender disparity in primary and secondary education, preferably by 2005, and in all levels of education no later than 2015.
Goal 4. Reduce child mortality.	Target 4.A. Reduce by two thirds, between 1990 and 2015, the under-five mortality rate.
Goal 5. Improve maternal health.	Target 5.A. Reduce by three quarters, between 1990 and 2015, the maternal mortality ratio.
	Target 5.B. Achieve, by 2015, universal access to reproductive health.
Goal 6. Combat HIV/AIDS, malaria and other diseases.	Target 6.A. Have halted by 2015 and begun to reverse the spread of HIV/AIDS.
	Target 6.B. Achieve, by 2010, universal access to treatment for HIV/AIDS for all those who need it.
	Target 6.C. Halt by 2015 and begin to reverse the incidence of malaria and other major diseases.
Goal 7. Ensure environmental sustainability.	Target 7.A. Integrate the principles of sustainable development into country policies and programs and reverse the loss of environmental resources.
	Target 7.B. Reduce biodiversity loss, achieving, by 2010, a significant reduction in the rate of loss.
	Target 7.C. Halve, by 2015, the proportion of the population without sustainable access to safe drinking water and basic sanitation.
	Target 7.D. Achieve, by 2020, a significant improvement in the lives of at least 100 million slum dwellers.
Goal 8. Develop a global partnership for development.	Target 8.A. Develop further an open, rule-based, predictable, non-discriminatory trading and financial system.
	Target 8.B. Address the special needs of least developed countries.
	Target 8.C. Address the special needs of landlocked developing countries and small island developing States.
	Target 8.D. Deal comprehensively with the debt problems of developing countries.
	Target 8.E. In cooperation with pharmaceutical companies, provide access to affordable essential drugs in developing countries.
	Target 8.F. In cooperation with the private sector, make available benefits of new technologies, especially information and communications.

Source: UN, 2000.

Several criticisms of the MDGs definitions have been raised [Melaned *et al.*, 2011; UN, 2012]. Some of the chosen objectives were not justified with enough analytic power and strong methodologies. Moreover, differences within countries were not considered in the definition of realistic indicators and there is a lack of data to monitor some of these indicators. The missing participation of some key actors, such as local organizations, and the lack of political will, diminished the interest of some stakeholders and contributed to a lack of legitimacy. Some critics underlined other issues that were not appropriately included in the MDGs, such as human rights issues (equity), insufficient emphasis on environmental sustainability, and the relevance of agriculture. Albuquerque [2013] stressed the weakness of the monitoring framework associated with the MDGs's measurement of sustainable access, and the potential incentives to develop unsustainable practices in order to achieve quick results. Furthermore, as the MDGs do not discriminate among Regions within countries or economic and social groups, the achievement of some of these goals could diminish the efforts in the universal access of basic services and other MDGs. Despite the criticisms, the MDGs have been a key instrument to driving significant change in national and international programs that strive to achieve the main goals.

In regard to the specific target for water and sanitation (Target 7C), the definition does not include the dimensions of safety, reliability and sustainability. According to the UN [2012], *as a result, it is likely that the number of people using improved water sources is an overestimate of the actual number of people using safe water supplies.* Some studies concluded that when compared to the official data, levels of safe and adequate access would decrease between 15 and 20 percent [McGranahan *et al.*, 2006 in Rojas, 2014]. Other critics point to the lack of distinction among rural, peri-urban, and urban areas, where access differs significantly, or the lack of consideration of equity issues and vulnerable populations. In addition, the safety associated with improved drinking water does not always protect health and it varies greatly depending on social and environmental practices [WHO, 2013]. In terms of sustainability the existence of infrastructure does not ensure the accessibility to the resource. Data available for some Regions shows that between 35 and 80 percent of water systems, such as hand pumps, were not functioning at the time the data was collected, which was between 5-10 years after the projects were finished [Sutton, 2004].

In 2002, 10 years after the UN Earth Summit, the World Summit on Sustainable Development was held in Johannesburg. Known as Rio+10 this summit focused on specific commitments rather than more resolutions without specific objectives or action plans. Some criticisms were underlined regarding the lack of enforcement measures and the weak definitions of concepts [Osofsky, 2003]. The UN committed to full implementation of the Agenda 21 and the achievement of the MDGs. Rio+10 supported the creation of new Regional commissions and reinforcement of existing ones. It also helped to recognized "sustainable development" as an overarching goal for institutions at all levels, including national and local governments, UN agencies, multilateral banks, and international financial institutions.

One year later, in December 2003, the UN General Assembly (A/RES/58/217) proclaimed the period 2005-2015 as the International Decade for Action 'Water for Life' [UN, 2003]. The main goal was to promote efforts to achieve the commitments made internationally on water-related issues, including the fulfilling of the MDGs and the implementation of the Johannesburg Declaration. In 2015, representatives of governments, international organizations, and civil society met to evaluate progress achieved during the ‘Water for Life’ Decade. Much progress has been achieved on some important issues, such as the development of integrated water resource plans, private sector involvement, and the stronger role of women in the sector. However some challenges still exist. Addressing water-related disasters and impacts of climate change on the availability and quality of the resource; managing waste water, especially in urban areas; improving sanitation services; and financing the expansion of services are some of the goals left to achieve in the coming decades [UN, 2015b].

In 2012, the UN Conference on Sustainable Development was hosted by Brazil and aimed to reconcile the economic and environmental goals associated with sustainable development. Known as Rio+20, the main goals were procuring political commitments, assessing the progress and implementation of previous commitments, and addressing new challenges. These included the development of the concept of green economy and the coordination among international institutions in achieving sustainable development. The outcome document ‘The Future We Want’ reaffirmed the commitment to meet MDGs Target 7C and the right to safe and affordable drinking water and basic sanitation for all. The Rio+20 conference was also the starting process to define the SDGs, to reflect the Region’s needs and challenges, and to provide a common framework to address these needs by 2030 [UN, 2012].

The UN summit for the adoption of the Post-2015 Development Agenda and the SDGs will be held in New York (United States) from September 25 to 27, 2015. According to the zero draft of the outcome document for the UN Summit, the new Agenda sets out to: 1) end poverty and hunger; 2) secure education, health, and basic services for all; 3) achieve gender equality and empower all women and girls; 4) combat inequalities within and between countries; 5) foster inclusive economic growth, shared prosperity, and sustainable lifestyles for all; 6) promote safe and inclusive cities and human settlements; 7) protect the planet, fight climate change, use natural resources sustainably, and safeguard our oceans; 8) strengthen governance and promote peaceful, safe, just, and inclusive societies; and 9) revitalize the Global Partnership for Sustainable Development [UN, 2015].

The SDGs included some of the shortcomings of the MDGs (e.g. hygiene, service level, equality, and sustainability of the services) and defined 17 goals with 169 targets that integrated the social, economic, and environmental dimensions of the sustainable development to be attained by 2030 (Table 2).

Table 2. Sustainable Development Goals.

Sustainable Development Goals
1. End poverty in all its forms everywhere.
2. End hunger, achieve food security and improved nutrition, and promote sustainable agriculture.
3. Ensure healthy lives and promote well-being for all at all ages.
4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.
5. Achieve gender equality and empower all women and girls.
6. Ensure availability and sustainable management of water and sanitation for all.
7. Ensure access to affordable, reliable, sustainable, and modern energy for all.
8. Promote sustained, inclusive and sustainable economic growth, full and productive employment, and decent work for all.
9. Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation.
10. Reduce inequality within and among countries.
11. Make cities and human settlements inclusive, safe, resilient, and sustainable.
12. Ensure sustainable consumption and production patterns.
13. Take urgent action to combat climate change and its impacts.
14. Conserve and sustainably use the oceans, seas, and marine resources for sustainable development.
15. Protect, restore, and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, halt and reverse land degradation, and halt biodiversity loss.
16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all, and build effective, accountable and inclusive institutions at all levels.
17. Strengthen the means of implementation and revitalize the global partnership for sustainable development.

Source: UN, 2015b.

The SDGs recognized improvement of water quality and wastewater management as essential to sustainable development by emphasizing the central role of water. In the outcome document, countries recognized the success of the MDGs in galvanizing action to eradicate poverty and promote human development. They agreed to build on the success of the MDGs by developing a set of sustainable development goals that are global in nature and universally applicable.

The UN-Water has defined six water targets linked with Goal 6 (*Ensure availability and sustainable management of water and sanitation for all*), in addition to one target associated with Goal 11 (*Make cities and human settlements inclusive, safe, resilient, and sustainable*). Suggested targets cover drinking water, sanitation, hygiene, wastewater, water quality, water use efficiency, integrated water resource management, and water related ecosystems [UN Water, 2014b] (Table 3).

Table 3. Targets for water issues, SDGs.

Targets
1. By 2030, achieve universal and equitable access to safe and affordable drinking water for all.
2. By 2030, achieve access to adequate sanitation and hygiene for all, and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations.
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 increasing recycling and safe reuse by x percent (to be determined) globally.
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.
5. By 2030 implement integrated water resources management at all levels, including through transboundary cooperation as appropriate.
6. By 2020 protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers, and lakes; this target includes two sub-targets: • By 2030, expand international cooperation and capacity-building support to developing countries in water- and sanitation-related activities and programs, including water harvesting, desalination, water efficiency, wastewater treatment, recycling, and reuse technologies. • Support and strengthen the participation of local communities in improving water and sanitation management.
7. By 2030 significantly reduce the number of deaths and the number of affected people and decrease by x percent (to be determined) the economic losses relative to GDP caused by disasters, including water-related disasters, with the focus on protecting the poor and people in vulnerable situations.

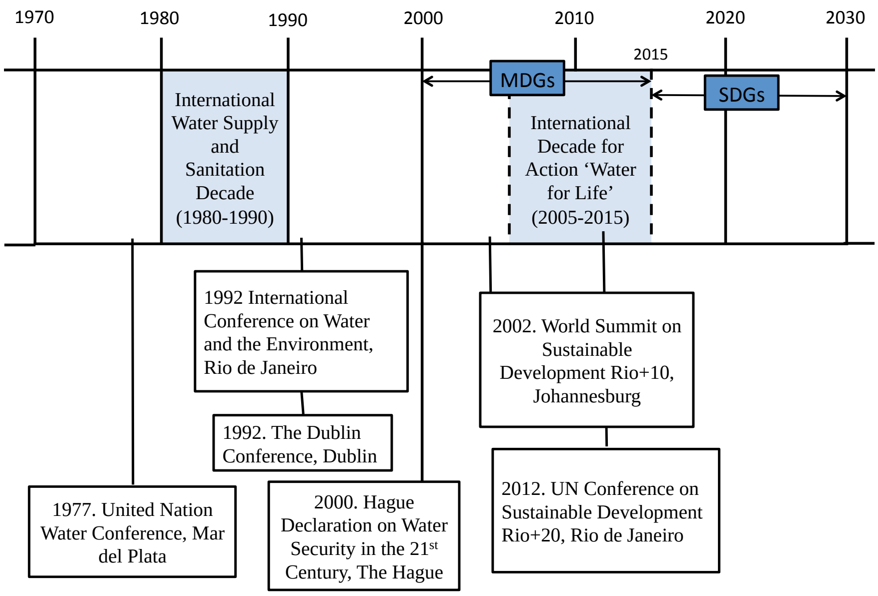
Source: UN Water, 2014.

The Post-2015 Development Agenda also established the means for implementation of the SDGs and their targets. For Goal 6 and its associated targets, the means of implementation were related to the expansion of international cooperation and capacity-building support to developing countries, and to the support and strengthening of local community participation in improving water and sanitation management [UN, 2015b].

Targets were consistent and complementary with each other and with other proposed goals (e.g. poverty, nutrition, health, education, gender, infrastructure, inequalities, and human settlements). Some important topics key to health and welfare impacts – such as the proper use of the resource, storing, hygiene, and environmental education – were still excluded from the definitions.

In 2010, the UN General Assembly (Resolution A/RES/64/292, 28 July 2010) declared *safe and clean drinking water and sanitation a human right essential to the full enjoyment of life and all other human rights* [UN, 2010]. This resolution drove new strategies to confront the lack of access to drinking water in the Region and some programs with ambitious goals associated with the recent SDGs. According to WHO [2012] the *right-based approach will result in intensified* *monitoring to be able to hold governments accountable for meeting their human rights obligations*. Derived from the right to an adequate standard of living (UN General Assembly Resolution A/HRC/RES/15/9), the Right to Water and sanitation provided details on the characteristics of the services, such as access to sufficient water for personal and domestic uses (between 50 and 100 liters of water per person per day); water safety, acceptability, and affordability (water cost should not exceed 3 percent of household income); and physically accessible flows (the water source has to be within one kilometer of the home and collection time should not exceed 30 minutes) [UN, 2010]. To summarize, Figure 2 compiles the most important conferences in water at the international level.

Figure 2. Main international conferences in water (1977-2015).



Source: author, 2015.

International aid has been an important stakeholder in the development of the sector for achieving universal access to safe water. Several conferences have discussed the role of international aid and its impact on development. In 2003, the Organization for Economic Cooperation and Development (OECD) organized the first High Level Forum on Aid Effectiveness in Rome. The Forum gathered the international donor community, developing countries, and civil society to discuss how to better coordinate and be more effective in aiding development [OECD, 2003].

In the second High Level Forum held in Paris in 2005, the ensuing Paris Declaration on Aid Effectiveness presented a practical, action-oriented roadmap to improve the quality of aid and its impact on development [OECD, 2008]. The principles of the Paris Declaration emphasized the improvement of aid effectiveness, highlighting the following five fundamental principles:

ownership, alignment, harmonization, results, and mutual accountability [OECD, 2008]. In 2008, the Accra Agenda for Action was designed to strengthen the implementation of the Paris Declaration, mainly in the areas of ownership, inclusive partnerships, delivering results, and capacity development.

Several authors have criticized the Paris Declaration and the Accra Agenda for Action, claiming that there was not enough evidence of the success of foreign aid interventions on the economic and social agendas of developing countries [Burall *et al.*, 2006; Barder, 2009; ODI, 2009; Moyo, 2009]. Moreover, the high financial dependence and the development of independent management systems decreased country appropriateness and reduced program sustainability in the long-term [Furukawa *et al.*, 2014].

One of the main challenges recognized among donors and participating partner countries in the Paris forum was aid fragmentation and its consequences in the improvement of aid effectiveness [OECD, 2008]. According to Kharas [2007] the average number of donors per recipient country has increased, resulting in the implementation of smaller projects. This evolution facilitates inefficiency and high costs in project administration [Furukawa *et al.*, 2014]. Although there have been efforts to encourage recipient country systems to decrease transaction costs and support their own governance (country-based systems versus project-based aid systems), aid fragmentation was again highlighted as the central problem to be addressed by international aid in the Busan High Level Forum, 5 years later (2010).

Challenges for international organizations regarding aid and development are still enormous. It is imperative that recipient countries take ownership of development programs and lead their own processes in the social, economic and political spheres in order to be effective and sustain results of development programs in the long-term.

C. The national context in Latin America and the Caribbean

Parallel to international conferences and declarations, countries in LAC have also changed their approach to rural water supply and management. Policies, regulatory frameworks, and strategies have slowly been adapted to a new international context. However, the rhythm and the depth of the reform processes have varied significantly depending on the country [Rojas, 2014].

The public sector has been the major driver for expansion of water services in the entire Region. Between the 1940s and the 1960s, new water infrastructure was built with public financing, mainly in areas with high population density [Mejia *et al.*, 2011]. Sparsely populated and rural areas were excluded and water supply in these areas came from unimproved sources, such as rivers and streams, resulting in negative impacts on health and welfare.

During the fiscal crisis of the 1980s, the decrease in international funding limited the progress of infrastructure works that were still under construction. There was still a high dependence on national budgets for investments, operation, and maintenance of water systems. The intervention of the public sector based on short-term political purposes facilitated inefficient management practices with widespread subsidies and low tariffs, which resulted in a lack of a financial sustainability of the service [Corrales, 2004]. Moreover, the rapid urbanization of the Region also limited the response of governments to fulfill the needs of new urban areas [Antunez *et al.*, 2003]. Governments focused on increasing coverage without considering the level of service regarding quality, quantity, or reliability [Raposo *et al.*, 2011]. The political, economic, and social context, together with the poor performance of the underfunded public sector in improving water access, guided governments to search for new institutional alternatives [Narayan-Parker, 1995].

Since the 1990s the water sector has undertaken a major restructuration. Three main revolutions have had profound impacts on the sector: the regulation and modernization of the legal framework, the inclusion of the private sector, and the decentralization of operations [Jouravlev, 2001; Corrales, 2004]. All these transformations took place mainly in urban areas, overlooking rural or sparsely populated Regions where the reforms are still weak or inexistent.

1. A new regulation framework

During the 1990s, several reforms and new regulatory frameworks were developed. Almost all countries in the Region built an institutional arrangement based on a new legal framework that separated the sector into different roles: policies, regulation, planning, operation, and commercialization. The transformation was slow and inefficient in some cases, especially in countries with weak institutions, lack of qualified professionals, and low efficiency in public management [Corrales, 2004].

One of the key aspects of the reform was the design of an institutional structure within the government to transparently manage the sector and the different institutional roles [Ballestero *et al.*, 2005]. Separation of resource use into different compartments (e.g. irrigation, industry, hydropower, and drinking water) hindered an integrated management of water and environmental sustainability. The new legal frameworks tried to combine needs and water uses and to define roles among the different institutions under a common governing body. They also helped to define a tariff policy to guarantee the financial sustainability of the service, taking into account the quality of the service and the characterization of subsidies [Corrales, 2004]. Regionally, Mexico has one of the clearest water sector structures [Ballestero *et al.*, 2005]. The national government defined an institutional framework under the National Water Commission (*Comisión National del Agua*, CNA*)*, an independent structure for regulating the resource. Previously, sector management was dispersed into several organisms and institutions in accordance with specific use. In 2000 the CNA was moved to the Secretary of Environment and Natural Resources (*Secretaría de Medio Ambiente y Recursos Naturales,* SEMARNAT), which proposes the policies regarding hydraulic resources. The CNA still kept its technical, executive, financial, and management autonomy as a regulator institution. The CNA exercises authority over the States through the Watershed Organizations, where the different stakeholders are represented (i.e. state governments, municipalities, users and Non Governmental Organizations – NGOs).

Nonetheless, new regulations have overlooked rural areas, and the incentives for the private sector to operate in these Regions were and are limited [Mejia *et al.*, 2011]. One of the few successful cases of regulation of water institutions reaching rural communities is in Colombia. In 1992, the Ministry of Environment, Housing, and Land Development developed the Business Modernization Program to incorporate the private sector into the preparation and strengthening of Regional schemes to provide water and sanitation services in rural areas and small municipalities [Pearce-Oroz, 2011]. The objective was to improve efficiency in management for providers of drinking water, sanitation, and other environmental services. Due to the success of the Program – with more than 1,100 municipalities served – a national policy was developed in 2006 to facilitate expansion of coverage, benefit from economies of scale, and ensure a more efficient use of funds invested. Known as the Departmental Drinking Water and Basic Sanitation Plan (*Plan Departamental de Agua Potable y Saneamiento*), it ensured cross subsidies among users within the same jurisdiction [Carrasco, 2011]. They also helped with the control and surveillance of the operators, as well as with technical support. The municipalities were responsible for guaranteeing the service supply. The infrastructure was financed by the national government and directly executed by the municipalities. Rural areas with less than 2,500 inhabitants were supplied by small providers organized under private models, such as water boards, associations, corporations, or foundations led by the community or by the public sector – as public administrations or cooperatives – or by partnerships between private and public sectors [Akhmouch, 2012]. In 2014, the National Council of Economic and Social Policy (*Consejo Nacional de Política Económica y Social,* CONPES) approved a specific policy for drinking water supply and basic sanitation in rural areas [CONPES, 2014]. The objective was to promote the access to drinking water and basic sanitation in urban areas through adaptive solutions that considered the specific characteristics of the Colombian rural areas. The policy attempted to support municipalities and user organizations with institutional and technical capacity training and with the formalization of the fragmented organizations within the sector.

2. The inclusion of the private sector

The incorporation of the private sector into the water sector in LAC was consolidated in the 1990s as an alternative for providing more efficient and quality services. The international recognition of water as an economic good at the Dublin Conference (1992) and the Washington Consensus (1989), and the new regulatory frameworks developed across the Region under a neoliberalism wave, framed a new approach in the sector, opening the water agenda to private sector entities [Savenije *et al.*, 2000; Williamson, 2004].

Argentina was the first country in LAC to include private entities within the water supply sector through concessions in the city of Buenos Aires. Other countries, such as Peru, Colombia, and Bolivia, followed this wave during the last years of the 1990s [Foster, 2012]. However, Chile was the first country to entirely privatize the most important state-owned Regional water companies, including those serving the largest urban centers (Santiago de Chile, Valparaíso and Concepción) [Akhmouch, 2012]. The main focus of the reform in Chile was to reach underserved populations as it reorganized the tariff system in order to reflect the real costs of water connections [IFIC, 2005]. Subsidies ranging from 25 to 85 percent of the water tariff were established to cover the difference between the tariff calculated by the government and that of the water company. Results of the mixed model including the private and the public sector resulted in an increase in drinking water access throughout the entire country.

In the majority of the countries the entrance of the private sector was accompanied by the public sector, under concession models and other public private partnerships (PPP). Institutional arrangements differ across different countries. The participation of the private sector was shaped under different modalities, depending on the ownership of the infrastructure and the direct operation of the system (direct provision, corporations, mixed enterprises, private enterprises, and cooperatives). Moreover, the private sector contributed in different stages of water sector development: financing infrastructure, operation and/or maintenance of the water systems, and operating the systems. Low institutional capacity and lack of public servants with experience managing PPP in some countries inhibited the required control and surveillance of the contracts. Moreover, the commitments of the governments varied [Pearce-Oroz, 2011].

The inclusion of private entities occurred primarily in urban areas through big international operators. The low profitability of the service in dispersed areas or areas with low-income populations – generally living in rural areas or peri-urban slums – discouraged the participation of private entities in those Regions. Furthermore, the difficulties in operation due to low population densities, higher costs, lower user’s capacity – and in some cases, willingness – to pay, and lack of economies of scale, reduced the eagerness of the private sector to expand services to these areas.

Finally, the lack of strong policies to prioritize universal access and manage private sector contracts also impaired the potential role of the private sector within the water sector.

The oversight of some governments to attend to non-serviced populations, together with strong increases in prices and unfulfilled promises of investments, was one of the most forceful criticisms against the privatization of the service, and many anti-privatization social movements emerged in the 2000s. As a consequence, sectoral policies changed and control over most water services were returned to the national and sub-national governments. The private sector did not consolidate its role as a key supplier in some countries, due to economic, institutional, and social causes, and its involvement in water provision and management remains controversial [Hall *et al.*, 2002; Barlow *et al.*, 2004; Bakker, 2007; Bell *et al.*, 2009; Pearce-Oroz, 2011]. Some countries, such as Bolivia and Argentina reversed the process of privatization and the public sector returned as the principal player in water service [Lentini, 2011]. Some of the negative impacts associated with the inclusion of the private sector inclusion in the water sector throughout the Region included inequitable access for tariff increases, reduction of water quality, and bribery. However, some studies showed no clear pattern concerning price changes following privatization, with evidence of improvements in service quality, higher efficiency, and increased water access in some countries [Budds *et al.*, 2003; Chong *et al.*, 2003; McKenzie *et al.*, 2012; Andres *et al.*, 2013].

Lessons learned during the last decades of PPP experience in LAC underline the importance of well-defined institutional and regulatory frameworks to guarantee efficient, sustainable, and equitable water management [Ducci, 2007; Akhmouch, 2012]. Furthermore, the participation of the community in the reform, especially at the local level, is key for the applicability and acceptance of projects. [Lentini, 2011].

3. The decentralization in the water sector

During the 1950s and 1960s, many LAC countries concentrated the operative functions of water services in national authorities, reverting from the local focus that had previously dominated water services [Corrales, 2004]. The process of centralization during the following decades had different impacts in the Region. In Peru, Chile, Colombia, and Nicaragua, control reverted to central governments while Argentina and Brazil kept the decentralized model. Other countries, such as Bolivia, Honduras, and Ecuador, maintained a combination of centralized and decentralized services.

In the early 1990s, the dominating trend in LAC countries returned again to decentralization of water services [Akhmouch, 2012]. The new democratic agendas in the Region facilitated the delegation of responsibilities across different levels of the government. As a result, municipalities increasingly participated in the management of public services, including the water sector. Other forces further incentivized the localization of the water sector, such as the low effectiveness of national monopolies under the direct control of the central governments and the demand to increase water coverage, especially in rural areas [Pearce-Oroz, 2011]. However, these changes were often unaccompanied by regulatory reform defining roles and responsibilities, limiting *de facto* changes to institutional competencies. This situation created complex relations among different public actors at all levels of government (i.e. national, Regional, and municipal). Some countries, such as Argentina, Colombia, and Peru, advocated for a fragmentation of the water industry into small municipal providers [Foster, 2012]. Argentina, for example, created provincial regulatory agencies in almost all its provinces and one specific agency for the federal capital. National governments in Bolivia and Brazil promoted the creation of communities of municipalities, in order to create economies of scale and improve efficiency in the management of the sector. Mexico continues to develop its water sector without a centralized regulator, leaving the provision of water services to the states, municipalities, and, in rural areas, to significant numbers of committees and water boards. The National Commission of Water (*Comisión Nacional del Agua*, CONAGUA) is the administrator of the resource but it does not have legal authority to regulate water suppliers [Lentini *et al.*, 2014].

Some authors have highlighted the dangers of the decentralization process, pointing out the high atomization of the services, the limitations to consolidating efficient structures, and the difficulties of regulating operators with different levels of management and competence [Foster, 2002; Corrales, 2004]. Furthermore, the Regionalization of the water sector was driven by structural and institutional reasons – political and geographical distribution in Regions, provinces, and municipalities – without consideration of environmental and social aspects that could facilitate a more efficient and sustainable management of the resource and the service. Successful decentralization tends to be accompanied by the development of national regulations that support the process with appropriate legal frameworks, and the institutional, technical, and financial capacities of the municipalities. Local governments are critically positioned to promote the participation of communities in the operation and maintenance of systems [Pearce-Oroz, 2011; Raposo *et al*., 2011].

4. Community management in rural areas

In rural areas, community-based organizations have been those traditionally responsible for the operation and management of systems. This model is the most common service delivery model for rural water supply [Lockwood *et al.*, 2011]. The weak presence of the State and the lack of interest of large private entities to work in rural and remote areas encouraged user coordination in order to cover needs and receive minimum service levels at the lowest price. The organization of the communities was largely informal until the 1990s, when governments, driven by international organizations, started the formalization of some community-based groups into sanitation boards, cooperatives, and other organizations. The idea of demand-based approach and community-based management was included in the 'bottom-up' agenda, although in some cases, rigorous regulations and norms imposed upon the communities, such as determined tariffs and administrative structures, diminished the drive toward community-based management.

Some countries lack the institutional organization in the construction of water systems and the provision of technical support behind the operation of the system [Fragano *et al.*, 2001]. However, successful examples of municipal technical support to communities have occurred in Nicaragua, through the Nicaraguan Water and Sewerage Enterprise (*Empresa Nicaragüense de Acueductos y Alcantarillado Sanitario*, ENACAL). A municipal agent provides local support for technical and maintenance issues at a Regional level. In Honduras, the Technician in Operation and Maintenance (*Técnico de Operación y Mantenimiento,* TOM) provides support to different communities with regular visits through technical and administrative activities.

Several studies have shown the effectiveness of the participatory community-based approach in rural areas when it is adequately supported and sustained [Peltz, 2008]. However, the formalization of community-based organization has been achieved in a limited number of countries. In Paraguay, for example, the sanitation boards have been established with financial and institutional support from the National Service of Water and Sanitation. On the other hand, most of the user organizations in Colombia remain informal, which prevents organizations from setting contracts with municipalities and receiving subsidies and technical support. This results in low levels of water system sustainability [Carrasco, 2011]. Barakzai *et al.* [2014] found in a study in rural communities that, although donors and national governments at one time financed the construction of systems and then handed them over to communities, future support for operation and management tasks of the systems was very low and affected the levels of service and sustainability of the systems. The government post-construction backup support is relevant as there are some elements that surpass the community capacity to manage, such as social conflicts or physical hazards that affect the systems.

D. Access to drinking water sources in rural LAC

1. Definitions and methodologies

Since 1990, the WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation (JMP) has monitored progress in global drinking water and sanitation coverage. Since 2000, when the JMP started to standardize data from country household surveys, the Program has carried the mandate to monitor progress towards the MDGs drinking water and sanitation targets. In this context, JMP has combined analytical, normative, advocacy, and capacity development functions to ensure better access to safe drinking water and basic sanitation globally [WHO, 2013b]. Despite some criticisms of the MDGs indicators and some methodological issues, the JMP has facilitated an easy approach to comparing countries, providing the first analysis of the overall situation. In addition, the MDGs have yielded positive impacts on the definition of Poverty Reduction Strategy Plans and Decentralization in several countries allowing for the designation of targets and common methodologies [Bonfiglioli, 2003].

Target 7.C is the MDGs-defined target for the water sector: *Halve, by 2015, the proportion of the population without sustainable access to safe drinking water and basic sanitation* [UN, 2000]. In order to assess the target, the MDGs define the concept "improved drinking water source" as *a source or delivery point that by nature of its construction or through active intervention is protected from outside contamination, in particular from contamination with fecal matter* [WHO/UNICEF, 2014]. It includes the following categories of safe or improved sources of drinking water:

- *Piped water into the dwelling,* also called a household connection, is defined as a water service pipe connected with in-house plumbing to one or more taps (e.g. in the kitchen and bathroom).
- *Piped water to yard/plot*, also called a yard connection, is defined as a piped water connection to a tap placed in the yard or plot outside the house.
- *Public tap or standpipe* is a public water point from which people can collect water. A standpipe is also known as a public fountain or public tap. Public standpipes can have one or more taps and are typically made of brickwork, masonry, or concrete.
- *Tubewell or borehole* is a deep hole that has been driven, bored, or drilled, with the purpose of reaching the water table. Boreholes/tubewells are constructed with casing, or pipes, which prevent the small diameter hole from caving in and protects the water source from infiltration by run-off water. Water is delivered from a tubewell or borehole through a pump, which may be powered by human, animal, wind, electric, diesel, or solar means. Boreholes/tubewells are usually protected by a platform around the well, which conducts spilled water away from the borehole and prevents infiltration of run-off water at the wellhead.
- *Protected dug well* is a dug well that is protected from runoff water by a well lining or casing that is raised above ground level and a platform that diverts spilled water away from the well. A protected dug well is also covered, so that bird droppings and animals cannot fall into the well.

- *Protected spring*. The spring is typically protected from runoff, bird droppings, and animals by a “spring box”, which is constructed of brick, masonry, or concrete and is built around the spring so that water flows directly out of the box into a pipe or cistern, without being exposed to outside pollution.
- *Rainwater collection* refers to rain that is collected or harvested from surfaces (by roof or ground catchment) and stored in a container, tank, or cistern until used.

As unimproved sources of drinking water, the following are considered [WHO/UNICEF, 2014]:

- *Unprotected spring*. This is a spring that is subject to runoff, bird droppings, or the entry of animals. Unprotected springs typically do not have a “spring box”.
- *Unprotected dug well*. This is a dug well for which one of the following conditions is true: the well is not protected from runoff water, or the well is not protected from bird droppings and animals. If at least one of these conditions holds true, the well is unprotected.
- *Cart with small tank/drum*. This refers to water sold by a provider who transports water into a community. The types of transportation used include donkeys, carts, motorized vehicles, and other means.
- *Tanker-truck.* The water is trucked into a community and sold from the water truck.
- *Surface water* is water located above ground and includes rivers, dams, lakes, ponds, streams, canals, and irrigation channels.

Bottled water is considered to be improved only when the household uses drinking water from an improved source for cooking and personal hygiene. Where this information is not available, bottled water is classified on a case-by-case basis.

The JMP definitions limit the analysis mainly to coverage and access. The JMP itself, along with other authors, has highlighted its own limitations in several reports [Kabeer, 2010; Melaned *et al.*, 2011; Sacks, 2012; WHO/UNICEF, 2012; Kayser *et al.*, 2013; Fehling *et al.*, 2013; Bartram *et al.*, 2014]. The MDGs indicators fail to reflect some important features in the analysis of the access to water service, such as continuity, reliability, quality, equity, affordability, or sustainability. There exists neither standard indicators agreed upon by the primary stakeholders nor sufficient financing to collect the information needed to fulfill the minimum data requirements for these features. Furthermore, the information by country regarding the percentage of the population with access to different sources of drinking water is not always available or comparable across countries. Definitions of sources vary across countries, and even within the same countries, different data sources result in different numbers.

Moreover, although the MDGs helped countries in prioritizing the sector and increasing levels of access, because the achievement of the targets is measured at the national level, the MDGs could discourage the development of specific strategies to address the lack of access in poor or remote areas. The declaration of water as a Human Right [UN, 2010] reinforced the idea of universal access to an affordable and quality resource, but specific strategies for rural areas are nonetheless lacking in most countries.

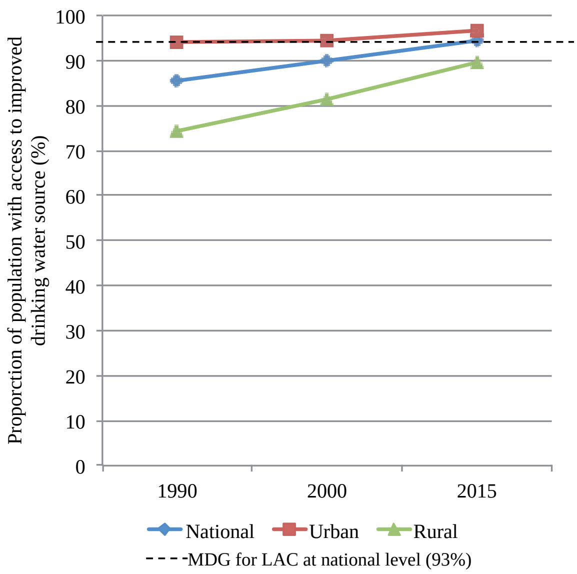
Despite the limitations, the JMP is the only available source with comprehensive and globally comparable information on drinking water coverage [Bartram *et al.*, 2014]. Data from the JMP will therefore be used throughout this chapter to describe access to drinking water in LAC.

2. Data analysis

In 2015, 91 percent of the global population was using an improved drinking water source, compared to 76 percent in 1990. That means that 2.6 million people have gained access to an improved drinking water source since 1990. Of those, 73 percent gained access to on-premise piped drinking water [WHO/UNICEF, 2015]. However, even if the MDGs water target were to be achieved globally by 2015, up to 76 million people would nonetheless die between 2000 and 2020 due to water-related diseases [Gleick, 2002 in Kumamaru, 2011].

In LAC, the goal to serve 93 percent of the population with access to an improved drinking water source by 2015 was surpassed. Most recent data [WHO/UNICEF, 2015] shows that 94 percent of the population in LAC has access to improved drinking water source. In urban areas, the access reaches 97 percent and in rural areas, 89 percent. The improvement of the proportion of the population with access in rural areas has been more significant than in urban areas, as the baseline for 1990 was much lower: 74 percent for the rural areas and 94 percent for the urban areas (Figure 3). The rate of increase of coverage in the Region has slowed as a consequence of the increasing difficulty to reach populations located in more remote or isolated areas or in periurban areas, where extending water coverage through

Figure 3. Proportion of population in LAC with access to improved drinking water source.



Source: author, 2015. Data from WHO/UNICEF [2015].

conventional public service delivery is more challenging [Rondinelli, 1991]. The definition of limits of peri-urban and small cities is also a central task for governments. The definition of peri-urban areas falls in between the definitions of urban and rural areas and their characterization differs in each country. The main area of ambiguity is in those settlements with populations of a few hundred to 20,000 inhabitants that could either be considered as "rural" (large villages) or "urban" (small urban centers) [Adank, 2013].

Only eight countries in LAC have failed to reach the MDGs for access to safe drinking water by 2015: Haiti (58 percent), Dominican Republic (85 percent), Ecuador (87 percent), Nicaragua (87 percent), Peru (87 percent), Bolivia (90 percent), Colombia (91 percent), and Honduras (91 percent) (Table 4). At the other end, Uruguay and Belize have achieved universal access to improved drinking water sources nationally [WHO/UNICEF, 2015]. All countries, except Haiti, have achieved proportions higher than 85 percent access to improved drinking water sources. Haiti is the only fragile state in the Region and the only country considered a Least Development Country in the Region by the UN. As a result, the country is defined by specific characteristics that make it an outlier in the analysis.

Table 4. Proportion of population with access to an improved drinking water source, LAC.

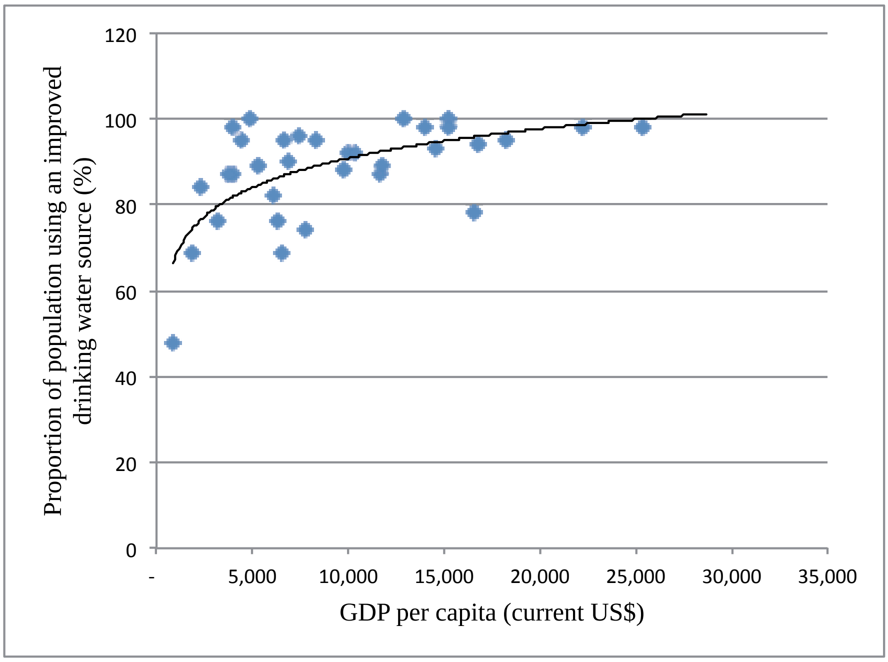
Country	**National (percentage)**			**Urban (percentage)**			**Rural (percentage)**		
	1990	**2000**	**2015**	**1990**	**2000**	**2015**	**1990**	**2000**	**2015**
Argentina	94	96	99	98	98	99	69	81	100
Belize	73	85	100	87	92	99	60	79	100
Bolivia	68	79	90	91	93	97	40	55	76
Brazil	89	94	98	96	98	100	68	76	87
Chile	90	95	99	99	99	100	48	68	93
Colombia	88	90	91	98	97	97	69	71	74
Costa Rica	93	95	98	99	99	100	87	89	92
Cuba	NA	91	95	94	95	96	NA	77	90
Dominican Republic	87	87	85	97	92	85	76	78	82
Ecuador	74	80	87	84	88	93	61	67	76
El Salvador	70	82	94	90	93	98	51	65	87
Guatemala	77	84	93	90	94	98	68	76	87
Haiti	62	61	58	91	82	65	50	49	48
Honduras	73	81	91	92	94	97	60	70	84
Jamaica	93	94	94	98	98	98	89	89	89
Mexico	82	89	96	92	94	97	59	73	92
Nicaragua	73	79	87	91	94	99	53	60	69
Panama	84	90	95	98	98	98	68	76	89
Paraguay	53	73	98	85	91	100	23	52	95
Peru	74	80	87	88	89	91	44	54	69
Uruguay	95	97	100	98	99	100	70	77	94
Venezuela, RB	89	91	93	93	94	95	68	73	78
LAC	**85**	**90**	**94**	**94**	**95**	**97**	**73**	**81**	**89**

Source: author, 2015. Data from WHO/UNICEF [2015].

Although significant progress has been achieved in the last decades, differences between rural and urban areas are still relevant. Haiti, Nicaragua, Colombia, and Peru show differences in water access of more than 20 points between rural and urban areas. This disparity reflects the limitations to extending water coverage to rural areas through conventional public service delivery [Rondinelli, 1991].

Differences within countries are not only limited according to geographical vectors – urban and rural– but also according to economic and social characteristics of the population. Poor and vulnerable populations, such as women, children, the elderly, and the disabled, have less access to water and sanitation services. Hence, inequality remains a main concern. Figure 4 shows the proportion of the population in rural areas with access to an improved drinking water source versus the Gross Domestic Product (GDP) by country. Generally, the lower the GDP per capita, the lower the access to improved services. However, there are some countries with low GPDs, such as Guyana (US$4,017 per capita) or Paraguay (US$4,479 per capita) that nonetheless achieved access levels up to 98 percent, similar to countries with significantly higher per capita GDPs, such as Chile (US$14,520 per capita) and Uruguay (US$16,811 per capita). The outlier again is Haiti, with a level of access lower than 48 percent and the lowest GDP of the Region (US$833 per capita) in 2014. Appendix A compiles specific data for this analysis.

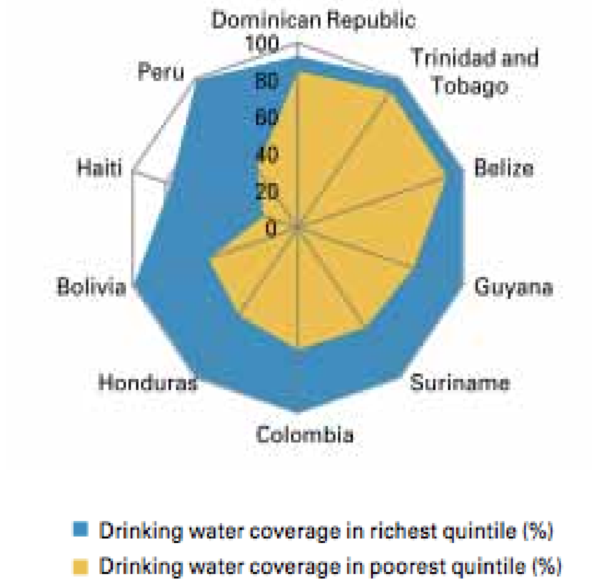
Figure 4. Proportion of population at rural level with access to an improved drinking water source versus GDP per capita (current US$).



Source: author, 2015. Data from World Bank [2015] and WHO/UNICEF [2015].

The household level analysis also reinforces these results. More than 70 percent of families without access to safe drinking water and 85 percent of families without access to an improved sanitation facility belong to the two lowest economic quintiles [WHO, 2014]. Populations in lower economic quintiles usually live in areas where the resource is limited, with low quality and/or expensive access. Figure 5 shows the gap between richest and poorest quintiles in proportion of populations that use an improved drinking water source for selected countries in LAC. According to UNICEF/WHO [2011], in all developing Regions the proportion of the population with access to improved drinking water resources increases with wealth. Furthermore, the richest quintiles – mainly concentrated in urban areas – have more access to piped water. Other studies have also linked poverty with low access to improved drinking water sources [Dayal *et al.*, 2000; Bosch *et al.*, 2001; Gross *et al.*, 2001; UN, 2012]. For example, according to the UN [2012], in rural areas piped in water is non-existent in the poorest 40 per cent of households.

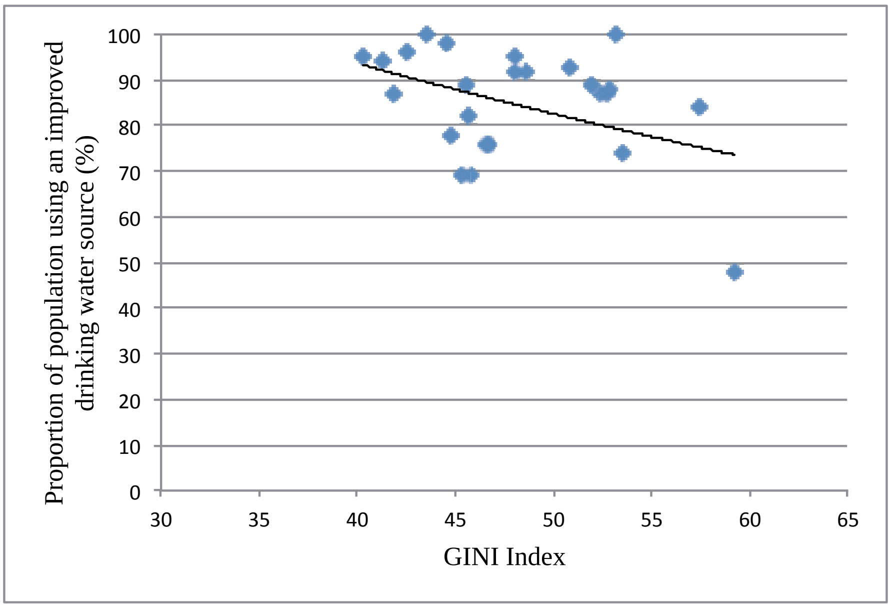
Figure 5. Population with access to improved drinking water source, by quintile.



Source: WHO/UNICEF, 2011.

Figure 6 shows the analysis by country regarding the relation of the access to improved drinking water sources in rural areas and the GINI Index. The GINI Index measures the extent to which the distribution of income or consumption expenditure among individuals or households within an economy deviates from a perfectly equal distribution. A GINI index of 0 represents perfect equality; an index of 100 implies perfect inequality [World Bank, 2015]. Data shows that although poverty has a negative impact on access to improved drinking water sources, inequality offers mixed results. The tendency shows that at lowest GINI levels, highest access to improved water sources. However, countries with a higher GINI index, such as Belize (53.13) or Brazil (52.67) have achieved levels of access comparable to other countries with a lower GINI, such as Argentina (43.57) or Uruguay (41.32). As in Figure 5 the outlier again is Haiti, with the lowest level of access and the highest GINI index in the Region. Appendix B compiles specific data for this analysis.

Figure 6. Proportion of population at rural level with access to an improved drinking water source versus GINI Index.



Source: author, 2015. Data from World Bank [2015] and WHO/UNICEF [2015].

Where water supplies are not readily accessible, water must be carried from its source. According to an analysis of data from 25 countries in sub-Saharan Africa, representing 48 per cent of the Region's population, women and girls bear the primary responsibility for water collection [Roy *et al.*, 2005]. The time and energy dedicated to water collection is considerable, even under the most conservative assumption of only one trip per day. For the 25 countries combined, it is estimated that a woman spends as much as a quarter of her productive life fetching water [COHA, 2009]. Globally, women spend at least 16 million hours each day per round trip; men spend 6 million hours; and children, 4 million hours [UN, 2012].

E. Challenges and opportunities

Institutional and financial efforts during the last decades have increased access to safe drinking water in rural areas, especially for vulnerable people. International and national agreements and regulations have pushed the agenda for achieving universal access, but there are still important challenges to overcome.

Some of the primary challenges that must be addressed relate to the improvement of quality of water services, especially for vulnerable populations in rural and remote areas; the assurance of investment needs and financial sustainability; the improvement of public and private governance; and the consideration of the potential impacts of climate change. Universal access necessarily entails the affordability and equity of water services and the development of flexible operational models to reach rural and remote areas [WSSCC, 2014]. These challenges are reflected in the new goals set under the SDGs, which contribute to the achievement of sustainable development, including water supply, by addressing and focusing on priority areas.

Upgrading and expanding water and sanitation services not only requires progress in financing infrastructure, but also in mechanisms and regulations, and the integration of policies that involve the integrated management of water resources. The interrelated nature of water issues demands an integrated approach to address these challenges. Efficient management should adopt measures to ensure optimal long-term operation, including a focus on safe water; efficient administration, operation, and maintenance; transparent oversight and efficient regulatory bodies; the development of adequate regulation to cope with operational and management deficiencies; and the establishment of tariffs and subsidies that take into account the social and economic characteristics of populations while keeping the service sustainable [Corrales, 2004].

The role of the private sector is important to the development of the sector in some countries and in rural areas, and is therefore critical to the achievement of universal access. However, it needs to be adequately regulated. Coordination mechanisms between the private and public sector are fundamental to maintaining alignment with country’s strategic objectives for the water sector and identifying opportunities for working alongside communities and municipalities to improve the service [Pearce-Oroz, 2011].

Chapter three
SUSTAINABILITY AND RURAL WATER

A. Sustainability: evolution of the concept

The World Commission on Environment and Development popularized the term sustainability in the late 1980s through its definition of sustainable development: *Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs* [UN, 1987]. Since then, the term 'sustainability' has become one the most overused and abused words in development vocabulary [Sudgen, 2003; Davies, 2013].

The first debates on sustainable development arose in the 1960s within the environmental movement, launched by Rachel Carson's book *Silent Spring* [Carson, 1962]. The key question revolved around the protection of finite natural resources and ecological systems from over-extraction and shocks or stresses [Lockwood *et al.*, 2003]. In 1968 the Intergovernmental Conference for Rational Use and Conservation of the Biosphere was held in Paris (France), with early debates on the concept of ecologically sustainable development. The main aim of the conference was to discuss how modern science could help develop methods to rationally use the resources of the biosphere *while ensuring their conservation* [UNESCO, 1968]. One of the topics discussed in the agenda was the role of human beings in the conservation of ecosystems and how to achieve a dynamic balance to satisfy economic, physical, social, and spiritual needs. This last need linked with nonphysical and nonmaterial concepts rapidly disappeared from the discussions and the debate focused on tangible indicators.

The concept of 'sustainable development' was first formally discussed at the UN Conference on the Human Environment in Stockholm (1972), the first UN Summit on the Environment. Principle 7 of The Declaration of Stockholm states: *to defend and improve the human environment for present and future generations has become an imperative goal for mankind-a goal to be pursued together with, and in harmony with, the established and fundamental goals of peace and of worldwide economic and social development* [UN, 1972]. In this conference the United Nations Environmental Program (UNEP) was created with the mission of developing Regional programs for sustainable development. The same year, Meadows *et al.* [1972] explored the impact of exponential economic and population growth on finite resources. They built three scenarios to analyze the feedback pattern achieved when altering growth trends among five variables: world population, pollution, food production, resource depletion, and industrialization. Results showed the collapse of the global system in two of the three scenarios built. Several updated versions have been published and debate over the methodology used and results interpretation is still ongoing.

Two years later, in 1974, the Cocoyoc Declaration put together the theories of environmental sustainability and economic development. The Declaration was adopted by the participants of the Symposium on Patterns of Resource Use, Environment, and Development Strategies held at Cocoyoc (Mexico) and organized by UNEP and the United Nation Conference on Trade and Development (UNCTAD). The Declaration aimed at the development of strategies for poor countries to preserve their ecosystems through sustainable models of growth and to ensure the long-term viability of their environments.

In 1984, the International Conference on Environment and Economics organized by the OECD concluded that the environment and the economy should be mutually reinforcing [IISD, 2010]. This statement helped to shape the report ‘Our Common Future’, also known as the Brundtland Report, published by the UN World Commission on Environment and Development in 1987. The report stated that environmental problems were critical and global. They were partly the result of the non-sustainable patterns of consumption of the Northern Hemisphere countries – the rich countries – and the poverty of the Southern Hemisphere countries – the poor countries. The report also called for a global strategy for ‘sustainable development’, a new approach that took into account environmental, social, cultural, and economic issues [UN, 1987]. This report popularized the term ‘sustainable development’ and helped to shape the international agenda and the international community’s approach towards a wider concept of development. The definition of sustainable development was biased towards the economic dimension, although it explored the interrelated nature of environmental, social, and economic issues. Moreover, the instruments to implement the new goals were still few and vague [Hopwood *et al.*, 2005; Appleton, 2006].

During the following years the concepts associated with ‘sustainable development’ were reinforced within several sectors at many conferences. For example, in 1990 the UN Summit for Children organized by the UN Children’s Fund (UNICEF) brought up the impact of the environment in future generations and the concept of intergenerational solidarity, one of the pillars of the definitions of sustainability stated in the Brundtland Report [UNICEF, 1990].

In 1992 the UN Conference on Environment and Development was held in Rio de Janeiro (Brazil). Known as the Rio Conference or the Earth Summit, the conference enhanced both national and local actions towards sustainable development. Several groups were established to ensure the follow-up of the Rio Conference at the international level, such as the Commission of Sustainable Development, the Inter-Agency Committee on Sustainable Development, and the High-level Advisory Board on Sustainable Development. At the national level, the Rio Conference instituted the National Committees for Sustainable Development [UN, 1992]. One of the most successful results of the Rio Conference was the adoption of Agenda 21, a comprehensive plan of action adopted voluntarily at the local or national level to implement actions with regard to sustainable development. However, the voluntary and non-legally binding nature of the agreement limited its implementation and its impacts towards environmentally sustainable growth [Archer *et al.*, 2000].

After the Brundtland Report and the Rio Conference, new concepts were developed to sharpen the focus of 'sustainable development' in an effort to lend some operational practicality to the overly broad term. In 1994 John Elkington presented the idea of 'Bottom Line' to describe the relation between the social, economic, and environmental dimensions of sustainability. His approach mainly referred to the business environment, and the term 'Triple Bottom Line' was used as a framework to measure and report corporate performance against environmental, social, and economic parameters. This new approach moved beyond the traditional measures of profits, returns on investment, and shareholder value [Slaper *et al.*, 2011; Ermilio *et al.*, 2014].

The Department of International Development of the United Kingdom incorporated the concept of sustainability into the institutional and management fields, adding the dimension of time. Under this model, sustainability was achieved when the *prevailing structures and processes have the capacity to continue their functions over the long term* [DFID, 2000]. Some international development organizations linked the concept of sustainability with other dimensions, such as economic and financial risks. Sustainability was defined as *the resilience to risk of net benefit flows over time*, and took into account political, economic, financial, social, and external factors in its assessment [World Bank, 2000].

Chambers *et al.* [1992] and Carney [1998] fostered a vision of sustainability of livelihoods (including capabilities, assets, and activities for a means of living). The concept was associated with a community's ability of coping with and recovering from stresses and shocks, and maintaining or enhancing its capabilities and assets both now and for future generations without undermining the natural resource base [Morse *et al.*, 2013]. Nicol [2000] also understood sustainability from the livelihood perspective, highlighting the role of water as a resource within wider livelihood strategies.

During the 1990s and after the Rio Conference, almost every institution working in development produced a similar definition of 'sustainable development'. Pearce *et al.* [1989] traced more than 25 definitions of sustainable development between 1979 and 1988. Some common elements appear in almost all definitions of sustainability, such as the limits of available resources; the interdependence of human activities, both for present and future generations; and issues of equity in the distribution of a good or benefits [Lockwood *et al.*, 2003].

The concept of sustainability was included in the MDGs, established by the UN Millennium Summit in 2000. Goal 7 specifically aims at *ensuring environmental sustainability*. Two of the four targets within this goal explicitly employ the concept of 'sustainability': *integrate the principles of sustainable development into country policies and programs and reverse the loss of environmental resources* (Target 7A); and *halve, by 2015, the proportion of the population without sustainable access to safe drinking water and basic sanitation* (Target 7C). However, limited data and methodologies were available to measure 'sustainability', partially due to the vague definition of the concept.

In 2002, the Johannesburg World Summit on Sustainable Development focused on specific commitments, although there were some criticisms, including enforcement issues, the focus on economic and business aspects, and the imprecise definition of concepts [Osofsky, 2003]. The World Summit also helped to confirm 'sustainable development' as an overarching goal for institutions at all levels, including UN agencies and programs, multilateral banks, and international financial institutions.

Ten years later, in 2012, the UN Conference on Sustainable Development, or Rio+20, aimed at reconciling the economic and environmental goals of sustainable development. The proposal of a list of SDGs, with more than a hundred international development goals set the stage for an ambitious future sustainable development agenda [UN, 2012b]. All the goals explicitly included the concept of sustainability in their definitions and indicators, although tools to measure sustainability are still under development.

B. Sustainability in rural water systems

The extensive variety of definitions of sustainability in rural water systems reflects the different approaches used by different organizations to assess sustainability over time [Lockwood *et al.*, 2003]. The concept of sustainability has been discussed in the water sector literature since the late 1970s, before the main international conferences popularized the term. Over time, there has been an evolution in its scope.

The first reports assessing 'sustainability' of water systems focused on functionality, assessing whether the infrastructure worked [IUCN, 1997; Abrams *et al.*, 1998]. The concept of 'functionality' was developed in the 1980s and focused on the idea of performance (How does the system work?). This concept reflects the effectiveness of the water system (level of service), and looks at some system characteristics, such as quality or quantity served.

Katz *et al.* [1997] presented the idea of sustainability not only from the infrastructure point of view but also from the integrated water system perspective. Their study did not focus only on the functionality of the service, but also on sustainability as *the maintenance of an acceptable level of services throughout the design life of the water supply system*, and aimed at measuring and quantifying the impact of demand-responsiveness on the sustainability of rural water systems. Six out of eleven indicators targeted the community's role in project implementation, whereas the remaining five measured the performance of the water system (physical condition, consumer satisfaction, operations and maintenance, financial management, and willingness to sustain the system). The study's policy recommendations advocated for investment in training of the water committees as part of the project design, which should be flexible, well communicated and comprehensible.

Several reports highlighted that the underlying causes of low sustainability – understood as premature breakdowns or poor service levels – were associated with failures in management, rather than with the physical infrastructure or its financial self-sufficiency. As reported in a United States Agency for International Development report (USAID) *it has become overwhelmingly clear from both research and field observations […] that the main obstacle in the use and maintenance of improved water and sanitation systems is not the quality of the technology, but the failure 'in qualified human resources and in management and organization techniques, including the failure to capture community interest' […]. An appalling 30 to 50 percent of systems in developing countries become inoperable after five years* [USAID, 1981]. The assessment tended to ignore some important problems related to the quality of the resource or the reliability of the service, as argued in a number of recent studies [Sutton, 2011; Lockwood *et al.*, 2011; IOB, 2011]. The World Bank [2009] identified the high breakdown rate of water supply systems, along with difficulties in the expansion of access, as one of the major challenges for sustainability of rural water services. Boulenouar [2014] also links the causes of low sustainability in rural water systems characterized by high levels of breakdowns with the inability to ensure timely maintenance and associated financial planning.

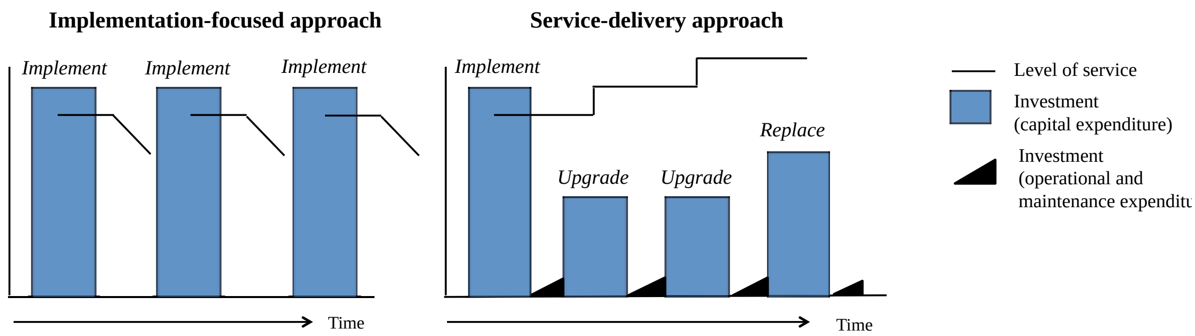
In the 1990s some studies started to investigate the relationship between sustainability and other dimensions of water systems. For example, Narayan-Parker [1993] introduced the concept of effectiveness of water systems as *the optimal hygienic and consistent use of water supply facilities to maximize benefits and minimize the negative consequences over a period of time*. This definition was understood as an indicator of the performance of the water system, including hygienic and health impacts associated with the use of the facilities in the evaluation. From this perspective, the analysis considered poor service levels – in addition to support services, financial aid, and the managerial skills of the operators – as a variable for measuring the sustainability of the system over time [Nisha, 2006].

Hodgkin [1994] was one of the first authors to include the concept of 'time' into the analysis of the sustainability in water services. Hodgkin defined 4 classes of sustainability, which were defined according to the duration of a project's benefits. The worst case of sustainability was Sustainability Class IV, where benefits dropped below an acceptable level and continued to decline or ceased completely. In projects where sustainability was Class III, benefits dropped down to a stable level somewhat below the end-of-project levels. Sustainability Class II and Class I maintained benefits and, in the case of Class I, exceeded end-of-project levels through system expansion or replication. However, the analysis focused more on functionality issues rather than on the causes of the system's sustainability level.

The analysis of a 'program's sustainability' was primarily associated with aspects of service delivery and the need to make projects financially self-sufficient, even in low-income communities, through cost-sharing [Black, 1998 in Lockwood *et al.*, 2003]. The service-delivery approach – focused on the long-term provision of services – replaced the implementation-focused approach where interventions focused mainly on infrastructure building as discrete, one-off projects at the community level [Smits *et al.*, 2012].

As seen in Figure 7, the implementation-focused approach (left) shows how service levels drop soon after the completion of the program (after the capital expenditure). There is not enough specific investment for operational expenditure. In contrast, the service delivery approach (right) is endowed with investments for the administration and management of the system (operational and minor maintenance expenditures). There are occasional capital-intensive interventions for rehabilitation and replacement as well as direct and indirect support to service providers and service authorities.

Figure 7. Level of service under implementation-focused and service-delivery approaches.



Source: author, 2015 based on IRC [2014b].

The service-delivery approach includes three levels of management to support sustainability: national or state level, local government level, and community or system level [IRC, 2011]. The national level has to enable the policy, legal, and institutional frameworks in order to facilitate investment, learning, and innovation activities in the sector. At the local government level, the functions are linked with planning, monitoring, regulation, and support to service providers. At the community level, the daily operation, administration, and maintenance of the system are the main functions, although some other management levels can also be involved in these activities. Different stakeholders can participate at the system level, including households (in self-supply systems), the community, and public and private utilities.

The service-delivery approach also considers the capacity of the different stakeholders to manage the life-cycle costs of water services to guarantee the sustainability of the system. Fonseca *et al.* [2011] presented the Life-cycle approach under the WASHCost initiative led by the International Water and Sanitation Centre (IRC) in 2008. This initiative ran from 2008 to 2013 and aimed to identify gaps in the cost of water and sanitation services in rural and peri-urban areas. The Life-cycle approach differentiated between the one-time expenditure to provide or expand water services (capital expenditure) and recurrent expenditures to maintain a service at an optimal level. These are defined according to national and local regulations: costs of capital, indirect support, direct support, capital maintenance, and operational and minor maintenance expenditures.

Other studies also concluded that the service-delivery approach was key to improving rural water supply in terms of sustainability and to guarantee the level of service (quality, quantity, reliability, and accessibility) [Katz *et al.*, 1997; Mukherjee *et al.*, 2002; Smits *et al.*, 2012]. However appropriate operational and investment expenditures do not guarantee the sustainability of the water system over time.

Abrams *et al.* [1998] presented a very simple definition of sustainability as *whether or not something continues to work over time*. Abrams *et al.* pointed out several elements required for the sustainability of water systems, such as financial requirements associated with recurring expenses, occasional requests for good design, and sound construction of the system. This was a dynamic definition, built into all stages and for all stakeholders, emphasizing participation as one of the key components for achieving sustainability [Carter *et al.*, 1999]. Webster *et al.* [1999] highlighted in their definition of sustainability the differentiation between hardware and software: *sustainability is the continuous functioning of the system, both hardware (physical), and software (non-physical), and the continuance of the derived benefits at the beneficiary level from that system once the 'external' hardware and software assistance have been essentially phased-out.* Within the hardware elements, the study emphasized appropriate technology, standardization, and convenience. Within the software elements, the study emphasized a conductive learning environment involving all stakeholders, building confidence, and continuing support. The study also stressed the importance of the participation of the community as beneficiaries of the service, which ensures sustained and responsible community ownership of the project. It also identified the existence of a backstopping organization with appropriate resources as essential to sustainability.

The Dublin Principles revolved around the concept of sustainability and introduced two new concepts: water as an economic good, and community participation as the most appropriate level of management for water services [Welle *et al.*, 2014]. As an economic good, water should be priced and regulated by the market with the involvement of the private sector in the management of the resource [Savenije *et al.*, 2002]. Some authors have included the cost-benefit concept in their definitions of sustainability. For example Harvey *et al.* [2004] considered the long-term vision and the cost-effective use of the resource in the following definition of sustainability: *a water service is sustainable if the water sources are not over-exploited but naturally replenished, facilities are maintained in a condition which ensure a reliable and adequate water supply, the benefits of the project continue to be realized by all users indefinitely and the service delivery process demonstrates a cost-effective use of resources that can be replicated.*

Researchers have also emphasized the role of the community in the design, construction, operation, and maintenance of water systems, especially in rural areas. The characteristics of rural areas make the community one of the most important stakeholders to maintain the sustainability of the systems. In this sense, sustainability has also been defined in terms of the capacity of the community to maintain the service [IRC, 2001]. From this perspective, many studies have assessed the impact of water services by distinguishing between demand-responsive and supply-driven approaches.

Over time, demand-responsive (or demand-driven) approaches have replaced supply-driven approaches, reflecting recognition of the importance of community participation in the management of water systems. According to many authors [Dayal *et al.*, 2000; Breslin, 2004; Whittington *et al.*, 2009; IRC, 2014], supply-driven interventions that substantially lack community participation in project design and/or implementation have not been successful in providing sustainable water supplies, mainly because communities do not have a sense of ownership of the project. Community participation can take several forms, such as cash, labor, or contributions in-kind.

The characteristics of the demand-responsive approach are [Breslin, 2004]:

- Communities must initiate the process by approaching district government or another appropriate implementing agency.
- Communities must contribute towards their project (a percentage of capital costs and usually 100 percent of the operations and maintenance costs).
- Local capacity must be built over time to manage the water system.

- Communities must be responsible for the system's operation and maintenance.
- Local people must participate in all decision-making (on technologies, management systems, hygiene, and payment scheme).
- Communities must own the system.

Under the demand-responsive approach, in Community-Based Management (CBM) the participation of the community is based in real demand, which increases ownership and, in the long term, the sustainability of the service [Klugman, 2002]. During the 1990s the CBM expanded in rural areas with the support of international aid organizations, with various levels of success [WaterAid, 2011]. However, measurements of sustainability were still based on a system's functionality and results were not always satisfactorily independent of the management model approach. The analysis of the inclusion of CBM approaches has produced uneven results. Several studies have shown a significant relationship between the participation and the effectiveness of a water system [Narayan-Parker, 1995; Mukherjee *et al.*, 2002; Peltz, 2008; Marks *et al.*, 2012; Pankhurst, 2013]. On the other hand Mansuri *et al.* [2004] presented a critical review of several programs based on the CBM approach, finding that with community participation the sustainability achievements of the systems were not as high as expected, and external support to sustain the service was essential. The same conclusion was highlighted by Harvey *et al.* [2004] and Lockwood *et al.* [2011]. The need of complementary external support and follow up from national and/or international stakeholders is articulated in the term 'community management plus' [RWSN, 2005 in Welle *et al.*, 2014]. Furthermore, the ability of the systems to recover from unusual external environmental, social, or economic impacts – such as extended droughts or other natural disasters, or mismanagement of community funds – has also been recognized as one of the factors (reliability) needed to keep systems sustainable and water supply safe [Ermilio *et al.*, 2014].

Researchers have discussed the importance of community participation in water services to achieving a sense of community ownership, and sustainability [WaterAid, 2011]. Marks *et al.* [2012] found that certain types of participation can enhance ownership. Their data included more than 1,100 households in 50 piped-water systems in Kenya and their analysis concluded that token cash or in-kind contributions had no effect on the development of a sense of community ownership. The highest levels of ownership of the water system correlated with households that both contributed large cash investments and actively participated in decisions about the system, followed by households that contributed labor. However, the study showed that the capacity of the community to lead some of the processes in this approach can sometimes be limited by social and economic factors.

Different experiences have highlighted certain obstacles to developing an effective implementation of a sustainable rural water system under the demand-responsive approach: the limited capacity of some communities to demand services, often due to low levels of education or lack of mechanisms and communication channels to demand water services; the limited institutional capacity of municipalities and districts and the lack of leadership to incentivize communities to demand services and manage responses; the lack of funds to manage demand effectively; the lack of coordination among actors (including public institutions, donors, NGOs in the field, and local associations); and the lack of normative and clear rules and enforcement mechanisms.

Many of the studies that introduced the concept of sustainability did not fully consider the post-construction stage of the programs, and focused mainly on the design and construction phases. Lockwood and other experts emphasized in a literature and desk review of rural water supply and sanitation projects the importance of looking at the whole life cycle of a program. Sustainability was linked not only to conditions and factors before and during construction, but also to conditions after construction ended, such as the operation, maintenance, repair, and even replacement of the systems [Lockwood *et al.*, 2003]. More complex definitions included other aspects, such as effectiveness, efficiency, and replicability [Harvey, 2007]. In many definitions, sustainability of water systems in rural areas has been presented as a multidimensional issue that involves the quality of the natural resource, the quality of the service delivered, and the financial models that ensure operation, maintenance, and replacement of the systems over the long term [Pearce-Oroz, 2011].

Mukherjee *et al.* [2002] included the concept of equity in the definition of sustainability in water programs, stating that sustainability occurs when *everyone (men and women, the rich and the poor)* […] *have equal access to benefits from projects*. The incorporation of social equity in the definition of sustainable access to basic services, such as water, is seen as a fundamental Human Right [Lockwood *et al.*, 2003]. The resolution of the UN General Assembly in 2010 of the Human Right to Water (Resolution A/RES/64/292, 28 July 2010) corroborated the importance of the provision to all people of *sufficient, safe, acceptable, physically accessible and affordable water for essential personal and domestic uses* [Albuquerque, 2012]. The Human Rights perspective added the concept of coverage and equity to the sustainability discussion: not only should the service be sustainable, with appropriate levels of service guaranteed in the long-term, but it also must be accessible to everyone.

In recent years the definition of sustainability has specifically incorporated impacts upon the most vulnerable, including the poor, women, the handicapped, and the elderly. According to Lockwood *et al.* [2003], services are more likely to be sustainable when gender and levels of poverty are taken into account in the establishment, management, and maintenance of the system. Previous studies, such as Gross *et al.* [2001], found that water and sanitation services in demand-responsiveness projects were more effectively used when associated with higher levels of gender and poverty sensitivity.

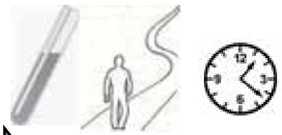
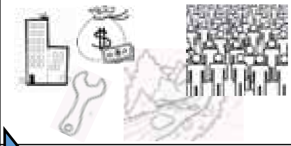
The complexity and heterogeneity of the concept of sustainability has been broadly accepted, but the perception of ‘what is sustainable’ was and still is different for different stakeholders (e.g. users, donors, governments, the private sector, or research institutions) according to the relative value of achieving the goals linked with the concept [Hodgkin, 1994]. Therefore, in achieving the ultimate goal of sustainability of a program, project, or strategy, different issues (e.g. technological, gender, environmental, health or financial factors), or some combination of them, may be emphasized.

External aid support is favored by some authors only for the construction, and not the operation and management, of the water systems [Hodgkin, 1994; Webster *et al.*, 1999; WSP, 2000b in Parry-Jones *et al.*, 2001]. However, many studies have recognized that in rural areas in which community management is the main organization model, most communities need some form of external assistance (financial, training, and technical support) to successfully manage their own water supply systems [Blagborough, 2001; IRC, 2001; Lockwood, 2002; Schouten *et al.*, 2003; Rosenweig, 2008]. This external back-up support may not be needed long term in some communities, depending on their management and financial capacities.

International aid organizations have been key contributors to the increased access to safe water in rural areas in developing contexts. Almost US$11 billion of Official Development Assistance (ODA) was committed in 2012 for drinking water and sanitation programs, 6.1 percent of the total reported development aid for that year. Aid commitments for drinking water comprised 75 percent of water and sanitation ODA in 2012, compared with 66 percent in 2010 [UN Water, 2014b]. Overall the amount of aid committed to basic drinking water systems and sanitation services decreased from 26 percent to 21 percent between 2010 and 2012. Estimates of the costs involved in reaching the MDG target for water and sanitation in 2015 differ considerably, ranging from US$9 to US$30 billion per year [Toubkiss, 2006 in Jimenez, 2010]. Despite the massive investment needed to provide water to those currently unserved, the sector also needs massive investment and capacity building to replace systems that have reached the end of their natural lives [Sudgen, 2003]. Even more worrisome is the fact that, according to several studies, the sustainability of the ODA-funded projects is low, with more than 40 percent of infrastructure in water non-functional some years after the end of the program and before the end of the technical life of the systems. Beyond the enormous economic losses, the breakdown of a water system may also have important social impacts on the community.

The discussion about sustainability in the water sector moved from the concept of functionality in the 1980s to incorporate characteristics of level of service (performance) during the following decade. In the end, the concept of sustainability included a broad set of dimensions and factors that added complexity, but also better reflected the definition of the concept (Figure 8). UNICEF [2014] presented one of the most recent definitions of sustainability, defining a sustainable system as the one that *continues to deliver the designated level of service (with respect to affordability, availability, quality and accessibility) over the long term*. In this sense, sustainability can be understood as the probability of a system to continue working in optimal conditions (level of service) in the future. This definition does not include the concept of universal coverage, a key aspect for achieving the Human Right to Water.

Figure 8. Evolution of the term 'sustainability' in the water sector

FUNCTIONALITY	PERFORMANCE	SUSTAINABILITY
System	System	System + context
 ?		
Does it work	*How does it work*	*Why does it work*
Yes/No	Quantity Quality Reliability Availability	Environmental dimension Institutional dimension Management dimension Technological dimension Financial dimension Social dimension

Source: author, 2015.

Several dimensions associated with the water system affect its sustainability. Furthermore, uncertainties – climate change, water availability, socioeconomic development, or population growth – can affect the sustainability of the system even when the assessment of current conditions appears propitious [Hassnoot *et al.*, 2011]. The analysis of the dimensions affecting sustainability help to illustrate the key factors to maintain optimal functionality of the system, to define the most appropriate indicators, and to propose better strategies for guaranteeing the access and benefit of the service.

C. Dimensions of sustainability

The way we define sustainability is important for establishing the dimensions that contribute to the probability of a water system maintaining an optimal level of service over time, and for setting the parameters and indicators to measure it [Lockwood *et al.*, 2003]. Several studies have attempted to define which are the primary dimensions – also defined as aspects, components or principles – in regard to sustainability [Sara *et al.*, 1997; Abrams *et al.*, 1998; Well, 1998; Wijk *el* *al.*, 2003; Mukherjee *et al.*, 2002; Lockwood *et al.*, 2003; Harve *et al.*, 2004; Kamruzzaman *et al.*, 2013].

The most recurring core issues found in the definitions of sustainability in rural water are associated with financial (financing of regular operation and maintenance costs by users) and technical dimensions (relating to the minimal external assistance in the long term and continued flow of benefits over a long period). However, the number of dimensions varies from three to eight according to different authors. The primary six dimensions considered in the literature in assessing sustainability are: environmental, institutional, managerial, financial, technical, and social. The definition of each dimension includes the following characteristics:

- **Environmental dimension** is associated with the natural environment where the resource is obtained. An integrated and sustainable management of the source (surface or groundwater) allows for the delivery of reliable and safe drinking water. The environmental sustainability analysis requires going beyond the simple assessment of the point of extraction of the resource. The entire water catchment needs to be considered in order to protect the source from over extraction, contamination, and lack of flows due to droughts, for example. The analysis of flows and seasonal fluctuations also needs to incorporate climate change and implement adaptation measures to mitigate related impacts. One of the main challenges related with environmental factors is the need to internalize costs in order to keep the water source in good condition among the different users of the source (e.g. communities, industries, agriculture, protection of aquatic ecosystems, etc.).
- **Institutional dimension** in the water sector is linked with institutions, policies, norms, procedures, and regulations, beyond the specific water system built. Institutions linked with water services at the local and national level should be functional and meet the demand of water users. Households and other water service users, authorities, and service providers have defined roles and responsibilities. The institutions should enable a policy, legal, and institutional environment to implement a sustainable water system [Smits *et al.*, 2012].
- **Managerial dimension** includes the administration of the water system by the operator, and the planning, monitoring, and evaluation of the operation and maintenance of the system, including roles, tasks, and responsibilities. In rural areas these are functions usually associated with water boards and other community groups managing the system, although in some cases local governments and even the private sector can be involved in managerial activities.
- **Financial (or economic) dimension** involves the financing of the activities to ensure the continuity of the delivery of products and services related to water. It includes taxes, local

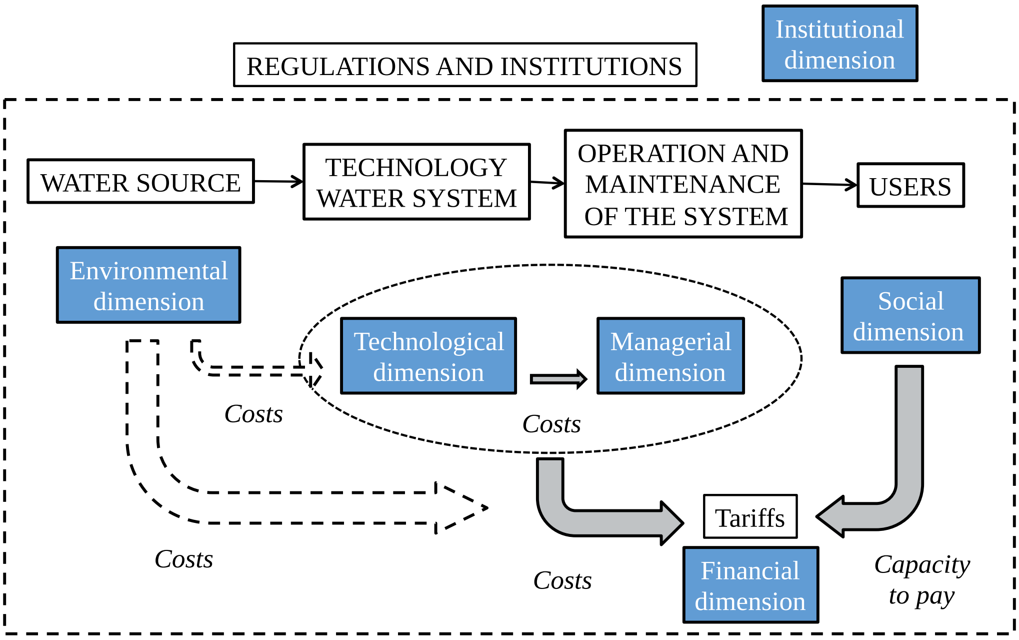
fees, local financing, subsidies, and external funding. Financial resources need to meet at least the cost of operation, maintenance and common repairs. Financial sustainability is linked with all the life-cycle of water services: capital expenditure (physical infrastructure and one-off implementation costs); operational and minor maintenance expenditure; capital maintenance expenditure (rehabilitation and replacement); expenditure on direct support (on-going technical, administrative and organizational support to service providers); expenditure on indirect support (macro-level support, planning, policy making and capacity building for decentralized service authorities/local governments); and costs of capital (interest payment on loans) [Fonseca *et al.*, 2011].

- **Technical (or technological) dimension** refers to the reliable and correct functionality of the system and the delivery of water in enough quantity and acceptable quality. It is linked with the continuity and functionality of the technology and hardware built and includes its reparation, maintenance, and replacement. The technical options must address the type of source and its vulnerability in order to keep quality and quantity. Some studies highlight the system design and the construction quality as the most important aspects within the technical dimension [Kamruzzaman *et al.*, 2013].
- **Social dimension** refers to the socioeconomic and cultural conditions of the community, including equity, gender, and inclusion needs. In community-based management and demand-driven approaches, the social dimension also includes the participation of the community in the design and development of the project, their willingness to pay, and perception and use of the service. The relations among users and between the users and the local authority are also included within this dimension.

Some authors aggregate under the institutional dimension both institutional and management dimensions [Mukherjee *et al.*, 2002; Harvey *et al.*, 2004]. The Dutch WASH Alliance – a consortium of six Dutch NGOs – calls the five areas of sustainability (financial, institutional, environmental, technical, and social) the FIETS sustainability approach [Dutch WASH Alliance, n.d.]. However, the research presented here takes the six-dimension approach to analyze in depth the factors linked to each of the dimensions in a more comprehensive way. The analysis discriminates between these two categories (institutional and management) displaying a deeper assessment that illustrates the variety of actors playing a role in the sustainability of rural water systems. On one hand, institutional factors are more related to public sector and national and subnational authorities. Managerial factors, on the other hand, are related with the operator of the system that may be a public, private or, more commonly, community organizations in rural areas.

Regardless of the number of dimensions that affect sustainability in rural water schemes, all are interrelated and interdependent [Harvey *et al.*, 2004; Giné *et al.*, 2008]. Figure 9 reveals the fundamental relationships among the six dimensions of sustainability in rural water systems defined in this research. The costs linked with the operation and maintenance of the system are related to the type of technology used to build the system. This technology in turn depends on the type of source and the alternatives to obtain water in optimal conditions. Costs linked with technological and managerial dimensions, together with user capacity and willingness to pay, influences tariffs to preserve the financial sustainability of the system in a specific institutional context. If users cannot afford to pay the real costs of the service (including environmental costs, often omitted in the tariff) subsidies are essential [Persoon, 2009].

Figure 9. Dimensions of sustainability in rural water systems



Source: author, 2015

Preconditions of the water service in the community also impact the definition of the new water system and the factors affecting its sustainability. These include alternative water sources used before building the new water system; perceived and real differences about costs; quality of the water; availability and quantity; and other possible factors. All these factors affect community preferences and the willingness to participate and pay for the new service. The geographical and physical conditions of the source also affect costs and selection of technology (including some legal aspects such as land tenure and right of way). The associative background of the community and social relations among different groups are crucial to enabling community-based management that can guarantee sustainability in the long term. A community's preferences are commonly reduced to the willingness to pay indicator, although the social dimension encompasses more complex indicators.

There are some contextual conditions that can also impact the sustainability of water systems. Some authors have highlighted the importance of the donors' role (national or international) to support reform and institution-building for rural water, to support decentralization and diversification of service delivery, and to address the unfinanced life-costs [Lockwood *et al.*, 2011]. Poverty is usually included in social factors, but some authors consider it a separate factor because of its importance. PEP [2006] discussed the contribution of water management in four key dimensions: poverty reduction as enhanced livelihoods security, reduced health risks, reduced vulnerability, and pro-poor economic growth. There are other conditions that can be understood to play a role in each and every dimension. This is the case for the flexibility condition, regarding either the physical system (in order to expand when needed and to cope with new climate conditions), the management system (as community needs may change over time) or the financial system. The capacity of adaptation would help the improvement and sustainability of the water service.

Lockwood [2004] highlighted some limitations that can diminish the probability of system sustainability: the lack of follow-up support to help communities resolve disputes or to expand systems successfully as population increases; the difficulties in finding affordable spare parts; the shortage of technical skills in carrying out preventive maintenance; the limited understanding of hygiene linkages; and the insufficiency of refresher training courses. Pearce-Oroz [2011] recognized sustainability of services in rural areas when the area was defined by the existence of a quality natural resource base, a quality service delivered, and a strong financial model. In this case, the financial model has to ensure operation, maintenance, and replacement of the water systems in the long term. Finally, the Joint Monitoring Program emphasized regulatory issues, institutional support, management, and life-cycle cost as the key factors [WHO, 2012 in Ermilio *et al.*, 2014].

Sudgen [2003] identified seven key critical factors for achieving sustainability in hand pump systems: policy context, institutional arrangements, financial and economic issues, community and social aspects, technology and the natural environment, spare parts supply, and maintenance systems.

Other studies have attempted to identify critical factors affecting rural water sustainability and to define key criteria for basic levels of service [Barakzai *et al.*, 2014]. The most common issues identified as causes for water system failure are poor construction of the infrastructure, inappropriate technologies, low quality operation, insufficient maintenance, lack of financial resources, weak institutional structures, lack of participation from stakeholders and political will, and lack of understanding of the specific context of the community [Elledge, 2003; Peltz, 2008; Persson, 2009].

Welle *et al.* [2014], after reviewing several studies, classified the factors affecting sustainability under these categories:

- Quality of project implementation, linked with technical and social preconditions.
- User satisfaction with the service provided (quality, quantity, accessibility, reliability).
- Operation and maintenance management, including financial management.
- Accountability and transparency.
- External support.

Some authors have also mentioned success criteria linked to sectoral policy and program design. Well [1998] highlighted effectiveness (the extent to which a project, intervention, or service delivers its intended benefits), equity (ensuring that the program benefits reach poor and disadvantaged groups), efficiency (the value for money in terms of per capita capital expenditure, increased coverage, and operation and maintenance costs) and replicability (the development of program models that can be replicated elsewhere to continue expansion of water services).

Rural and urban contexts share the dimensions associated with sustainability of water services, although there are some differences due to their distinct geographical and socio-economic characteristics. In rural areas the costs per capita of building water systems are higher as populations are smaller and normally scattered over a large area. This geographical distinction also increases costs in operation, maintenance, and repairs, and these costs are covered by fewer users [Naughton, 2013]. Furthermore, institutions in rural areas are normally weaker as human and financial resources are more limited in poor regulatory contexts. This leads to a lower capacity of collecting fees and solving technical and social issues regarding the water system [Cozzens *et al.*, 2007 in Perssons, 2009]. However, there are some successful rural water systems with the participation of the community, the local authorities, and the private sector.

In sum, sustainability in rural water is a multidimensional concept that comprises an enormous variety of factors, variables, and indicators, whose relevance and weight depends at the same time on numerous contextual variables. For instance, in a community with high levels of wealth, financial factors may be less important than other factors, while in a community located in an area prone to natural disasters, the design of the infrastructure and the environmental factors may be of a higher importance.

Several mechanisms to monitor and assess the most relevant factors affecting sustainability for each dimension have been developed over time (tools, methodologies, and indices). These mechanisms range from simple and specific checklists to analyze the functionality of the system to complex methodologies integrating weighted factors.

D. Measuring sustainability of rural water systems

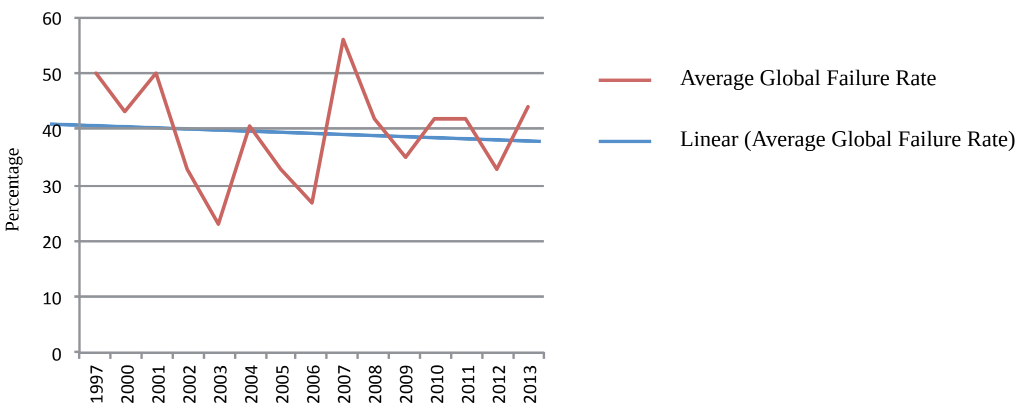
One of the main challenges for the different stakeholders involved in rural water systems is measuring sustainability. The challenge has been, and still is, to understand why a system is or is not sustainable and which are the main factors that will maintain the conditions of optimal functionality over time. Sustainability is a dynamic process with interrelated components that vary according to the context and over time, which means that measuring it involves several layers of complexity [Lockwood *et al.*, 2003].

In 1983 the WHO published the Minimum Evaluation Procedure, the first set of procedures for assessing the use and functionality of water supply and sanitation services with a global applicability and a structured approach [Dayal *et al.*, 2000]. Data (observations and surveys) to assess functionality were collected by outsiders, without the participation of the community and the methodology missed important topics in the analysis, such as local participation, organizational structures in the community, gender, and other operation and maintenance procedures. In order to redress some of these limitations, the same year the UNDP developed the program Promotion of the Role of Women in Water and Environmental Sanitation Services (PROWWESS) as a participatory assessment tool and method, based on the Minimum Evaluation Procedure [Narayan-Parker, 1993; Srinivasan *et al.*, 1993]. During the 1990s the UNDP/World Bank Water and Sanitation Program adopted PROWWESS as a tool for assessing the water projects under their Program [Simpson-Hebert *et al.*, 1997]. The tools and methodologies proposed in PROWWESS helped projects and communities to address the social, technical, and institutional aspects of community-based water supply and sanitation programs including gender aspects. It was one of the first systematic approaches for participatory evaluations of water and sanitation programs, but it did not propose quantitative or comparable information over time at a reasonable cost [Dayal *et al.*, 2000].

The first measures of sustainability were based on a system's functionality as a proxy indicator of sustainability in simple water systems, such as hand pumps [IRC, 2011]. This on-site assessment supported the analysis of coverage, although it did not measure access to the service, its characteristics, or the probability to keep its functionality – the probability of the system to work over time. Furthermore, this type of measurement prevented ascertainment of the underlying factors that made the system functional and, in the long term, sustainable.

Several studies show consistently low levels of functionality of rural water systems during the last decades [Kleemeier, 2000; Harvey, 2009; Adank *et al.*, 2014; Ryan, 2014]. Improve International [2014] displays on its webpage a compilation of statistics about several programs around the world with failure rates of water points (Figure 10). The average global failure rate reached almost 40 percent during the last decades. These data are consistent with other studies that show levels of failure between 30 to 40 percent for hand pumps, although they also inform about cases of non-functionality with rates as high as 70 percent [Rivera *et al.*, 2004; RWSN, 2009; Taylor, 2009; Kumamaru, 2011; Barakzai *et al.*, 2014]. The percentage of failure in water points (non-operational systems) reached more than 65 percent in Peru; and almost 50 percent in Haiti and Honduras [Blanc *et al.*, 2012; Smits *et al.*, 2012].

Figure 10. Average global water point failure rate.



Source: Improve International, 2014.

Welle *et al.* [2014] reviewed the Global Water Initiative (GWI) in East Africa to monitor governance factors affecting rural water supply sustainability. The report analyzed findings about functionality of water systems supported by the GWI through the structured questionnaire GiFT (Governance into Functionality Tool). The tool measured the system's functionality on the day of the survey (whether the system was working or not) and organized focus groups to address community judgment of the system's overall functionality since its establishment. Results indicated the weakness of the CBM approach in regard to the functionality of the system, as the functionality in the three-country study – Ethiopia, Uganda and Tanzania – decreased over time. The focus groups tried to capture some characteristics of the level of service (such as hours of functionality), as well as reasons for poor functionality performance (the most frequently cited reason was mechanical failure). The study concluded that the sustainability of the system was affected by a combination of factors, including physical design issues, user satisfaction of the service, a good functioning CBM structure, and the provision of external support and oversight. This coincides with the primary factors described in the literature. Regarding governance factors, the overall performance of the water user committees and their financial management capacity were the most significant factors affecting the functionality of systems for all countries.

In some cases, the analysis added an intermediate status – reduced functionality – to provide more detail. However it continued to omit the underlying reasons that explain the functionality of the system [Leclert, 2013]. WaterAid developed a three-scale ranking system to assess functionality: a) the water system is likely to be sustained; b) the water system is unlikely to last beyond a first major breakdown; and c) the water system is unlikely to last beyond its first breakdown [Sudgen, 2003].

Even for simpler systems (point source), functionality must be tracked over time to give a picture of sustainability [IRC, 2011]. A system that is working at the time of observation, no matter how good its performance, may break down in the next hours. On the flip side, a system that is not working at the time of observation can be repaired within hours, and achieve an acceptable level of functionality. This variability and inaccuracy explains why the measurement of functionality and even performance must include information about other factors affecting sustainability.

Functionality can also be classified according to the operational level defined at the design stage. The system is considered functioning when water flows at least 85 percent of the designed rate, partially functioning when water flows at a rate less than 85 percent of the designed rate, or non-functional if no water flows when the tap is opened [Adank *et al.*, 2013].

Several methodologies use simple analyses to measure functionality and performance, including a 'sustainability scale' to measure the likelihood of sustainability [Lockwood *et al.*, 2003, IRC, 2003; WaterAid, 2009]. However, these analyses still give an idea of the 'current picture' of the system, with some additional information about the quality of the service. It is important to assess whether structures and arrangements are in place to ensure that the facility is not only providing water services today, but are capable of doing so for a long time to come [Adank *et al.*, 2013]. Furthermore, functionality predominantly measures the level of the system service related to infrastructure rather than the service within the household.

Generally, sustainability assessments in more complex systems also include the analysis of indicators related to the level of service (assessment of performance). This approach allows for differentiation of levels of system functionality. Different authors have examined which are the main characteristics that define the level of service for a rural water system [IRC, 2011; SNV, 2013]. In general, the number of indicators is low (no more than 4 or 5) and most of them are directly linked to the resource. The most common indicators to assess performance are quantity, quality, reliability and accessibility.

- **Quantity**. Basic/intermediate access is suggested at 20-50 liters of drinking water per person per day, including consumption (drinking, food preparation, and dish washing) and basic personal hygiene (hand/face washing, brushing of teeth, toilet pour flushing, laundry, and bathing). According to Albuquerque [2012], 20 liters per capita per day is the minimum quantity required to realize minimum essential levels of the right to water, but substantial health concerns remain significant even at these levels. To ensure the full realization of the right, quantity should be at least 50 to 100 liters per person per day.

- **Quality**. Water must be safe for consumption and other personal uses, so that it presents no threat to human health. Normally these standards are established by the national water authorities or, otherwise, by the World Health Organization.
- **Reliability**. Water must be accessible all year independent of quality. Services should be provided with a reliability of 95 percent, interpreted as at least 345 days per year of regular service without interruption.
- **Accessibility**. Water services must be accessible to everyone in the household or its vicinity on a continuous basis. Acceptable levels of accessibility require water supplies to be less than 1 km distance away from the household, or the time spent to collect water to be less than 30 minutes per person per day.

IRC [2011] distinguished 5 levels of service depending on four characteristics of the system (quality, quantity, accessibility and reliability): high, intermediate, basic (normative), sub-standard, and no service (Table 5). It included the JMP's definition of sustainability, one of the first global efforts to measure quality of water systems as a proxy for sustainability. The JMP established a standard set of drinking-water categories used for monitoring purposes [WHO/UNICEF, 2014]. The JMP defined an improved drinking-water source as *one that, by the nature of its construction and when properly used, adequately protects the source from outside contamination, particularly fecal matter.* This methodology fails to capture the full scope of functionality issues, as it is linked to the type of technology rather than to the service provided. Understanding the reasons for the determined degree of non-functionality or sub-standard service delivery is crucial for defining appropriate remedial actions (Adank *et al.*, 2014).

Table 5. Water service ladder indicators.

Service level	Quantity (lpcd)	Quality	Accessibility (mpcd)	Reliability	Status (JMP)
High	≥ 60	Good	≤ 10	Very reliable	Improved
Intermediate	≥ 40	Acceptable	≤ 30	Reliable/ secure	
Basic (normative)	≥ 20				
Sub-standard	≥ 5	Problematic	≤ 60	Problematic	Unimproved
No service	< 5	Unacceptable	> 60	Unreliable/	

Notes: lpcd (litres per capita per day); mpcd (minutes per capita per day spent fetching water, taking into consideration distance and crowding).
Source: IRC, 2011.

The WASHcost program [Moriarty *et al.*, 2011 in Barakzai *et al.*, 2014] also outlined quantity, quality, accessibility, and reliability as the four indicators for measuring service levels. The program built a generic matrix to assess the service of rural water systems (Table 6). In some cases, the WASHCost program introduced the criterion of use [Smits *et al.*, 2012]. Both the indicator of use (the majority of the population in the service area received a basic level of service) and the indicator of reliability (an improved source that worked at least 350 days a year without a serious breakdown) had definition problems, especially because the terms 'majority' and 'serious breakdown' are not defined.

Table 6. Framework or Rural Water Service level matrix.

Level of Service	**Quality**		**Quantity (lpcd)**	**Accessibility (mpcd)**		**Reliability (months/ year)**	**Overall Level or Service**
High	Household perception of quality	Improved Rural Water Service	>100	<30	Within household compound	12	The lowest score of each household's four individual indicators
Intermediate			50-100		<100 m	10-11	
Basic (as national standards)			20-49		100-1000 m	8-9	
Substandard		Unimproved Rural Water Service	5-20	31-60	>1000 m	5-7	
No service			≤5	>60		0-4	

Notes: lpcd (litres per capita per day); mpcd (minutes per capita per day spent fetching water, taking into consideration distance and crowding).
Source: Barakzai *et al.*, 2014.

Some countries present national and/or local guidelines for defining optimal or standard levels of service. For example, national guidelines in Ghana suggest that water supply infrastructure should function 95 percent of the time [IRC, 2011]. The World Health Organization, which has published several guides, is the leading institution in defining criteria and standard levels of service regarding domestic water needs [WHO, 2013].

The UN General Assembly and the Human Rights Council explicitly recognized the Human Right to water and sanitation in 2010 and a number of criteria were used to specify the content of this right [Albuquerque, 2012]. These criteria include some of the variables commonly used to measure level of service, such as availability, quality, acceptability, accessibility, and affordability. However, other factors, such as the principles of non-discrimination, access to information, participation, and accountability, cannot be assessed under the level of service approach and need a broader analysis.

In general, water systems show a gradual deterioration in performance when the quality, quantity or reliability of the water supply decreases over time. This decrease in the level of service may come as a result of the expected physical deterioration of the system (linked with its life expectancy) or of a sudden system breakdown (e.g. due to lack of maintenance or repair, or natural disasters).

The adequate provision of sustainable water services goes beyond functionality or performance [Adank *et al.*, 2013]. For more complex water systems, such as piped water systems, the assessment of the characteristics associated with the level of service is accordingly more complex [Leclert, 2013]. In order to deliver reliable water services, the functionality and level of service associated with the *hardware elements* of the system (such as infrastructure) is as important as the presence of so-called *software elements* (such as financial plans, continued training and maintenance, trustworthy institutional assistance, and social agreements) [Pearce-Oroz, 2011; USAID, 2013].

The number of tools and guidelines for measuring sustainability in rural water systems has increased recently with more concrete efforts underway during the last three to five years [Boulenouar *et al.*, 2013]. There has been an increased understanding of and attention to the design and the different stages of the water systems (construction, operation, maintenance, replacement) as essential to making projects more successful and more efficient [Lockwood *et al.*, 2003]. However, traditional indicators remain inadequate to provide a sound methodology for recurrent monitoring [Jimenez, 2010].

Most sustainability assessment methods are based on a three-pillar model of technological, economic, and environmental dimensions, although in some cases, institutional, management, and social dimensions are also included. Each of these factors can be measured through multiple methods and indicators. The criteria to decide which indicators to use depend on several factors, including how sustainability is defined, which are the main factors impacting system sustainability, the availability of data, the objective of the study, the budget available, and stakeholder (public sector, private sector, users) willingness to participate. Thus there is no set of indicators supported by compelling theory, rigorous data collection, and analysis, to provide an optimal methodology for measuring sustainability case by case [Parris *et al.*, 2003].

In order to measure factors affecting sustainability for each dimension, a series of questions and indicators must be developed. These questions must be directed toward different stakeholders at different institutional levels (households, service providers, district and national level), and in some cases may be answered through review of relevant legislation and sector policy [USAID, 2013].

As stated, many tools and methodologies exist to measure sustainability. Some of these tools are part of bigger programs that attempt to evaluate the impact of program investments. In some cases tools are linked with governmental programs to monitor national or subnational programs or international goals, such as the MDGs [Boulenouar *et al.*, 2013]. However, not many countries have enough resources to gather the data needed to monitor these targets or they have little information on the sustainability or the status of rural water services [Lockwood *et al.*, 2011]. Data tend to not be collected regularly or with comparable methodologies. Although most countries have met their objectives, the assessment of sustainability of services is necessary in order to ensure appropriate health and economic benefits.

In 2008 the Sustainable Service at Scale initiative (Triple-S) started. Led by IRC as a six-year (2008-2014) multi-country initiative, the aim was to contribute to the discussion about sustainability challenges in rural water supply. One of the objectives of the Triple-S was to complement the concept of Service Delivery Approach (SDA) through several case studies and to experiment with good practices for achieving sustainable services. According to the Triple-S end of project evaluation – Water Services that Last [Hydroconseil, 2015] – the initiative helped to articulate a series of concepts associated with water sector sustainability, such as the SDA of the Whole-System Change Approach. The Theory of Change was based on the Whole-System Change Approach and consisted of 3 pillars: the service delivery approach, the learning and adaptive strategy, and the harmonization and alignment between donors with government-led processes. However, the Theory of Change did not demonstrate improvements in the service levels and user satisfaction, and it was too ambitious to be implemented completely in any of the case studies.

The Triple-S initiative also discussed and reviewed the concept of 'building blocks' originally developed by Harvey *et al.* [2004]. First used for the analysis of hand pump systems, the building blocks are factors ranging from a focus on implementing stand-alone water systems (infrastructure) to delivering sustainable services, thereby integrating all the factors involved in the sustainability of the systems. Lockwood *et al.* [2011], based on the IRC study, identified 10 building blocks that contribute to supporting the shift toward the sustainable delivery of services:

1. Professionalization of community management.
2. Increased recognition and promotion of alternative service provider options.
3. Monitoring of sustainability indicators and targets.
4. Harmonization and coordination.
5. Post-construction support to service providers.
6. Capacity support to decentralized government (to the service authorities).
7. Learning and sharing of experience (adaptive management).
8. Planning for asset management.
9. Financial planning frameworks to cover all life-cycle costs.
10. Regulation of rural services and service providers.

The Triple-S initiative called for applying these blocks at different levels of service provision, namely at the service provider, service authority and national levels.

Schweitzer *et al.* [2014] conducted one of the most recent studies on the tools to measure sustainability, based on a previous work by Boulenouar *et al*. [2013]. The authors reviewed 25 tools to analyze the methodology used to measure sustainability. Some of the tools focused exclusively on rural water systems, such as the Triple-S building blocks framework, while others had a wider focus and also included sanitation and hygiene topics, such as the FIETS sustainability approach, the USAID Sustainability Index Tool, and the WaterAid sustainability framework. Some of the tools, such as the Gender Analysis Snapshot or the Technology Applicability Framework, only analyzed one dimension affecting sustainability. Other frameworks included some of the 6 dimensions defined by the research presented here, as in the case of the USAID Sustainability Index Tool, which considered 4 factors: institutional arrangements, management practices, financial conditions, and technical operations and support. More than half of the tools assessed were applied in Africa and only 5 tools were applied nine times or more [Schweitzer *et al.*, 2014], which illustrates that most organizations adapt their own sustainability tools according to their unique contexts and conditions, without a general agreed upon framework that would help the comparison assessment.

This research examines 24 of these tools specifically related to water issues and includes 5 more tools to complete the desk review (see the complete list of tools in Appendix C).[3] Furthermore, the analysis examines over a hundred case studies to assess the most common indicators used to assess sustainability in rural water systems. In total this research examines tools and case studies that included 1,128 indicators used to measure sustainability. Each indicator is classified along the 6 dimensions (environmental, institutional, management, technological, financial, and social).

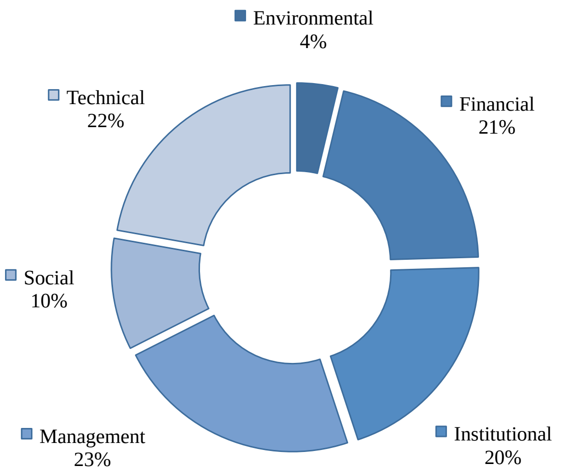
The analysis reveals that management, financial, and institutional indicators each comprise approximately a fifth of the total number of indicators analyzed (23 percent, 21 percent, 20 percent respectively) (Figure 11). The social dimension constitutes 10 percent of the total number of indicators and the technical dimension an additional 10 percent. Finally, indicators associated with the environmental dimension were the least common with only 4 percent of the total.

This analysis also classifies the indicators according to the stage in the project cycle where they are located: planning, construction, operation, maintenance, or knowledge. The knowledge 'stage' is associated with information sharing, training, and monitoring of indicators at the national

[3] The tool Enabling Environment Assessment is focused only in sanitation and hygiene and has not been included in this research.

level, among other factors, and it is measured transversally during the life cycle of the water system (at the planning, construction, operation, and maintenance stages). Some indicators can be measured in several stages, but in general, the appropriate stage for classification is well defined. The operation phase includes 38 percent of the indicators followed by the planning phase (pre-construction) with 32 percent, which together comprise 70 percent of the total. Indicators linked directly with the construction phase are the least common in the analysis of system sustainability (4 percent), followed by the maintenance stage (post-construction) (10 percent), and knowledge (16 percent).

Figure 11. Number of indicators assessing sustainability by dimension.



Source: author, 2015.

Table 7 shows the most frequently used indicators across each dimension. The analysis shows a high variability of indicators, with few indicators repeated. These indicators were used to build the index of sustainability applied to the case study in chapter four.

Table 7. Most referred indicators assessing sustainability by dimension.

Environmental dimension
1. Is the water source exposed to pollution?
2. Is there sufficient available ground water/surface water for current and future needs?
3. Is there a local reservoir, sufficient to store water for dry periods?
Institutional dimension
1. Is there a common sector-wide approach accepted and do development partners share information and collaborate within national policy and guidelines?
2. Are there formalized roles and responsibilities for the service authority?
3. Are there national (or local) norms and standards for the composition of a water committee?
Management dimension
1. Is the water service authority adequately staffed?
2. Are technical records kept and shared with the community on a regular basis?
3. Are administrative records kept and shared with the community on a regular basis?
Financial dimension
1. Does the water committee keep financial records?
2. Was the budget created considering total life-cycle costs including operation and minor maintenance costs, as well as making provisions for capital maintenance (rehabilitation and replacement)?
3. Are funds available and sufficient for maintenance when needed, even for the most expensive maintenance process?

Technical dimension
1. Does the system meet the criteria on reliability (e.g. hours per day, days per week, months per year)?
2. Is there a preventive maintenance of the system?
3. Can spare parts be obtained?
Social dimension
1. Are users satisfied with water quality?
2. Do users participate in planning and design of monitoring and evaluation?
3. If user consumes water for production, what is it for? (horticulture, animals, brick making, food/drink preparation, other)

Source: author, 2015.

Despite the self-evident importance of the factors associated with the quality and quantity of water sources, the number of indicators associated with the environmental dimension is very low compared to other dimensions. Water programs tend to overlook the watershed as part of the system, and data is normally weak or non-existent when measuring availability. Furthermore, the presence of other users exploiting the resource in the watershed (e.g. agriculture, industry), the negative effects of climate change, and the urbanization of areas near the source are not monitored. These factors can have a direct impact on resource management and sustainability. Environmental indicators are normally measured in the planning and construction stages, although their monitoring during the operation stage of the system is essential in order to foresee changes in the quality and availability of the resource.

Policies in LAC have improved in the last decade in regard to the institutional dimension. The political approaches in the water sector have progressed together with international conferences on water issues and the results of programs led by countries and local and international organizations supported by foreign aid assistance. Regulations have been developed in order to facilitate the sector management under the ‘Human Right to Water’ approach [UN, 2010]. The institutional context determines the legal setting, the management model, the level and characteristics of subsidies, and the participation of the public and private sector, including external support, that facilitate sustainable services to the entire population. The indicators associated with this dimension are based on desk review analysis and are generally assessed at the planning level. In most cases, the institutional factor is taken for granted, given that regulation is already in place. Although in some cases, especially at the local and rural levels, there are significant limitations to the definition of institutional frameworks.

According to our analysis, indicators related to the management of the system are the most frequent. These indicators assess operator performance in terms of achievement of administrative and operational activities. Evaluation is normally carried out through the analysis of records managed by the operator and is measured during the operation phase of the systems. The governance within the administrative structure is also associated with institutional indicators, in regard to how the decision-making processes are organized to manage the service. The management indicators include post-construction support (regularly or on-demand) and the training activities implemented by the public or private sector.

Technical factors arise at the planning and operation stages. At the planning stage, the indicators are linked to system design (including treatment/quality of the source) and innovation, which have a direct impact on the performance and robustness of the system and the related costs (operation, maintenance). Indicators are normally measured through technical assessments at the source and reports about technical characteristics of the system. At the operation stage, technical indicators are related to the maintenance of the system (preventive maintenance), repairs, and finally, the partial or total replacement of the system. Data to measure indicators in this stage can be found in technical reports made by the operator.

Financial indicators are related to budget management and costs, mostly in the operation and maintenance stages. In general, infrastructure in rural water systems is built by the public government with national/subnational financing and/or international aid funding. Sometimes the capital expenditure is repaid through user tariffs if the government does not take over the costs. The recurrent expenditure (e.g. operation and maintenance, indirect and direct support, and repairs) depends on the technology selected and the management model. The tariffs associated with the service also depend on user capacity and willingness to pay for a specific quality of the service. The tariff structure must take into account several socioeconomic considerations to achieve cost recovery for the system. The imbalance between cost recovery (tariffs) and real costs is compensated through direct subsidies (government paying for part of the service) or indirect subsidies (government subsidizing electricity or other services to reduce costs). Also some operational costs can be reduced through economies of scale, in which some of the costs are shared among several operators (e.g. purchase of materials and sharing of training and technicians). Data to assess financial indicators are normally found in administrative reports, although data highly varies in quality and availability.

Finally, social indicators are related to community participation and sociocultural issues within the community. They also have a direct influence on the demand-response of the communities. These indicators are difficult to measure because normally data come from qualitative analysis that is expensive and challenging to obtain. Willingness and capacity to pay are some of the main topics highlighted among the social indicators to assess sustainability in rural water systems. These are related to the use of the resource and the perception of the quality of the service and the water. Other indicators linked with the social dimension have either direct or indirect impacts on other factors, including user capacity to pay (linked to poverty rates), the financial structure of the service, and the political interferences with the management model.

Sudgen [2003] defined 6 characteristics that a tool must have to be an effective measure of sustainability. A tool must be easy to understand and use, able to be quickly applied, discussion provoking, applicable to all circumstances, non-prescriptive, and effective even in exceptional circumstances. Jimenez [2010] concludes that it is imperative to define EASSY indicators (Easy to get at the local level, Accurately defined, Standard and internationally applicable, Scalable at all administrative levels, and Yearly updatable). Adapting indicators to focus on the service provided and defining sector targets is an important step in creating more sustainable rural water services at scale [IRC, 2011].

Conventionally, the assessment and monitoring of indicators involve outside experts through standardized procedures and tools. However, participatory monitoring and evaluation have been more frequently used in the assessment of sustainability in rural settings. Some qualitative methods, such as the Methodology for Participatory Assessment, were developed in the nineties in order to involve communities in the assessment of sustainability and to track specific issues such as gender and social equity in large-scale infrastructure projects [Wijk *et al.*, 2003; Mukherjee *et al.*, 2002]. The participation in the assessment of stakeholders – users of the service at the community level, providers, technical assistance organizations, private sector, and municipalities – provides several advantages [Mostert, 2003; Lockwood, 2004; Amerasinghe, 2009; USAID, 2013; Zeraebruk *et al.*, 2014]. At the technical level, participatory assessments tend to be more flexible and adaptive to context or project changes. Data is collected at more levels (users, providers, regulators), and having more information allows better assessment of the level of service and the identification of measures to improve it. At the social level, the process is more reliable as users and other stakeholders participate directly in the design and/or implementation of the evaluation, and have the opportunity to provide ideas to improve the service. As a consequence, the ownership of the program is reinforced as the trust in the results of the assessment grows. However, participation assessment can be more expensive and time consuming, not only in regard to data collection but also in regard to training stakeholders for the assessment. Participation needs to reflect all points of view in the community, avoiding dominating voices that could jeopardize the process. Also, the commitment of the stakeholders is key to developing a reliable participatory methodology. Therefore communities often are not able to manage their water systems properly and need external technical and financial support.

USAID [2013] differentiated the application of key indicators at three levels according to geographic scope: service provision (at the local level), district level, and national level. IRC

[2011] outlined three aspects for monitoring sustainability in rural water systems according to type of stakeholder:

- Services received by users, linked with functionality aspects in terms of quantity, quality, accessibility, and reliability.
- Performance of the service provider or operator in terms of technical, financial, and management functions to deliver a sustainable service to users.
- Performance of the service authority in terms of institutional functions (planning, coordination, regulation, and support functions) to ensure the organization and performance of service providers.

The assessment of sustainability is a shared responsibility of all stakeholders involved in the planning, operation and maintenance of the service system [Lienert *et al.*, 2013; Starkl *et al.*, 2013]. Setting up monitoring systems appropriate for users, service providers and governments, in order to gather the required information to set targets, monitor progress, take corrective action and ensure accountability, is essential to creating more sustainable services at scale [IRC, 2011]. At the local level, water service monitoring provides an opportunity to see how the service is functioning in terms of service levels [Adank *et al.*, 2013]. The results of the monitoring help users and service providers improving the service level to achieve national standards. At the district and Regional level, monitoring information about water systems can inform strategic planning in the improved allocation of budgets and other resources, allowing greater focus on more challenging areas. National institutions need to set up an efficient information system to gather and validate indicator-based sequential information, first, to ascertain the coverage of their status at the municipal and community level and, second, to understand the context and the main factors that impact systems sustainability [Pearce-Oroz, 2011].

E. Challenges in defining and measuring sustainability in rural water systems

The concept of sustainability has changed over the last decades, not only in regard to its conception but also in regard to the stakeholders responsible for system assessment and management. The first discussions of the concept of sustainability in the water sector, from functionality to level of service, only focused on the system, the infrastructure, and how it worked. In the last decade the approach has expanded and studies include factors affecting sustainability under the environmental, technical, financial, institutional, management, and social dimensions, and the interaction among them. The approaches focused particularly on economic dimension over the environmental and social dimensions, especially after the Brundtland report. Many examples assess sustainability using several tools and methodologies but the challenges are still significant.

First, the definition and adaptation of indicators to specific contexts requires socioeconomic and cultural knowledge of the area. This information is not always available, and accessing it can be expensive and time-consuming. Furthermore, definitions of sustainability are broad and have commonly ignored certain social aspects, such as distributive justice and equity. In general, if data exist, they are partial in terms of coverage and often out of date [Pearce-Oroz, 2011]. In the analysis of the dimensions affecting sustainability, the common approach is to assign the same weight to each indicator. Few tools try to develop a methodology to assign weights [Nardo *et al.*, 2005 in Juwana *et al.*, 2012].

Another limitation is uncertainty over how to ensure, assess, and validate the quality of the data with simple and low-cost methodologies. In many cases rural water supply systems are not efficiently monitored, due to lack of planning, institutional weakness, lack of human resources to coordinate and manage the assessment, and the lack of financial resources, among other problems. Finding the balance among costs and results achieved is strategic to developing an effective methodology. The participation of the community in so-called ‘action evaluations’ [Lockwood *et al.*, 2003] can improve the quality of the assessment, but minimum technical and social requirements are needed to develop this type of methodology [Barakzai *et al.*, 2014]. Once the methodology is selected, the systematic and recurrent monitoring of the indicators and its posterior analysis of the results should be conducted over time in order to be able to use them in the decision-making processes at the local, Regional and national levels [Lockwood *et al.*, 2011; IRC, 2011; Pearce-Oroz, 2011].

The definition of the tariff structure is also a key criterion for reflecting an accurate balance between costs and quality of the service, taking into account user capacity and willingness to pay. The inclusion of environmental costs into the tariff improves the sustainability of the service and controls shortages in availability and potential contamination of the source. Other essential criteria for assessing sustainability in rural water systems include the analysis of external follow-ups and the roles of the public and private sectors in the post-construction stage. Dependence on international aid development agencies or NGOs is a significant risk to maintaining long-term sustainability. Finding measures to build financial and operational sustainability is one of the biggest challenges in rural areas.

Chapter four
SANITATION BOARDS AND SUSTAINABILITY IN PARAGUAY

A. Rural water in Paraguay

1. Context

Paraguay is a South American country, bordered by Argentina to the south and southwest, Bolivia to the northwest, and Brazil to the northeast and east (Figure 12). The Paraguay River runs through the center of the country, from north to south, dividing Paraguay in two halves with distinct features and characteristics: the Eastern Region – or Paraneña Region – and the Western Region – or Chaco. The country is divided into 17 different provinces, called departments, and one Capital District, Asunción. The country had an estimated population of 6.9 million in 2014 [World Bank, 2015] mostly concentrated in the Paraneña Region (97 percent of the total population in 40 percent of the total territory).

Figure 12. Location of Paraguay.

Source: Google Maps, 2015.

Almost a third of the Paraguayan population lives in the capital and the metropolitan area (Figure 13). Paraguay is one of the least urbanized countries in LAC, with only 59 percent of the population living in urban areas (the average for LAC is 78 percent). In rural areas, the poverty index doubles that of urban areas (42.5 percent versus 23.1 percent) and the extreme poverty index almost quadruples (28.9 percent versus 7.3 percent). Paraguay is also one of the least dense countries in the Region with only 17 people per square kilometer of land area, far below the average for LAC (31 people per square kilometer of land area) [World Bank, 2015].

The main economic activities are in agriculture and livestock production. Soybean and beef comprised 40 percent of total exports in 2013. In recent years, the Paraguayan economy has grown due to the increase in agricultural exports. Furthermore, agriculture activities employ about 45 percent of the total formal working population. Some of the main World Development Indicators are presented in Table 8.

Table 8. Paraguay World Development Indicators (selection).

Indicator	1990	2000	2005	2010	2014*
Population, total	4,249,747	5,350,253	5,904,170	6,459,721	6,917,579
Population growth (annual %)	2.63	2.08	1.90	1.75	1.68
Population density (people per sq. km of land area)	11	13	15	16	17
Poverty headcount ratio at national poverty lines (% of population)	-	-	39	35	24 (2013)
GNI per capita, PPP (current international $)	-	4,130	4,510	6,380	8,010
Life expectancy at birth, total (years)	68	70	71	72	72 (2013)
Mortality rate, under-5 (per 1,000 live births)	46	34	29	24	22 (2013)
School enrollment, primary (% gross)	104	120	111	97	96 (2012)
School enrollment, secondary (% gross)	31	61	66	68	75 (2012)
Forest area (sq. km)	211,570	193,680	184,750	175,820	172,248 (2012)
GDP (current US$ million)	5,695	8,196	8,735	20,047	30,985
Exports of goods and services (% of GDP)	-	47	58	55	45
Imports of goods and services (% of GDP)	-	38	46	51	42
Net official development assistance and official aid received (current US$ million)	57	82	51	121	130

* Unless otherwise indicated.

Source: World Bank, 2015.

The country is in general flat, with some hills in the Paraneña Region (Cordillera de Amambay, Cordillera de Mbaracayú, and Cordillera de San Rafael). Four main rivers dissect the land: the Paraguay river, which runs through the center of the country; the Apa and the Parana Rivers, which define the border with Brazil; and the Pilcomayo River, which defines the border with Argentina.

The overall climate in Paraguay ranges from subtropical to temperate, with wet (May to August) and dry (September to April) periods. The absence of mountain ranges contributes to the climate of the country: high temperatures in summer with hot and humid, high-speed North winds (up to 160 km/h); and mild temperatures in winter, with dry, cold polar winds from the south that can suddenly cause the temperatures drop to 0ºC.

Figure 13. Population in Paraguay.

Source: World Trade Press, 2007.

Figure 14. Precipitation in Paraguay.

Source: World Trade Press, 2007.

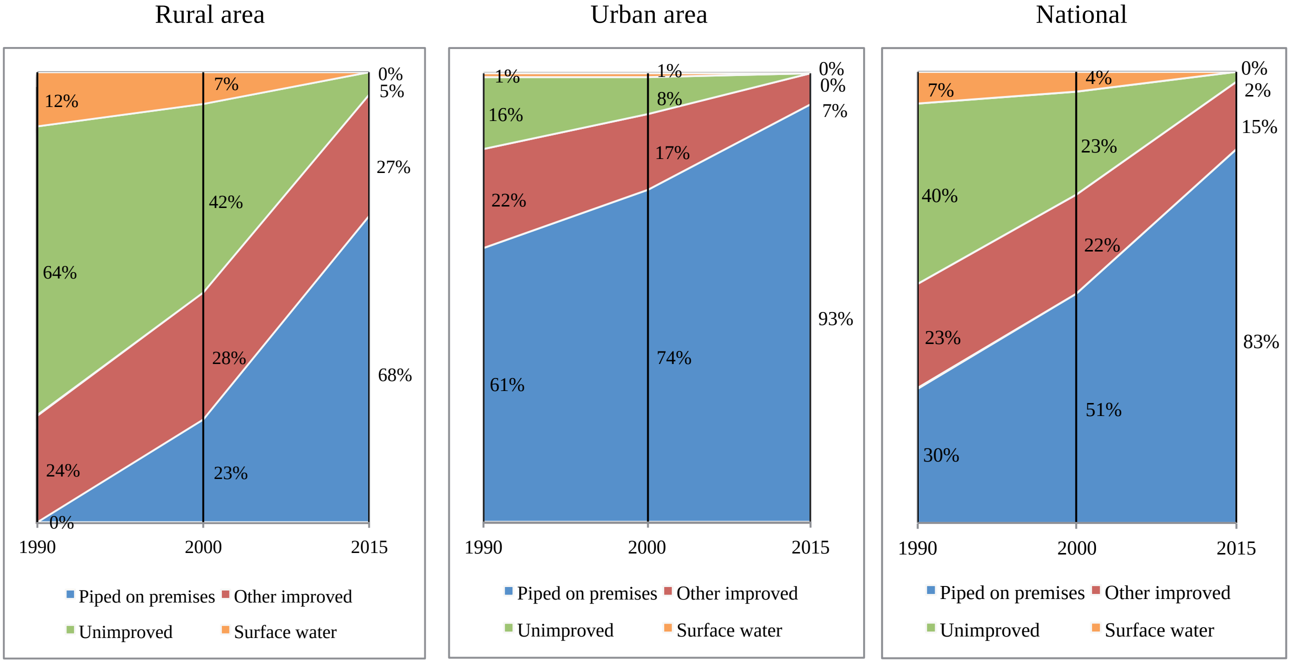
Rainfall averages from 1520 mm/year along the Paraneña Region to 1270 mm/year along the Paraguay River and 760 mm/year in the Chaco Region (Figure 14). The variation is significant, and defines the vegetation pattern of the country. The Chaco is semi-arid, with constant droughts, characterized with sparse vegetation (mostly scrubs and grasses) and high levels of evaporation. The Paraneña Region, characterized by substantial rainfall, contains dense patches of evergreen forest and tropical vegetation. The Guarani Aquifer is one of the largest water sources in the world and underlies 71,700 km^2 of Paraguay (6 percent of the total aquifer which is shared with Argentina, Brazil, and Uruguay), providing groundwater resources to the Paraneña Region. According to Aquastat [2014], renewable water resources in Paraguay total 388 km^3/year on average (including surface water, groundwater recharge, and surface inflows from surrounding countries), mainly concentrated in the East. This abundance makes Paraguay the highest per capita country in the Region for water availability (followed by Venezuela and Brazil). However, groundwater in the Chaco is mostly saline, and only a few specific localities are endowed with fresh groundwater coming from small aquifers. The scarcity of potable water in the Chaco has prevented large-scale colonization of the area and has produced a fragile ecosystem.

2. Water access in rural areas

In recent decades, drinking water coverage in Paraguay has increased significantly, especially in rural areas. According to the last JMP update [WHO/UNICEF, 2015], Paraguay had the highest increase (53 percent) of on-premise piped water access during the period 1990-2015 among all countries globally. Other countries with significant increases were Botswana (52 percent), China (45 percent), Egypt (37 percent), El Salvador (36 percent), Belize (35 percent), Guatemala (34 percent), Senegal (33 percent), Bolivia (32 percent), and Honduras (30 percent). Levels of on-premise piped-water at the national level rose from 30 percent in 1990 to 51 percent in 2000 and 83 percent in 2015 [WHO/UNICEF, 2015]. This remarkable increase is mainly due to the expansion of water services in rural areas, which rose for on-premise piped water from a near absence in 1990 to 68 percent of the total 25 years later (Figure 15).

Although Paraguay has already achieved the MDG for water in rural areas, more than 900,000 rural inhabitants continue to lack access to piped water, accounting for a large portion of the 1.2 million Paraguayans who lack access at the national level. Furthermore, as the population grows, investments for maintaining coverage levels remain necessary. UNDP [2011] anticipated that during the period from 2016 to 2020, Paraguay will need to invest US$519 million for drinking water systems (new and rehabilitated) to achieve and maintain improved water source access to 90 percent of the population.

Figure 15. Access to improved water sources. Paraguay.



Source: author, 2015. Data from the Joint Monitoring Program [WHO/UNICEF, 2015].

While piped-water coverage has increased in the last decades, the gap between rural areas (68 percent) and urban areas (93 percent) is still significant. This gap is larger in indigenous communities, where coverage is limited to a meager 6 percent [DGEEC, 2014]. At the other end of the spectrum, highly urbanized departments (Asuncion, Cordillera, Central, Amambay, and Concepcion) have piped water coverage at rates as high as 97 percent.

According to DGEEC [2015], 43.9 percent of the population with access to drinking water in rural areas is served by the National Service of Environmental Sanitation (*Servicio Nacional de Saneamiento Ambiental,* SENASA), 20.6 percent by the private sector or community networks, 28.1 percent by a protected well, 3.6 percent by an unprotected well and 3.8 percent by other sources.[4] This data differs slightly from the JMP data.

A study specific to the water sector, published by the DGEED [2010], highlighted that populations with higher levels of education used more improved drinking water sources (95.3 percent of the population with university level studies versus 50.9 percent of population without education and 69.7 percent with only primary school education).

Areas with lower coverage are generally the poorest and concentrate in the Western part of the country, in rural areas and within indigenous communities. Only 35 percent of the poorest communities in rural areas are connected to piped-water systems managed by sanitation boards [IDB, 2013]. Furthermore, less than 41 percent of the poorest households in rural areas are covered by public providers [Gonzalez, 2011]. People with an income higher than Gs.4 million used almost exclusively improved sources of drinking water (92.4 percent) compared with only 61.9 percent of the population with an income lower than Gs.700,000. DGEEC [2010] also highlighted that in rural areas, improved drinking water comes primarily from out-house pipes within the property (29.2 percent) and in-house pipes (24.8 percent). Finally, 4.8 percent of the population accesses improved drinking water from a neighbor.[5] Regarding time spent to collect water in the rural areas, 25.7 percent take 5 minutes or less to collect water daily, 30.1 percent take from 6 to 10 minutes, 41.2 percent of the population take from 11 to 30 minutes, and 3.1 percent take more than 30 minutes. Almost 50 percent of users collect water 3 to 5 times per day, 24.9 percent collect 1 or 2 times per day, and 24.0 percent collect 6 times per day or more. Generally it is women who are responsible for collecting water, both in rural areas (68.8 percent) and in urban settings (63.1 percent).

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[4] Indigenous communities are not included in this study.

[5] For urban water, 58.8 percent from in-house pipes, 15.6 percent out-house pipes but within the terrain, 13.3 percent bottled water, and 3.2 percent from a neighbor.

Less than 25 percent of total wastewater is treated. Data indicates that if treated, 25 percent of the samples from water-treatment plants present coliforms, the same proportion as samples taken from wells [OPS, 2013]. Moreover, 33 percent of households receive water with coliforms and 10 percent with thermo-tolerant coliforms; only 38 percent of households receive piped water with concentration levels of residual chlorine complying with national regulations (Table 9). Because water quality is perceived as good, only 10 percent of the population treats the water in-house. If treated, 40.9 percent use bleach or chlorine, 37.7 percent boil the water, and 19.3 percent use water filters.

Table 9. Water quality national standards, Paraguay.

Variable	**Unit**	**Limits (max.)***	
		Wells	**Systems**
Total coliforms	UFC 100 ml	3	3
Thermo tolerant coliforms	UFC 100 ml	0	0
Conductivity	Micro Siemens /cm	1250	1250
Residual chlorine	mg/l	NA	0.2 – 2.0
PH	-	6.5 – 8.5	6.5 – 8.5
Turbidity	UNT	5	5
Nitrate	mg/l	45	45
Iron	mg/l	0.3	0.3
Fluoride	mg/l	1.5	1.5

* Unless otherwise indicated.

Source: ERSSAN, 2000.

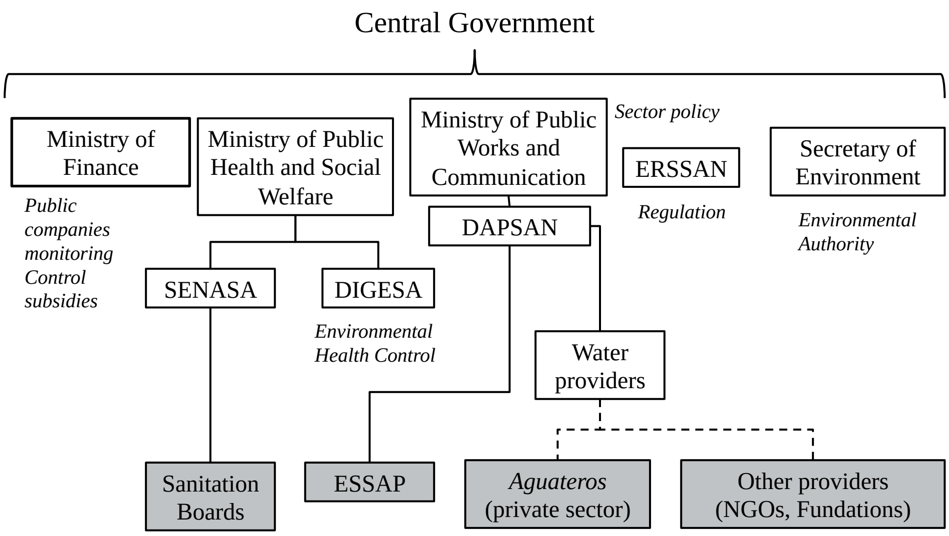
3. Institutions in water management

In 2000, the Paraguayan government introduced changes to the water sector’s organizational structure. The General Law for the Regulatory Framework and Tariffs (*Ley 1614/2000 General del marco regulatorio y tarifario del servicio público de provisión de agua potable y alcantarillado sanitario para la república del Paraguay*) defined the new institutional model. The Regulatory Agency for Sanitation of Paraguay (*Entidad de Regulación de los Servicios de Saneamiento de Paraguay*, ERSSAN) was created as a new autonomous entity to regulate and supervise the services (including monitoring the quality of providers) and to control tariff application. The establishment of a regulatory body represented an important improvement in the legal and institutional frameworks, although the institution is still too weak to coordinate and establish suitable policies in all areas [UNDP, 2009]. Furthermore, although ERSSAN undertakes the inventory of water facilities for urban areas, it does not assess functionality. Studies about cost-effectiveness are not regularly conducted and sector information systems are not related to financial information [UNDP, 2009].

The Ministry of Public Works and Communication exerts leadership over the sector through the Water and Sanitation Direction (*Dirección de Agua Potable y Saneamiento*, DAPSAN). The main role of the DAPSAN is to propose the design of water sector public policies; to establish strategies for expanding service, especially in rural areas; to formulate and implement financing and public investment policies, including subsidy policy; and to promote the participation of the private sector and communities to manage and expand the service.

The sector is institutionally divided between rural and urban subsectors. Water supply and sewerage services for cities with more than 10,000 inhabitants fall under the responsibility of the Sanitation Service Company (*Empresa de Servicios de Saneamiento y Agua Potable*, ESSAP). ESSAP is an autonomous public company that replaced the former National Sanitation Works Corporation (*Corporación Paraguaya de Saneamiento Ambiental*, CORPOSANA). Meanwhile, SENASA, an institution under the Ministry of Public Health and Social Welfare created in 1972, is responsible for planning and implementing projects in rural areas and settlements with fewer than 10,000 inhabitants, using sanitation boards as system providers. The Secretary of Environment (*Secretaría de Ambiente*, SEAM) is the environmental authority responsible for executing the national environmental policy (Figure 16).

Figure 16. Institutions in the water sector, Paraguay.



Note: Shadowed, service providers.
Source: author, 2015 modified from OPS [2010].

The water and sanitation sector is primarily financed through the public budget, with strong external financing participation from multilateral organizations (reimbursable or otherwise). Almost half of these resources are executed through the Ministry of Public Health and Social Welfare (mainly through SENASA) and the Ministry of Public Works and Communication (mainly through DAPSAN), and the rest are executed through other public institutions (Secretary of Social Action, Secretary of National Emergency, ESSAP, and others), bi-national entities (Itaipú and Yacyretá), or local governments. The budget has increased in the last years (from US$28.5 million in 2005 to US$116.8 million in 2012), although execution rates are still very low (55 percent), indicating management limitations. According to the UNDP [2011], the average monthly tariff for water and sanitation services in Asuncion is approximately US$20, while the national monthly tariff is US$7.5. Tariffs in rural areas, for systems managed through sanitation boards, are the lowest, with an average between US$3 and US$5. The government applies subsidies to service supply in the rural water and sanitation sector through SENASA (Presidential Decree 3617/04)[6]. The subsidies are set according to the number of household connections and do not take into account other socio-economic characteristics of the community (Table 10).

Table 10. Financial structure for new water systems built in rural areas and indigenous communities.

Financial source	Financial structure		
	Rural area Number of connections		Indigenous communities
	≤ 150	> 150	
Sanitation boards contribution in cash before building works begin (%)	1	5	0
Sanitation boards contribution in cash during works execution (%)	2	10	0
Sanitation boards valorized contribution in kind (%)	15	15	15
State subsidy (%)	82	40	85
Long-term loans for the community (%)	0	30	0
Total (%)	100	100	100

Source: SENASA, 2004.

This situation may promote regressive subsidies in favor of smaller systems with families of medium or high income, and also incentivize small sanitation boards to search for bigger subsidies. Therefore, the sector needs to better define and clarify subsidy policies, ensure their transparency, and ensure that they target the most vulnerable families.

One of the most challenging aspects in the law is the regularization of non-state providers through permits, delegation, and concessions for the provision of water service. ERSSAN has established that any service provider must fall under one of these two legal frameworks: concessionaires for systems with more than 2,000 connections, and license holders for systems with fewer connections. In 2012, there were 48 concessionaire systems and 2,598 license holders systems in the country: 29 of the systems were operated by ESSAP (public concessionaire with

6 In urban areas, operated through ESSAP, the government applies subsides for consumption.

more than 2,500 connections), 1,479 by Sanitation Boards, 775 by neighbor commissions, 298 by private operators, and 17 by other institutions (IDB, 2014).[7] Public water providers (ESSAP and SENASA) covered only 49 percent of total households in 2011 [Gonzalez, 2011].

The sanitation boards are promoted by SENASA and are responsible for the management of systems in rural areas and small towns (less than 10,000 inhabitants). The private providers, called *aguateros*, finance, build, and manage their systems. *Aguateros* first appeared in peri-urban and urban areas in the 1980s, as a result of strong population growth and migration from rural areas to cities. The emergence of private providers can be explained by the weak institutional framework (until the Law of 2000 there was no regulation of the sector and until 2002 there was no specific regulation for rural areas), the lack of control and regulation measures, and the incapacity of the government to cover demand. In 2009, almost 13 percent of suburban area water systems were operated through these small-scale private sector companies [UNDP, 2009]. The quality of the service delivered by these providers is heterogeneous and there are low levels of efficiency [IDB, 2014]. However, in some cases the fragmentation of the service has created a payment culture higher than in other countries of the Region. This situation demands higher regulation and supervision efforts to better plan the sector and achieve national goals.

In 2002, the Paraguayan parliament sought to promote sector decentralization by amending the Regulatory Law to allow the transfer of responsibilities for water and sewage to local governments. However, this attempt failed due to a presidential veto. To this day, no clear mechanisms of coordination for sanitation and hygiene promotion are in place, although some local governments collaborate with sanitation boards and user associations [UNDP, 2009]. Other institutions, such as NGOs, work mainly in rural areas. In some cases, they have pushed hard to develop capacity strengthening for local communities and sanitation boards. For example, the NGO AVINA has published the Regional Unified Program for Capacity Strengthening in collaboration with SENASA and other institutions in the sector.

One of the main challenges in the water sector is the participation of communities and the private sector in the provision of service. Service is characterized by fragmentation and atomization, resulting in low quality and very heterogeneous levels of provision. This problem, along with the small size of providers, which hampers the creation of economies of scale, was highlighted by ERSSAN. In 2009, 77 percent of providers had less than 200 connections. Only 5

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7 Estimates are not precise and different institutions (within and outside the government) provide different data. For example, the DGEEC data in 2010 added up to 4,959 providers. These differences are mainly due to lack of precise data in rural areas. UNDP accounted for almost 2,100 sanitation boards in 2009, covering 46 percent of the rural areas and small towns with more than 10,000 inhabitants [UNDP, 2009].

percent had more than 1,000 connections, which, according to technical and economic estimates, is considered the minimum number for creating economies of scale and sustaining the service [ERSSAN, 2009]. Furthermore, the private sector is considered small and inefficient. Providers are concentrated in systems of less than 2,000 users, and ESSAP still does not have a clear definition of how to include the private sector in the provision of service. Population is distributed in rural areas with very low densities and high geographical dispersion, meaning that small-scale solutions are not profitable for a potential provider [ERSSAN, 2009].

Other problems regarding Paraguayan water service that have been identified in several studies are: high delinquency rates (more than 60 percent of users do not pay); outdated tariffs (between US$0.25/$m^3$ to US$0.65/$m^3$) that generally only cover costs for operation and maintenance, but limit the investment capacity of the providers to expand the service and improve the systems; low percentage of meters (only 28.8 percent of the providers have macrometers and 27 percent of the users have micrometers installed); disruptions in service (27 percent of connected households do not receive a continuous 24 hour service); inadequate monitoring (although 94.4 percent of the providers say that they carry out water quality analyses, none do it with the frequency recommended by the ERSSAN); lack of registration of pipe networks and users; and insufficient human capacity for technical and management activities [UNDP, 2009; OPS, 2010; UNDP, 2011]. In sum, there is a limited capacity to manage and maintain water supply systems. Moreover, the technical deficiencies in design of infrastructure, wells, and tanks, and the low supervision of these facilities also limit the sector efficiency. Local contractors have sufficient capacities for civil works, but supervision needs to be improved, especially financial management [UNDP, 2009].

The Law approved in 2000 included service sustainability among the principles of the sector policy.[8] ERSSAN defined more specific principles, including 100 percent coverage, minimum quality standards, minimum pressure, continuous service, minimization of service interruptions from major causes, production optimization, and reduction of non-accountable water [ERSSAN, 2009]. The new Law also promoted a tariff regime, which based billing on the measure of consumption (micro-measure), although in some cases fixed tariffs can be implemented for certain users or systems.

After more than 10 years since the reforms, institutional progress is still weak and the regularization of providers is still ongoing. The institutional capacity remains constrained, especially due to departmental institutions having low capacities for strategic planning and budgeting. Most actions are planned and executed by the central government [UNDP, 2009].

8 Other principles are the universalization of the service, the efficiency of water resources, the neutrality in the treatment of all providers and users, and environmental protection.

Although SENASA has consolidated its role of promotion and strengthening of services in rural populations, there are still challenges to the coordination of the different institutions that provide these areas with services. The progress in urban areas is more limited, because the creation of ESSAP was not accompanied by a financial and technical strategy able to substantially improve provision and technical indicators. The legal framework should be reviewed in order to incorporate incentives for the private sector to invest in water for rural areas, and to support ESSAP in developing its commercial plan and financing strategy for service provision, while also strengthening management [UNDP, 2009]. There are also other challenges to the sustainable increase in drinking water coverage, especially in rural areas, and to the increase in service quality (water quality, continuity, and pressure), which must be overcome in order to reduce risks to health and improve sector indicators.

4. Community-based management in Paraguay: the sanitation boards

Since 1972, SENASA has provided water and sanitation services in rural areas and small towns with fewer than 10,000 inhabitants (Law 369/72). The program to assist rural areas has been financed since the 1970s with external aid from the World Bank and the IDB, and it continues to this day. SENASA constructs water provision systems through treasury funding and international loans and then transfers management to sanitation boards.

Sanitation boards (*juntas de saneamiento*, in Spanish) are community-based management organizations responsible for delivering and managing drinking-water services in rural areas. Sanitation boards are entities under private law whose members are elected by the community. They must coordinate with SENASA to decide the type of system that should be built, the funding scheme, and the service rates that should be paid by consumers. The board generally includes a president, vice-president, secretary, treasurer, and a municipal representative. In most cases, the municipal representative does not participate in the sanitation boards. The board members serve four-year terms and can be reelected no more than twice.

The sanitation board is responsible for operating, maintaining, and repairing the system. Together with the ERSSAN, it also defines the tariff for the service. An unclear subsidy policy has promoted the disaggregation of services and produced a highly unfair system. In the specific case of expansion of rural service, subsidies linked with investment were defined through a differential system according to number of inhabitants of the community to be served (Decree 3617/04). When a community is bigger than 150 households, the subsidy for investment offered by SENASA decreases from 82 percent to 40 percent of the total investment needed to build the water systems and sanitation works (Table 10). This modality of subsidy creates a high incentive to keep communities small and disaggregated to capture more public contributions, thus increasing the number of sanitation boards to manage the systems. The policy further stated that sanitation boards and user associations could access credit to build rural water systems. A revolving fund has been established for construction of water systems, but because users must pay back 100 percent of the loan, reliance on the fund is low [UNDP, 2009].

Community participation to provide water services through sanitation boards is a viable and adequate framework for the geographically dispersed rural sector. However, atomization could limit the capacity to expand services. Furthermore, policy should incentive the consolidation of sanitation boards in the same municipality or area to promote economies of scale (associations) and therefore facilitate easier expansion of systems. In conjunction, it is also important to strengthen the technical assistance scheme and the capacity for rural providers to ensure system sustainability in the long term.

In rural areas, users connected to sanitation boards usually pay for operation and maintenance. Generally, tariffs are insufficient to fund the replacement and expansion of services. Tariffs are established at the outset with no formal mechanism to change them. ERSSAN defines minimum and maximum tariffs but the sanitation board decides the final amount and when this amount will be updated. In urban areas, users connected to ESSAP pay for the full cost of operations and, to some extent, for replacements, although urban utility tariffs are set below cost recovery levels with little financial sustainability as a result. Paraguay’s unit costs – US$2,525 for a borehole fitted with a hand pump, or US$200 per capita for a rural water supply system (US$150 for an urban water supply system) – are slightly higher than in neighboring countries. Tariffs are still politically defined and do not reflect the real cost of the service. There have been no recent assessments conducted on the impact of the tariff levels on household bills (in urban centers, towns, or rural areas).

Some Regions have created associations of sanitation boards to foster economies of scale and save in purchases, to work together in conflict resolution, to hire technical assistance, and to manage financial issues. However, most sanitation boards do not see the benefits in joining the associations, especially due to high annual fees and a perception that activities are not helpful to improving sanitation board management. These associations do not have any contractual relation with SENASA. Moreover SENASA cannot officially offer any technical or strengthening support. The majority of the associations are part of the Federation of Associations of Sanitation Boards of Paraguay (*Federación Paraguaya de Juntas de Saneamiento,* FEPAJUS). However, this organization has not succeeded in incorporating all of the associations of sanitation boards and providing them with technical, legal, and administrative services. Furthermore, political interferences and conflicts, especially among the biggest associations, limit the potential role of the Federation.

Some of the limitations to management of the sanitation boards are the limited technical assistance that SENASA offers; the small size of the sanitation boards, which limits financial sustainability; very low and outdated fees; and fees insufficient to maintain (in some cases) and/or expand (in the majority of cases) systems. SENASA has explained that staff rotation in sanitation boards (directives) is also high, which does not allow for maintaining institutional capacity. Other limitations are associated with political interferences, especially in larger sanitation boards; weak links to other institutions, including the private sector; limited expansion of the system due to lack of technical capacity and financial resources; lack of diagnosis of the state of the resource – how much water is available and its quality; and a lack of instruments (meters) to measure consumption. Associations of sanitation boards are not legally associated with SENASA and they are not regulated nor subject to oversight. Finally, weak financial management by community-managed water associations threatens service viability [UNDP, 2009].

SENASA has no departmental offices and all procedures are concentrated in the capital, Asuncion. In some cases, this centralized management model limits some sanitation boards since they have to travel to the capital to obtain specific documents or permits.

Some of the key factors that SENASA has identified for improving sustainability are the ownership and the technical capacity of sanitation boards. In addition, sanitation boards must be able to build economies of scale to mobilize greater investments, to pool resources together to share fixed costs (such as technical assessments, training, and equipment purchases related to maintenance), and to improve research on technology adapted to the needs and conditions of users [Alvarez *et al.*, 2014]. Furthermore, sanitation boards should engage in monitoring processes.

B. Water sustainability in rural Paraguay: the project

The case study analyzed in this chapter is based on the project “Drinking Water Supply and Sanitation in Small Communities Program in Paraguay” (hereafter, the project). This project was approved in February 2001 and funded with US$12 million from the Interamerican Development Bank and US$5.1 million from SENASA, the counterpart and executing agency of the project. The main objective was to improve sanitary conditions in rural communities through the adequate provision of drinking water supply and sanitation services. The project financed the construction of water systems and sanitation facilities in 100 rural communities and 10 indigenous communities. It also strengthened the provision of services of sanitation boards and SENASA through training activities in system operation and maintenance. Other activities promoted were the efficient and rational use of water, and environmental education and hygiene activities in selected communities.

The conditions for the selection of communities to participate in the program were:

- Preferably communities with more than 70 households and less than 200.
- Electricity available in the community.
- Access roads in good condition.
- Interest of the municipality.
- Application signed by the representatives of the community in order to agree to the participation of the community with SENASA, and commitment to comply with demands and financial contributions established by SENASA and the program.
- The community was not participating in another similar program.

The first system was constructed in 2004, although the majority of the systems (80 percent) were built between 2007 and 2009. They were simple systems that relied on gravity, with one tank (from $15m^3$ to $30m^3$ on average), a monophasic electric extension, and in general, one pump.

The project ended in December 2010. At the moment of completion, 100 water supply facilities had been provided to 100 rural villages serving an estimated 57,700 beneficiaries (11,774 households).[9] The average cost for the water systems was US$160 per inhabitant.

The project was effective in terms of systems built and the impacts on health indicators, although at the project's conclusion it was still too early to draw a connection between the project and these positive impacts [IDB, 2010b]. All the water systems were managed through a sanitation board, either already in place or created as part of the project activities.

The project completion report noted limitations to the characteristics of the sanitation boards and found constraints in their capacity to manage the systems. Weak institutional governance and lack of program ownership were mentioned as the main challenges. The low capacity to repair and maintain the long-term quality of the system at the technical, financial and operational levels was also a constraint on program sustainability. However, according to the project completion report, the sustainability of the water systems was achieved.

C. Objectives

This case study had the general objective of analyzing the main factors that affect the sustainability of the water systems built under the 'Drinking Water Supply and Sanitation in Small Communities Program' in 100 rural communities in Paraguay.

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9 The list and location of the communities are described in Appendix D.

The specific objectives were:

- What is the evolution of the communities participating in the project with regard to behavior toward water supply?
- What is the level of service of the water systems?
- How do different dimensions of sustainability affect the level of service?
- How sustainable are the water systems?
- How do factors affect the sustainability of the systems?

D. Methodology

This case study combined quantitative and qualitative methods. Several sources of information, data collection, and analysis methods were used in order to gather maximum knowledge about the project and generate data to assess the main hypothesis of the research.

The case study only examined the 100 rural communities benefitting from the project, and did not include indigenous communities. Moreover, it focused on water systems, leaving aside the sanitation-related activities and infrastructure built, in addition to specific strengthening training for SENASA.

1. Sources of information

Document review

First, a document review of available project documents was completed. Some of the documents were provided by IDB specialists in Washington DC (USA) and Asuncion (Paraguay). The rest were provided directly by the technicians working in SENASA in Asuncion. In the case of the baseline surveys conducted in 2004, information was not available in electronic format, which required the use of photocopies and subsequent digitalization of the data. Table 11 describes the available documents.

Table 11. Available documents.

Documents available	Support	Year	Source
Project document	Electronic (pdf)	December 2001	IDB
Operational regulations	Electronic (pdf)	March 2002	IDB
Baseline report	Paper	December 2003 – January 2004	TYPSA / SENASA
Progress Monitoring Reports	Electronic (pdf)	From 2003 to 2010 (biannual)	IDB
Mission reports	Electronic (pdf)	From 2003 to 2010 (episodic)	IDB / SENASA
Intermediate evaluation	Electronic (pdf, excel)	July 2008	National University of Asuncion, Paraguay
Progress Completion Report	Electronic (pdf)	December 2010	IDB
Final evaluation	Electronic (pdf, excel) and paper	December 2010	ICAP Consultants and Engineers

Source: author, 2015.

Grey literature about project evaluation, survey design and implementation, water infrastructure in rural areas, and other topics, was consulted during the research. Furthermore, the research involved the examination of numerous case studies in sustainability and rural water in order to have examples for comparative purposes.

Interviews

After the review of the available information, several interviews were conducted in order to better understand the sector in the country, to gather additional information about the design and implementation of the project, and to prepare the follow-up survey to be conducted in 2014. Semi-structured interviews, tailored according to the type of stakeholder, were prepared and conducted between 2013 and 2014 both in Asuncion (Paraguay) and Washington DC (USA).

A total of 62 stakeholders were personally interviewed including specialists in SENASA; water and policy specialists and the director of the institution; the main NGOs in the country working in the water sector; academic experts in social surveys; IDB specialists in water; consultants working in the sector; professionals participating in the mid-term and final evaluation of the project; the Ministry of Health; the private sector working in the water sector; and the Federation of Sanitation Board Association. Moreover, open interviews with project beneficiaries were also conducted during the fieldwork phase, in order to gather information about the implementation of the project and the perceptions of users.

Surveys

Data from three surveys collected during the project were available at the beginning of the research process in 2013: the baseline survey (2004)[10], the intermediate evaluation survey (2008), and the final evaluation survey (2010). Except for the baseline survey, which only focused on future beneficiaries of the water systems, the surveys also polled the sanitation boards created by the project that operated the new water systems, the users of the water service, and the assessment of the water system infrastructure.

In order to follow the results and impacts of the project, a new survey, specifically prepared for this research, was designed and distributed in 2014. This survey included questionnaires to sanitation boards and users, and a technical assessment of the water systems. In total, 4 surveys constituted the base for the analysis (Table 12).

Table 12. Characteristics of the surveys.

Surveys	Year	Number of surveys		
		Households (number of communities)	Sanitation boards	Water systems
Baseline	2004	8,931 (100)	NA	NA
Midterm	2008	149 (30)	30	30
Final	2010	11,872 (100)	100	NA
Follow-up	2014	545 (30)	100	100

Source: author, 2015.

At the beginning of the project, a survey was conducted to establish a baseline in order to evaluate the results of the project at its completion. The survey was addressed to future beneficiaries of the project in the 100 communities. In total, 8,931 households participated in the baseline survey. The survey was designed and conducted by the consultancy TYPSA under the supervision of SENASA. The baseline survey (38 questions) included questions about socioeconomic characteristics of the household (e.g. property regime, income, occupation); household characteristics (e.g. type of materials, use of electricity); state of health (regarding water-related diseases); water supply (e.g. type of supply, who is responsible for fetching water, water use, costs); and basic sanitation services (e.g. type of excreta elimination system, maintenance of the septic camera).

10 The baseline survey was conducted between December 2003 and January 2004, 50 communities each month. In order to simplify the nomenclature during the methodology and discussion sections of this research, the baseline survey will be linked to the year 2004.

In 2008 the National University of Asuncion carried out the intermediate evaluation of the program under the supervision of SENASA. The main objective of the evaluation was to assess the progress of the project in terms of effectiveness with special attention paid to factors affecting operational and financial sustainability. A total of 30 rural communities participating in the program were randomly selected.[11] The surveys included a comprehensive questionnaire for the sanitation boards and for a sample of water users (149 households) in the 30 communities, and a review of the 30 water system infrastructures. The questionnaire for the sanitation boards included questions about the functioning of the sanitation board (e.g. number of members of the board and their roles, participation in meetings, membership in the Association of Sanitation Boards); the administration of the sanitation board (e.g. regulations, record books, reports); tariffs (e.g. amounts, additional payments); financial status (e.g. incomes, costs, delinquency rates); project status (e.g. perception of the works finished, maintenance program); training (e.g. days, type of training, participants); and perception of the management company (e.g. participation during the implementation of the project, quality of the process). In the case of water users, the survey focused on user perception of the sanitation boards (e.g. management, participation); tariffs (e.g. amounts, perception about the tariff, willingness to pay); infrastructure built and water service (e.g. perception of service quality, time of service); training (e.g. hours, materials); and socio-economic characteristics of the household (e.g. income). Finally, the evaluation assessed the status of the water infrastructure built, looking at the source (e.g. type, damages); the system components (e.g. pump, tank, distribution system); and the operation and maintenance of the system (e.g. pressure, disinfection).

After the completion of the project in 2010, a final evaluation was undertaken. The survey administered to households participating in the project was the same as that conducted in 2004. ICAP Consultants and Engineers SA were hired to perform the evaluation under the supervision of SENASA. In total, 11,872 households in the 100 communities were surveyed. In addition, the survey directed questions to the 100 sanitation boards (on meetings, tariffs, delinquency rates). No system assessment data was gathered for this evaluation. Information about the state of the system was collected through questions to sanitation boards (e.g. main problems in the system operation, main requirements for improving the system).

The follow-up survey, completed in June 2014, polled the 100 sanitation boards, 545 households in 30 communities, and assessed all 100 water systems. The 30 communities included in the follow-up survey were the same that participated in the 2008 survey in order to have

[11] The study also included 10 indigenous communities. These results will not be considered in this research.

comparable data. The survey design was based on the available data from previous surveys in order to be able to do comparative analysis across all the questionnaires. The Catholic University of Asuncion (*Universidad Católica de Asunción*, UCA) facilitated the implementation of the surveys and the digitalization of the data in the Stata® program.

In March 2014, interviewers from the University were trained via three sessions in order to introduce the surveys and solve doubts and questions. All the questionnaires were translated into Guarani (one of the official languages in Paraguay) because it is the mother tongue for the majority of rural inhabitants. In April 2014, a first set of 10 surveys was conducted in five communities in order to administer the questions (to users, sanitation boards, and the technical assessment). Afterwards, some adjustments were made and final versions of the surveys were completed. Between April and June 2014, the surveys were administered in the field. The sanitation boards were contacted in advance to set a date for the meeting, and to ask in advance for documents needed on the day of the survey (administrative, financial). The questionnaires from the follow-up survey are presented in Appendix E.

The questionnaires for the 100 sanitation boards included 225 questions organized into six sections: 1) institutional characteristics of the sanitation board (e.g. members, meetings, participation in other associations); 2) administrative management (e.g. operation manuals, records, legal constitution); 3) financial management (e.g. tariff, subsidies, income, delinquency rates); 4) technical capacity (e.g. training, maintenance program, reliability); 5) Service (e.g. level of service, quality, perception); and 6) social capital (e.g. other associations in the community, appropriateness of the community). The president of the sanitation board was present during the survey administration along with other members of the sanitation board (normally the secretary and the treasury), who assisted in completing the questionnaire. Pictures were taken of financial statements and administrative documents in order to check for possible inconsistencies during the analysis of the data.

For water service users, 178 questions were organized into seven sections: 1) socio-economic characteristics of the household (e.g. education, income); 2) Water service (e.g. frequency, main failures); 3) service assessment (e.g. satisfaction, use); 4) management assessment (e.g. qualification of the sanitation board; willingness to pay); 5) House characteristics (e.g. property regime, type of sanitation service); 6) health (e.g. illness related with water-diseases); and 7) social capital (e.g. relations among neighbors, confidence). The users surveyed were randomly selected, in numbers in accordance with size of the system. For systems with fewer than 90 members (9 communities), 10 users were randomly selected; in systems with between 91 and 129 members (12 communities), 12 users were selected; and finally, in the 9 communities with more than 130 users per water system, 25 users were selected for the survey. In some communities more surveys were administered in the event that some surveys results were invalid. The total number of respondents was 545 households in 30 rural communities.

Finally, the technical assessments were conducted by water engineers with the support of sanitation board members responsible for the system. The main topics analyzed (40 questions) were the type of source (e.g. pollution) and the system parts and operation (e.g. tank, operation room, electric system, distribution lines, disinfection system). Pictures of all the system components were taken, as well as problems detected during the inspection (e.g. broken pipes, pollution in the source).

2. Analysis

The analysis was based on the surveys conducted in 2004, 2008, 2010, and 2014. Since the baseline (2004) and final (2010) surveys presented limited data the main analysis incorporated the midterm (2008) and the follow-up (2014) surveys. All data was processed in the statistical software Stata®. A process of cleaning and checking the data was also performed. A basic descriptive analysis was completed for all the surveys.

Level of Service

The level of service describes how the system works, taking into account (in accordance with the literature reviewed) the following characteristics: quality of the resource (smell, flavor, color, pressure), quality of the service, and accessibility and reliability of the service. Two different methods were developed to build the Level of Service index (equation 1). First was a simple average of the four characteristics:

$$Level\ of\ service_{c,t} = \frac{\sum_1^i x_{c,t}^i}{i} \qquad (1)$$

where x is each one of the characteristic defined above, c the communities included in the sample and, t the year when the observation of the system was undertaken.

If = 0 ⇒ the system does not work

If = 1 ⇒ the system works at the most optimal conditions

Under this definition, all the characteristics included in the level of service index carry the same weight.

The second methodology for measuring the level of service index used the Principal Component Analysis (PCA) method, which considered the existence of a latent (unobserved) variable to explain the variation for all the characteristics included in the index and accounted for differences in the weights of these characteristics. The unobserved factor explaining the larger proportion of variance for all the index characteristics mentioned above is the level of service index.

Sustainability

As seen in the literature review, six dimensions may affect the sustainability of water services: environmental, institutional, management, economic, technical, and social. The review also concluded with the most frequently cited indicators for each dimension (Table 7 in chapter three).

Equation (2) below sets the factors linked with the level of service index defined in Equation (1):

$$Level\ of\ Service_{c,t} = \propto + \beta_1 Env_{c,t} + \beta_2 Eco_{c,t} + \beta_3 Ins_{c,t} + \beta_4 Man_{c,t} + \beta_5 Tec_{c,t} + \beta_6 Soc_{c,t} + \varepsilon_{c,t} \quad (2)$$

where c are the communities included in the sample, and t the year when the observation of the system was made. *Env* corresponds to the factors within the environmental dimension, *Eco* to the factors within the economic dimension, *Ins* to the factors within the institutional dimension, *Man* to factors within the management dimension, *Tec* to the factors within the technical dimension and *Soc* to the factors within the social dimension. The coefficients α and β in Equation (2) are estimated through an econometric model. Finally, the term ε_c is a term of error that includes different characteristics than the ones included in the six factors in Equation (2) and not observed in the data.

3. Limitations

There were several limitations to the scope of this research. First was the availability of data – some survey data was missing in the original datasets. Hard copies (questionnaires) were not available in the majority of the cases. Furthermore, the format used to digitalize the data was different for each survey (e.g. some at the household level, some at the community level). A new database was built in Stata® to systematically include all the existing information.

Lack of financing limited the number of surveys administered to users in 2014, with only 30 communities polled out of the 100 participating in the project. However, the survey design included enough information to compare the data with earlier surveys and analyze the level of service and sustainability of the water systems built.

E. Results and discussion

This section examines the main results from the surveys administered during the project implementation and follow-up (2014). The discussion of results considers information from interviews with key stakeholders, as well as informal exchanges with water specialists and beneficiaries.

1. Evolution of communities

Only a few questions were common to all 4 surveys (2004, 2008, 2010 and 2014), all of which were part of the household survey (Table 13). The average income per household increased but in 2014 it still did not reach the minimum monthly wage, established at Gs.1,824,055. Most households grew a vegetable garden and had small livestock and poultry providing basic products that should have been added as non-monetary income, which the survey did not capture. Moreover, levels of expenditure did not exceed income in any of the surveys.

In 2004, 61 percent of the households obtained their water from a dug well. There was no information about locations of the wells, but data regarding time used to fetch water indicated 15 minutes on average. This time is consistent with responses for households not connected to the piped-water system in 2010 (14 min on average). The person responsible for fetching water in 2014 was usually an adult woman (58 percent). As expected, almost 100 percent of the households in 2004 showed willingness to have water service in-house. Furthermore, 87 percent of those surveyed were willing to contribute economically to the construction of a system, 83 percent with labor (in-kind) in the construction, and 16 percent with materials. Only 33 percent stated that they would not contribute with anything.

Data shows that cost for water before the water systems were built (2004 survey) was on average lower than cost once the systems were built (Gs.8,188). However, no clear methodology was used to capture this data. In 2004, 27 percent of the households replied that cost was zero. For 32 percent of the households, costs were higher than the average in 2008 (Gs.11,573) and for 17 percent, costs were higher than the average for 2014. Data from 2008 and 2014 are consistent with information collected from the sanitation boards for the same years.

Table 13. Main characteristics of the communities.

Characteristic	2004	2008	2010	2014
Income (average, Gs.)	486,339	1,138,348	NA	1,213,640
Expenditure (average, Gs.)	413,992	NA	418,576	950,970
Pipe-water service (percent)	0	84	97	96
Monthly costs (average, Gs.)	8,188	11,573	12,345	17,198

Source: author, 2015.

Unfortunately, there was not enough data to analyze in depth the changes in the use and perception of water in surveys conducted in 2004 and 2010.

2. Descriptive data from the follow-up survey

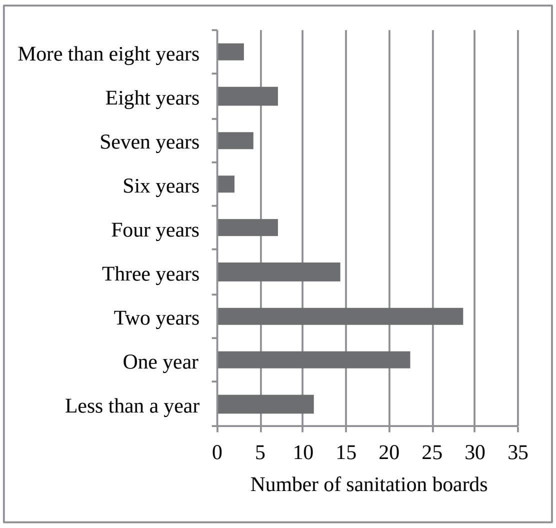
The main characteristics of the sanitations boards, users, and water systems in 2014 are described in the figures below. The association between the descriptors of service level and sustainability of the systems will be discussed in the following sections.

Sanitation boards

The surveys were administered at the offices of the sanitation boards, normally in a church or in one of the member's house. More than three quarters of the interviewees (78 percent) were men. Almost 70 percent of the main interviewees held the position of president of the sanitation board, 13 percent were treasurers, and 11 percent were secretaries. Generally, several board members participated in the interview.

A member of a sanitation board should hold his or her position for a maximum of 4 years. However, 16.4 percent of the interviewees said that they had served on the sanitation board for more than 4 years (Figure 17). In the majority of the cases, interviewees had held another position on the previous board. More than 50 percent of the respondents communicated that there had not been renovation to the sanitation board in the last years. Two reasons were identified: first, the lack of interest of the community to participate on the board, and second, the trust of the community in the current members of the board. More than 30 percent of respondents stated that at least one vacancy existed on the sanitation board. In more than half of those, cases the vacant seat was that of the municipal representative.

Figure 17. Seniority of the members of the sanitation board.



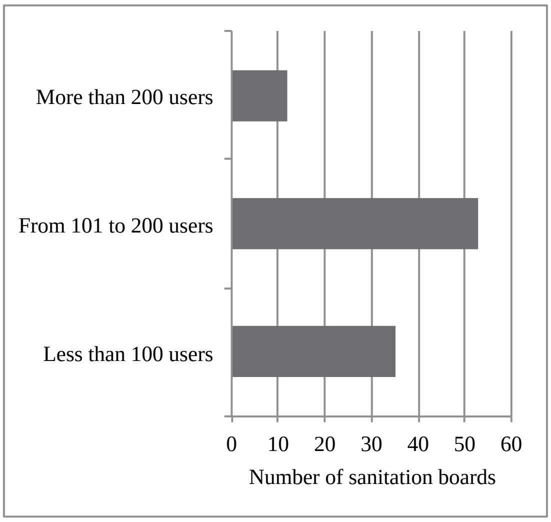
Source: author, 2015.

Only 3 percent of the sanitation boards reported formal participation in an association of sanitation boards. In fact, almost two thirds of the interviewees did not know about the existence of an association of sanitation boards in their department.[12] The perception was that the benefits for participating in an association of sanitation boards were limited mainly to requesting help as a group from SENASA.

Questions related to administrative management of the sanitation boards reveal high levels of formality. 94 percent of the sanitation boards were legally constituted; the rest had unresolved problems with the approval of documents with SENASA. Also 94 percent of the sanitation boards had a follow-up process to monitor their management and 90 percent had social protocol rules. Only one quarter of the sanitation boards interviewed were registered in ERSSAN and 43 percent had a contract with SENASA. The contracts were not mandatory and the sanitation boards could only have a technical or training agreement.

All the sanitation boards had a user registry. More than half of the sanitation boards (53 percent) had between 101 and 200 users connected to the water system. 35 percent were smaller systems with less than 100 connections, and only 12 percent had more than 200 users (Figure 18). Almost all the sanitation boards also kept a register of incomes and expenses.

Figure 18. Users per sanitation board.



Source: author, 2015.

Regarding the sanitation board relationship with SENASA, 86 percent of the boards had already paid off the debt owed to SENASA for the construction of the water system. None of the sanitation boards had received another financial contribution from SENASA; only 10 percent had received technical assistance, and 3 percent administrative and technical training. However, at the time of each board's creation, more than three quarters received an orientation from SENASA about tariff regulations. Only 61 percent of the tariffs were fixed by ERSSAN-SENASA and the rest were fixed by the sanitation boards according to their needs.

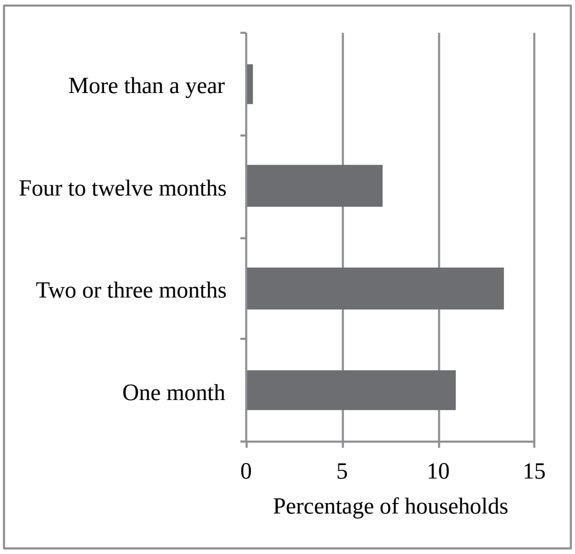
The tariff was fixed for 78 percent of the sanitation boards. The boards with a variable tariff reported that they had different tariffs because some users consumed more water (e.g. households with a pool, or a small business at the household). If fixed, 61 percent of the users paid between

12 Currently there are associations of sanitation boards in 11 of 17 departments of the country: Caaguazú, Caazapá, Canindeyú, Central, Concepción, Cordillera, Guairá, Itapúa, Misiones, Paraguarí, and San Pedro. In 2006 the Federation of Associations of Sanitation Boards was created.

Gs.11,000 and Gs.20,000, 37 percent paid Gs.10,000 or less, and only 2 percent pay Gs.30,000 or more. All the payments were made monthly. 69 percent of the communities had households that occasionally did not pay the tariff due to economic problems. 28 percent of the sanitation boards had users with special tariffs, which were normally higher than the average (e.g. hospitals, schools). Delinquency rates were low, and only 31 percent of households declared that they had not paid their bills in the last months.

Only 7 percent of households reported delinquency of more than 4 months (Figure 19). Users delinquent for fewer than 4 months were normally not included in the delinquency rate, and instead were included in the rate of delayed payment. Almost half of the sanitation boards reported that they had disconnected some users due to lack of payment. In total, only 152 users throughout the 100 communities had been disconnected (1 percent). 60 percent of the sanitation boards had an accountant to manage the financial books, and more than half of those accountants assisted more than one sanitation board.

Figure 19. Delinquency rate. Time of delay.

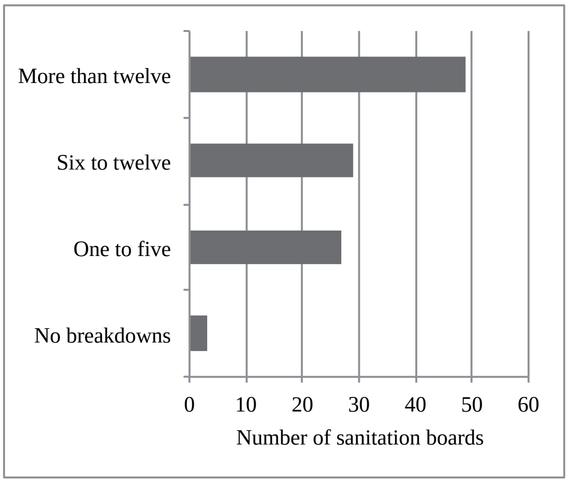


Source: author, 2015.

Expenses in the sanitation boards were related to office rentals, salaries, electricity, system maintenance, and repairs. 87 percent of the sanitation boards reported income greater than expenses, and 83 percent had a savings fund that varied from Gs.60,000 to Gs.39 million. Almost 80 percent of the sanitation boards used the saving fund for system repairs (mainly the pump). 21 percent of the sanitation boards had organized one event within the community in the preceding year to raise money for maintenance and repair activities.

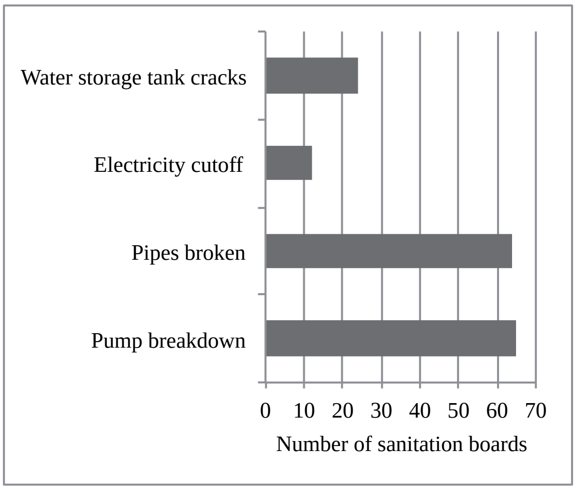
Almost three quarters of the sanitation boards reported not having a maintenance plan in writing although the majority confirmed that they conduct maintenance activities even if there was not an official document in place. At the time of the survey, only 4 percent of the systems were non-functioning. 59 percent of the sanitation boards reported one or fewer breakdowns per month (Figure 20). 63 percent of the sanitation boards had a specific registry to track system breakdowns. 85 of the breakdowns were repaired by technicians hired by the sanitation boards, 2 percent were repaired by personnel from SENASA, and 13 percent were solved by sanitation board members. The main causes for system breakdowns were related to problems with the pump (65 percent), or a pipe break (64 percent). Less frequent were problems with the water storage tank and power cutoffs (24 percent and 12 percent respectively). Generally, the power cutoffs affected the functionality of the pump and could cause the breakdown of the pump (Figure 21). If there was a system breakdown, more than 87 percent of the sanitation boards reported that the problem was solved in less than a day. The rest reported that repairs took no longer than two days.

Figure 20. Number of breakdowns per year.



Source: author, 2015.

Figure 21. Main causes for breakdowns.



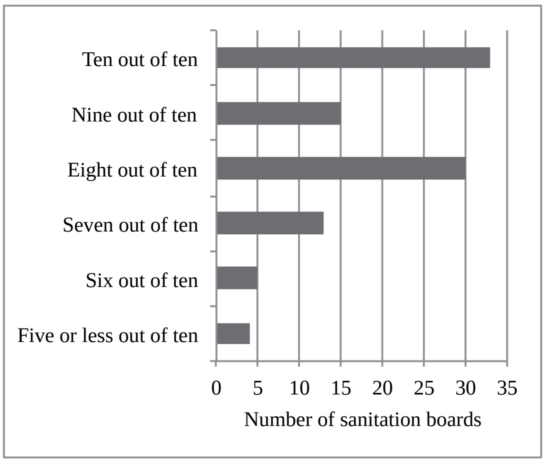
Source: author, 2015.

Most of the communities enjoyed water service 24 hours per day (83 percent). However, 10 percent of sanitation boards reported providing water access between 12 and 24 hours per day, 6 percent reported access for less than 12 hours per day, and only one board reported not having water everyday.

The sanitation boards were questioned on perception of the service. On a scale of 1 to 10 points, only 4 percent of the sanitation boards considered the general quality of the system to be under 5 points. 33 percent claimed that the systems worked perfectly, giving a valuation of 10 out of 10 points.

Only 32 percent of the water systems had a meter. The project financed by the IDB did not include meter installation and the installation of micrometers had been implemented independently by the sanitation boards.

Figure 22. Perception of the service (1 to 10).



Source: author, 2015.

According to the sanitation boards, half of the communities had households that desired to connect to the systems. Of those, 44 percent of households could not be connected due to technical limitations (e.g. not enough pressure, water tank too small), 21 percent due to geographical issues (e.g. households were too far away from the main network, households were in the mountains and the system could not access them), and 33 percent due to economic issues (i.e. households could not afford the connection and tariff payment).

When asked about how the system management could be improved, the most frequent desire was for more technical assistance from SENASA (45 percent of the sanitation boards) or more financial assistance (19 percent).

Almost three quarters of the interviewees believed that the system would keep functioning in the next years. Interviewees that thought that the service may stop functioning held the perception that users did not pay the tariffs and there was not enough assistance from the government.

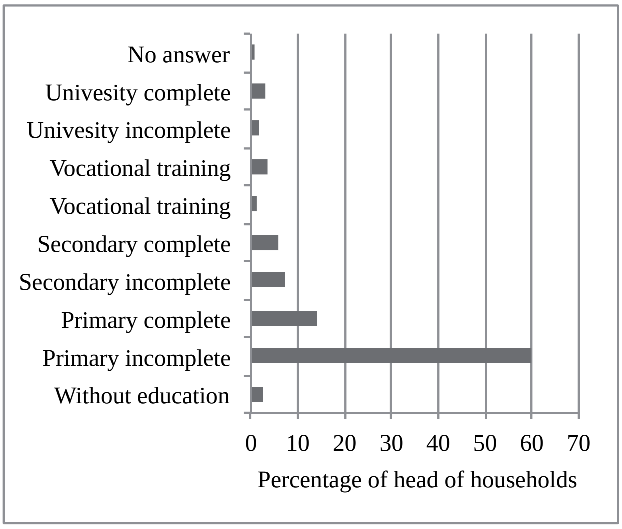
Users

A total of 545 households were interviewed in 30 rural communities distributed across 10 departments. More than half of the interviewees (57 percent) were the head of household, 29 percent were the spouse, and the rest were other relatives. The average age of the interviewee was 51 years old, and almost three quarters (74 percent) were male.

Regarding socioeconomic characteristics of households, 65 percent of households reported having between 1 and 4 members, 33 percent reported 5 to 8 members, and the rest reported more than 9 members. In total, 2,182 people had access to improved piped water systems built under the program. Almost 60 percent of the heads of households reported not finishing primary school and only 14 percent reported finishing. 13 percent of the heads of households reported starting secondary school, but only 6 percent reported finishing (Figure 23). One third of the interviewees (34 percent) reported their main economic occupation as agriculture, together with other informal jobs (e.g. artisans, mechanic).

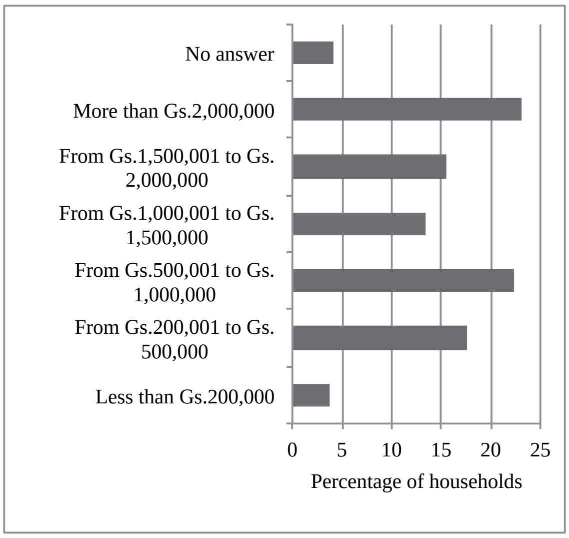
The minimum monthly wage in Paraguay in 2014 was Gs.1,824,055. Only 39 percent of the population reported income above the minimum monthly wage. However, the income question in the survey did not capture non-monetary income in terms of things such as food grown at home, small livestock and poultry that can be sold, or other things not considered “salary” in the survey. This definitional limitation of the question restricted the analysis of the resulting data (Figure 24).

Figure 23. Level of education.



Source: author, 2015.

Figure 24. Income.

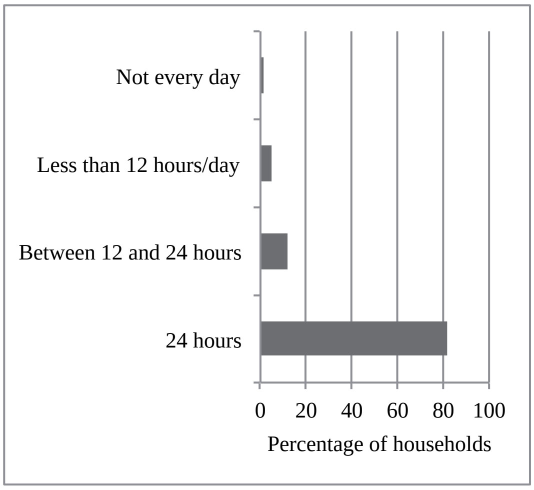


Source: author, 2015.

Almost all the interviewees owned their homes (90 percent). The characteristics of the households were diverse. 54 percent of the households had tile roofs, 32 percent had □rea□ity, 12 percent had wicker, and 2 percent had concrete. Walls were normally built with bricks (65 percent) or wood (35 percent). All the households had a bathroom, 53 percent inside the house, and 74 percent had a bathroom shower.

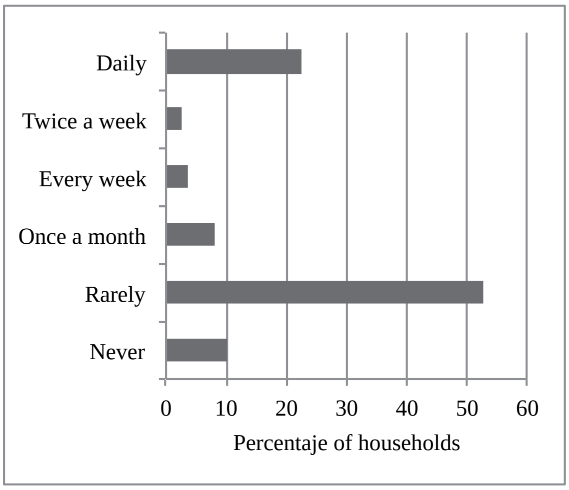
In regard to water service, 98 percent of the households interviewed were connected to the piped water system. When asked about the reliability of water provision, 82 percent of households reported service 24 hours per day, 12 percent reported service between 12 hours and 24 hours per day, and 5 percent reported service for fewer than 12 hours per day (but still received some hours per day of water). Only 1 percent of households did not receive water every day, and instead received water every other day (Figure 25). 63 percent of the households interviewed responded that there were never or rarely water cutoffs. 23 percent reported that there were cutoffs daily, but that the time it took to solve the problem was less than a few hours (16 percent only one day, 12 percent two days, and the rest 3 or more days).

Figure 25. Hours of service.



Source: author, 2015.

Figure 26. Water cutoffs.

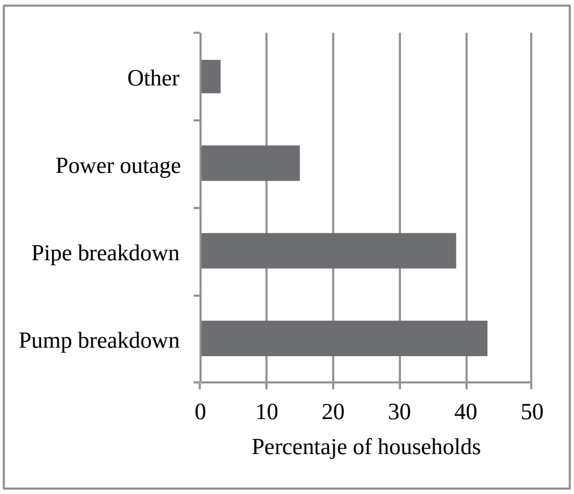


Source: author, 2015.

The most frequently reported problems were pump breakdowns (43 percent), followed by pipe breakdowns (39 percent). Power outages (15 percent) were also linked to damages to the pump (Figure 27).

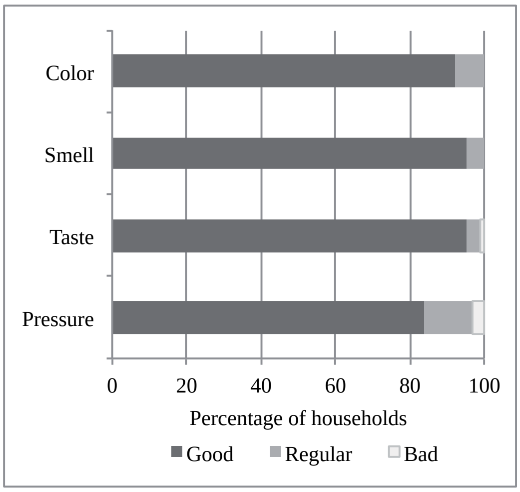
In regard to perception of service quality, levels were high for all indicators (Figure 28). Almost all the households reported that the quality of the water was very good in terms of color (92 percent), smell (94 percent), and taste (95 percent). Only 8 percent of the interviewees reported the water color to be fair, 5 percent reported the smell as fair, and 4 percent reported the taste as fair. Only 1 percent reported the taste to be bad. The indicator on pressure received the most negative responses. 84 percent of the interviewees reported the service to have good pressure, 13 percent fair and 3 percent that the pressure was bad.

Figure 27. Hours of service.



Source: author, 2015.

Figure 28. Water cutoffs.

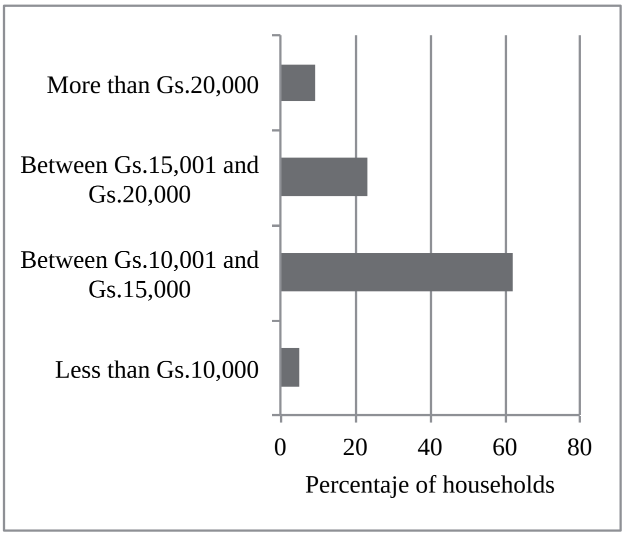


Source: author, 2015.

Only 21 percent of households had micrometers installed. Almost three quarters of households without micrometers said they would agree to pay for installation in order to control the quantity of water consumed.

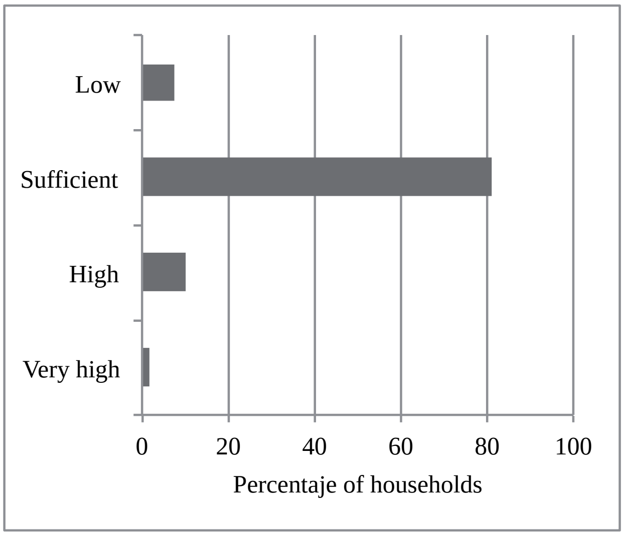
Almost all households interviewed (99 percent) paid a fixed monthly tariff. 70 percent of households paid up to Gs.15,000 monthly for water consumption (Figure 29), and only 9 percent paid more than Gs.20,000. In regard to perception of the tariff amount, 82 percent considered the tariff to be sufficient for the services received and 7 percent perceived the tariff to be low. 11 percent reported that the tariff was high or too high.

Figure 29. Monthly tariff.



Source: author, 2015.

Figure 30. Perception of the tariff.

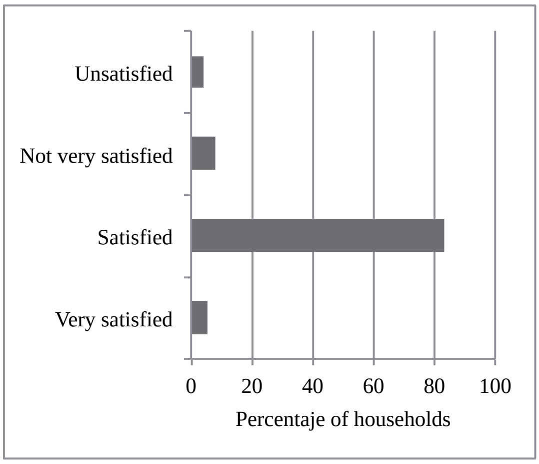


Source: author, 2015.

In regard to participation of the community in sanitation board meetings, more than half of the interviewees (53 percent) reported that they participated in the last meeting. The interviewees that did not participate reported that they were not in the community, or someone attended in their place, or that they did not feel the need to attend every meeting.

The service assessment was in general positive, with 83 percent of the interviewees satisfied with the service (Figure 31). Only 12 percent of the responses characterized the service as not very good. The survey asked the users how they thought the system could improve and a long list of actions were identified: installing micrometers, having bigger tanks, analyzing water quality, lowering delinquency rates, improving system maintenance, improving communication between the sanitation board and users, and improving system management. Respondents were specifically asked to assess the sanitation boards. 72 considered the management of the service to be good, 25 percent reported it to be fair, and 3 percent reported it to be bad. In order to improve the management of the service, users suggested several actions: greater user participation; increased coverage; installation of micrometers; and improved communication.

Figure 31. Assessment of the service.



Source: author, 2015.

Almost all households used the piped water for drinking (97 percent). The rest did not use it due to the taste of chlorine in the water and instead bought bottled water or used their own wells. 69 percent of users also use piped water for watering plants, and 56 percent for watering their small vegetable garden (*chakra*). The rest used water from their well. Only 5 percent of the interviewees reported the need for complementary water for daily activities, and those users obtained it primarily from their own wells.

A superficial analysis of willingness to pay was conducted by asking users if they would pay more for keeping the current level of service or having better service. 87 percent of users answered that they would pay more, but there was no data on how much or under what circumstances. Finally, 93 percent of the interviewees believed the system would continue functioning in the coming years, reflecting a high assessment of system sustainability.

Water systems

The systems built in the 100 communities shared the same characteristics with a few differences. All the systems had a borehole well (85 percent, one unit and 15 percent, 2 units). In general all the sources were accessible with accessibility limited in only 17 percent of wells (e.g. inaccessible roads). In regard to the quality of the source, 88 percent of the observations did not find any damage to or pollution in the source (Figure 32).

Figure 32. Borehole well.

Source: UCA, 2014.

Figure 33. Storage tank.

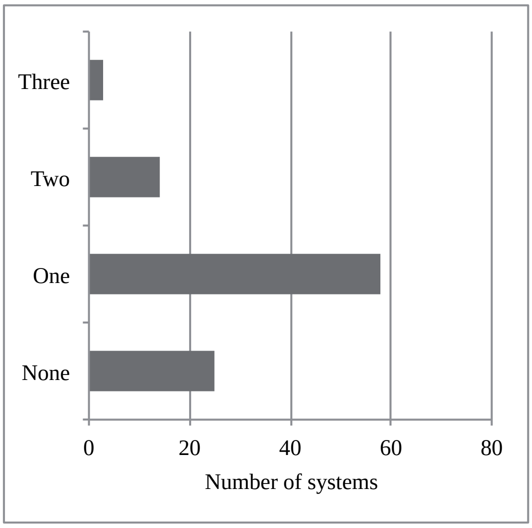
Source: author, 2014.

In regard to the number of pumps that propelled water to the storage tank, 88 percent of the systems had one pump and 12 percent had two pumps (Figure 36). Almost all the pumps were in good condition and had enough power to supply the system (92 percent). Three quarters of the systems had a standby pump (58 percent one standby pump, 14 percent two standby pumps, and 3 percent 3 standby pumps) (Figure 34).

All the systems have a storage tank (95 percent one tank, and 5 percent 2 tanks), built with a variety of materials (e.g. metal, fiberglass, masonry) (Figure 33). The capacity of the tank varied from 1,000 liters to 90,000 liters. The most common tanks had capacities of 15,000 liters (26 percent of the systems) and 30,000 liters (18 percent of the systems). 90 percent of the tanks were in good condition and only 3 percent were in bad condition (i.e. cracks).

Only one system visited did not have a chlorination tank. 71 percent of the systems with a chlorination tank used it, 3 percent used it sometimes, and 26 percent did not use it. The reason for not using it was because users had complained about the taste of chlorine, or the sanitation boards had the perception that the quality was high enough to make the chlorination process unnecessary. The majority of the chlorination tanks were in good condition (83 percent) and only 4 percent were in bad condition (Figure 35).

Figure 34. Number standby pumps.



Source: author, 2015.

The distribution network varied depending on the number of connections and the physical characteristics of the community (e.g. area, distribution). Distribution networks ranged from 1,200 meters to 60,000 meters. The most common length was 4,000 meters (18 percent of the systems). Almost all the distribution networks (93 percent) had shut-off valves, and 98 percent were in good condition. In 14 percent of the systems, some cracks were observed, along with loss of water.

Figure 35. Chlorination tank

Source: author, 2014.

Figure 36. Standby pump

Source: UCA, 2014.

3. Functionality

The assessment of functionality is the first step in the analysis of a water system's sustainability. It addresses the question "Does the system work?" without delving into how it works or why. Data from the 2008, 2010, and 2014 surveys was used to analyze the functionality of the systems (Table 14). In 2004 the functionality was set at zero as no system under the project had yet been built.

The intermediate evaluation (2008) examined 30 water systems in 30 rural communities. The majority of the systems were built in 2006 (8 systems) and 2007 (10 systems). One system was built in 2005 and 5 systems in 2008. Only 5 of 30 systems were not in operation at the time the survey was conducted. In all these cases, the systems were built in 2008 but they were not yet operating at the time of the survey. There was no specific information in the 2008 survey regarding where households in these 5 communities accessed water. In 2010, 97 percent of the 100 water systems were working. The majority of households without piped water service obtained their water from a dug well (with or without pump). The 2014 survey analyzed 100 communities. Only 4 water systems built under the project (4 percent) were not functioning at the time the survey was conducted. One of the communities without piped water service reported that the majority of inhabitants fetched water from a natural source (stream). The rest of the communities fetched water mainly from a dug well (with or without pump).

Table 14. Functionality.

Year	Functionality (percentage)
2004	0
2008	84
2010	97
2014	96

Source: author, 2015.

Levels of functionality were high for all years: almost all the piped water systems were functioning at the time of the survey. However, delving into quality and the factors that impact service requires the scrutiny of other data.

4. Level of service

The literature reviewed described four characteristics for defining the level of service: quality, quantity, accessibility, and reliability. In this case study, there was no data available to measure quantity, as most of the households did not have meters installed.[13] In terms of accessibility, all of the households connected to the water supply network had full accessibility to the service. If the water system built through the project did not work, the level of service was considered zero. The reliability factor was based on the number of hours that the system worked per day. Finally,

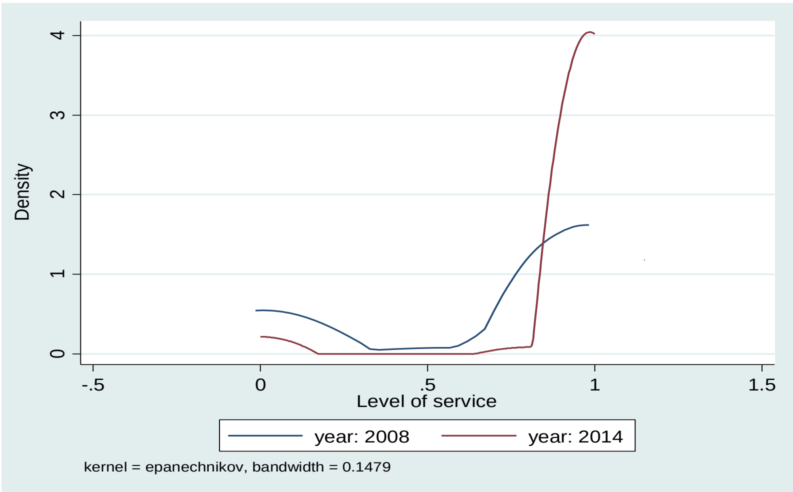
13 The project did not consider the installation of micrometers. However, some sanitation boards installed some units in households but no data is available.

assessment of service quality included 4 sub-indicators: pressure, smell, color, and taste. Due to the qualitative nature of all these sub-indicators, direct questions were formulated for users.

The index of level of service ranged from 0 (not working) to 1 (optimal level of service). Data sufficient to build the index was only available for the years 2008 and 2014.

Figure 37 shows the distribution of the “level of service” index constructed using PCA for 2008 and 2014. For both years, the majority of water systems concentrated around value ‘1’ (axis x), which means that the system worked at the most optimal conditions. The density (axis y) was higher for 2014, as 100 communities were surveyed compared to only 30 in 2008.

Figure 37. Distribution Level of Service 2008 – 2014.



Source: author, 2015.

As seen above in the functionality section, only 5 communities in 2008 and 4 communities in 2014 had systems that were not working at the time the surveys were conducted. The rest of the communities for both years reported high levels of positive perception for the quality indicators, as well as high reliability.

Table 15 presents the results for each indicator of service level to users. These questions were also included in the survey for the sanitation boards and results were slightly more positive. Overall in both cases data showed a positive perception and reliability of the service, although the values for all the indicators were slightly higher in the 2014 survey. In 2008, the systems were only recently built and some adjustments were being made that could have affected the quality of the water. The only indicator that somehow decreased in value was the ‘pressure’ indicator. The addition of individual connections to the system over time could have negatively affected the level of this indicator, as indicated by some of the sanitation boards during the surveys.

Table 15. Level of service. Indicators.

Indicator		Value	Results (percentage)	
			2008	2014
Quality	Pressure	Good	93	84
		Fair*	-	13
		Bad	7	3
	Taste	Good	90	95
		Fair	3	4
		Bad	7	1
	Smell	Good	91	95
		Fair	1	5
		Bad	8	0
	Color	Good	89	92
		Fair	3	8
		Bad	8	0
Reliability	Time of service (hours/day)	24	85	83
		Between 12 and 24	7	9
		Less than 12	8	8
Accessibility	Pipe-water system in-house	Yes	84	96
		No	16	4

- In the 2008 survey, options for the indicator Pressure are only ‘good’ and ‘bad’.

Source: author, 2015.

The average analysis showed that the level of service for 2014 was slightly higher (96) than for 2008 (93) on a scale of 0 to 100, where 100 means that the systems were working at optimal level of service. Results were consistent with the PCA analysis.

5. Factors affecting sustainability

In order to identify the main factors that affect the level of service in a community, two analyses were executed. The first analysis looked at the indicators most frequently mentioned in the literature for the six dimensions: environmental, institutional, management, technical, financial, and social. Some data was missing, as the surveys did not include all of the indicators.

Data shows variation in some indicators between responses for 2008 and 2014 (see Table 16). For the management dimension, the sanitation boards in 2008 did not generally report any technical issues of water systems, primarily because the systems were very new and they had not yet been subject to a formal follow up. This also explains low levels of financial records, as some of the communities had not begun payments at the time the survey was conducted. For the technical dimension, more than 50 percent of the sanitation boards in 2008 answered that they did not know if there were spare parts available, and only 39 percent knew where to find spare parts for repairs. This percentage increased significantly in 2014, as the systems were older and sanitations boards had needed to repair them. Finally, the low percentage of sanitation boards with a formal maintenance plan in 2014 (27 percent) was surprising. Some of the interviews with the sanitation boards revealed that even if a plan did not exist, they nonetheless completed all the activities expected for current maintenance of the water system. In some cases, the directors of the sanitation boards said that the document may have existed, but they did not need to use it, as they already knew how to perform the tasks.

Table 16. Factors affecting sustainability, theoretical indicators (2008 – 2014).

Dimension	**Indicator**		**Average (percentage)**	
			2008	**2014**
Environmental	Source is polluted		14	12
	Sufficient ground/surface water		NA	NA
	Local reservoir to store water in dry season		NA	NA
Institutional	There is a common sector approach		100	100
	There are formalized roles		100	100
	There are national norms		100	100
Management	There is adequate staff in the sanitation board		NA	98
	There are technical records		45	94
	There are administrative records		90	100
Technical	Hours of service	24 hours/day	85	83
		12 to 24 hours/day	7	9
		Less than 12 hours/day	8	8
	Spare parts are available		39	87
	There is a maintenance plan		66	27
Financial	Tariff covers expenditures		88	74
	There are financial registers		67	96
	Budget considers total life-cycle costs		NA	NA
Social	Water quality is good (smell, taste, color)		90	93
	Participation of the users in the design and operation of the system		100	100
	Use of water (apart from domestic use)	Water plants	NA	68
		Water garden	NA	26
		Land	NA	1
		Animals	NA	49

Source: author, 2015.

Next the analysis addressed other indicators specific to this case study. The selection of indicators was based on previous reports and surveys conducted under the project, and interviews with water specialists and experts in SENASA (Table 17).

During the building stage of the water systems, SENASA offered several trainings to the sanitation boards on the operation and maintenance of the systems and financial management. These trainings were not regularly scheduled, and in 2014, only 22 percent of the sanitation boards reported that their members had participated in any training during the preceding year. However, interviewees reported that knowledge was transmitted from older members to newer members and as a result, no additional training was needed (85 percent of the sanitation boards). The number of women on the sanitation boards increased but in the end still only accounted for 24 percent of the boards, and women generally acted as treasurers.

According to surveys and interviews with members in several communities, sanitation boards did not see the benefits in participating in the Regional association of sanitation boards. The associations were created to generate economies of scale and help the sanitation boards in legal, technical, and administrative issues, and therefore could assist sanitation boards in lack of capacity issues, recognition by SENASA, and internal conflicts. In 2014, almost 20 percent of sanitation boards reported that when they needed to buy materials for repairs, they informally joined with other sanitation boards. Moreover, 53 percent of the sanitation boards reported having an accountant that also assisted other boards.

The installation of micrometers to measure water consumption in-house was not originally included in the project. However, in order to collect consumption-based tariffs, some sanitation boards installed these devices. Users of the system were asked about their willingness to have meters installed to measure household water consumption. For both years, over 70 percent reported that they would agree to this initiative.

In 2014, almost 80 percent of the tariffs were fixed (37 percent Gs.10,000, 61 percent between Gs.11,000 and Gs.20,000, and 2 percent more than Gs.21,000). In the 2014 survey, almost 70 percent of the sanitation boards had clients that occasionally did not pay due to economic reasons. Other clients, such as the school or the church, were exempted from monthly payments. Furthermore, almost 30 percent of the sanitation boards had clients that paid more than the fixed tariff, because they had pools or big gardens/crops. These decisions were taken in participatory meetings and, according to the interviews, normally there were no community conflicts regarding these economic issues. Almost 90 percent of the interviewees in 2008 and 87 percent in 2014 considered the tariff assessed to be fair. Only 15 percent of the households that participated in the survey were not willing to pay more to maintain the quality or to improve the system.

Table 17. Factors affecting sustainability, specific indicators (2008 – 2014).

Dimension	Indicator	Average	
		2008	2014
Management	Participation of users in the sanitation boards (%)	41	43
	Training in operation and maintenance (%)	88	22
	Number of women in the sanitation board (%)	8	24
	Member of the Association of Sanitation Boards (%)	24	7
Technical	Presence of a second pump (%)	86	75
	Size of the system (number of connections)	116	138
	There is a chlorination system in use (%)	83	74
	Presence of meters in-house (%)	7	21
Financial	Delinquency rate (more than 4 months) (%)	10	6
	Tariff (monthly average, Gs.)	11,573	15,348
Social	Perception of the sustainability of the system in the future (% positive perception)	90	74
	Status of the sanitation facilities (tube, toilette) (% good condition)	100	87
	Perception of the tariff: is it enough to cover costs? (% of positive perception)	93	89

Source: author, 2015.

In order to analyze which factors described above (theoretical and specific for the project) may have significant impacts on system service levels, a regression analysis was completed for the 2014 survey. Due to the small number of observations and the low variability of the measurements this analysis was not viable for the 2008 survey.

For the theoretical indicators, the only statistically significant variable was the reliability of water for less than 12 hours a day (Table 18). The analysis showed a negative correlation between having less than 12 hours a day of service and the level of service.

Table 18. Regression, theoretical indicators.

Variable	Coef	P>|t|
Source is polluted	0,0065065	0,820
Tariff covers expenditures	-0,0144955	0,267
There are financial registers	0	
There is adequate staff	0,0049307	0,736
There are technical records	0,0197693	0,618
There are administrative records	0	
Hours of service: 24 hours/day	0,0051621	0,846
Hours of service: 12 to 24 hours/day	0	
Hours of service: less than 12 hours/day	-0.074108	0,035*
Spare parts are available	0,014992	0,300
There is a maintenance plan	0	
Constant	0.9599696	0,000

t-statistics :*p<0.05

Source: author, 2015.

Among the indicators chosen specifically for the case study, the only variable statistically significant was the delinquency rate (see Table 19). A delinquency rate greater than 4 months was negatively correlated to the level of service.

Table 19. Regression, specific indicators, 2014.

Variable	Coef	P>|t|
Delinquency rate (more than 4 months)	-0,1286860	0,044*
Training in operation and maintenance	0,0155408	0,533
Member of the Association of Sanitation Boards	0,0228433	0,593
Presence of a second pump	0,027995	0,409
Size of the system	-0,000149	0,301
Participation of users in the sanitation boards	0,0589386	0,248
Constant	0,841169	0,000

t-statistics :*p<0.05
Source: author, 2015.

According to the interviews with the sanitation boards, the presence of a second pump was one of the key elements for high levels of service. The main problem reported in all the communities surveyed, both in 2008 and 2014, was the power outages, which caused serious damage to the pumps. If the system had another pump, the technicians could overcome this challenge, and limit the time that the system was not working. If not, the repair of the pump could take up to 3 days, depending on the availability of spare parts. In other cases, a community that was currently in a state of pump repair would ask for a standby pump from another community's sanitation board.

As highlighted in the interviews with some beneficiaries and sanitation board members, user participation in meetings was not a prevalent characteristic in the majority of communities and had no significant impact on the level of system service or its sustainability. This is probably due to the small size of the systems (less than 200 connections on average) and also the high social cohesion of the communities. Users reported confidence in their representatives to the sanitation boards and they did not feel the need to frequently attend the meetings.

In regard to coverage, in 2014, 52 percent of water systems did not cover the entire community. 60 percent of the reasons for exclusion were technical (not enough pressure in the system, households too far away, or inaccessible areas), and the rest were economical (not enough funding to expand the service).

Finally, the analysis compared the level of service across 30 communities in 2008 and 2014 for all indicators. A water system of a given community was considered sustainable if the level of service shown in 2014 was equal or greater than in 2008. The limitation of the data for this study restricted significant findings. However, as seen in the analysis described in this section, several conditions may positively influence high levels of system sustainability and the preservation of these levels.

F. Main conclusions of the case study

The drinking water and sanitation sector in Paraguay has some particularities when compared to other countries in the Region. Paraguay has one of the higher levels of water availability, although the resource is unevenly distributed. The resource abundance, its quality, the easy access (in the Eastern part of the country), and low population density have produced a highly decentralized supply system, with multiple providers (public, private, and community-based) serving communities located in water rich areas.

Levels of access in Paraguay have increased notably in the last decades. The support of the national government for expanding access to drinking water in the entire country and the presence of a governmental institution dedicated to water services in rural areas – SENASA – have contributed to making these achievements. Furthermore, the high levels of electricity coverage, high levels of community social cohesion, and the culture of payment for services in rural areas have facilitated the implementation of the model promoted by SENASA. Although the public sector faces challenges, significant achievements have increased access to improved water sources, especially in rural areas.

The case study developed here shows rural communities with high levels of service and optimal characteristics under the six dimensions that support the sustainability of the service. The low variability of the data – with most of the systems operating at an optimal level – limits the discussion regarding statistically significant factors. However, some of the key elements contributing to both high levels of service and high probability of becoming a long-term sustainable water system. For example, the presence of a second pump that is used for quick repairs, decreasing the time of non-functioning of the system and positively impacting the user's perception regarding the system's level of service. Other factors key elements are the high social capital within the communities, low delinquency rates, and the support of SENASA, especially at the beginning of the project both financially and for training. In addition, communities considered water to be a valuable resource and individuals were willing to pay for good service. If the service was good (88 percent of the interviewees considered the service as good or very good), the households paid the tariff (low delinquency rate with better average than the country average), facilitating the existence of savings funds to maintain high levels of system service.

One of the challenges that sanitation boards face is the expansion of service. Normally the savings fund is not sufficient to expand the system to other community households. The

Resolution of the Human Right to Water in 2010 highlighted the need to provide all people with sufficient, safe, acceptable, physically accessible, and affordable water for essential personal and domestic uses (Albuquerque, 2012). The declaration, together with the recently approved Sustainable Development Goals, contextualizes the challenge to achieve 100 percent access in rural areas. This challenge is further complicated by the lack of specialists in SENASA to cover all rural areas with technical and management assistance, the lack of capacity in some communities to keep system maintenance and repairs, the low tariffs that limit system expansion, and the difficulties associated with population dispersal characteristic of rural areas.

Finally, the other big challenge is the maintenance of groundwater and surface water quality in Paraguay. Several reports have highlighted the deterioration of some water sources, especially near the urban and peri-urban areas, but also affecting rural sources. Impacts associated with climate change add a level of complexity to the management of the resource. More efforts must be implemented for the sustained analysis of the quality of the resource and the control of water uses (especially from industrial and agricultural practices). The internalization of environmental factors within the management and financial models is fundamental to reinforcing this dimension and maintaining the sustainability of a high quality water resource.

Chapter five
CHALLENGES TO AND OPPORTUNITIES FOR SUSTAINABILITY IN RURAL WATER

A. Sustainability and rural water in LAC

Access to improved water sources has increased significantly in recent decades. Globally in 2015, 91 percent of the population had access to improved water sources, which reflects a 15 percent rise since 1990. Most of the achievements occurred in rural areas, where the percentage of the population enjoying improved water sources rose from 53 percent in 1990 to 84 percent in 2015. LAC is represented among the world Regions that have achieved the MDGs for drinking water (*Target 7C. Halve, by 2015, the proportion of the population without sustainable access to safe drinking water and basic sanitation* [UN, 2012]). However, differences among countries and among economic and social groups are still significant.

The achievement of international goals (MDGs and SDGs) may decrease the interest and efforts of some governments and international organizations toward universal access to improved water services, with negative impacts in rural areas and vulnerable population. Furthermore, the JMP definitions to measure access to improved water sources limit the analysis and data overestimate the actual numbers of people using safe drinking water, decreasing current numbers of level of access between 15 to 20 percent [Mcgranahan *et al.*, 2006 in Rojas, 2014]. Despite theoretic achievement of national-level goals, several challenges must be addressed: decreasing gaps between the richest and poorest quintiles; increasing access for the most vulnerable (elderly, disabled, and women); increasing access in rural and remote areas; increasing affordability of the service; and improving the level of service in terms of quality of the resource, quantity, availability and reliability. The level of service has a direct impact on the health and economic status of households, especially for the poorest.

The increases in water access have been facilitated in LAC by recent regulations and policies, as well as by the participation of international development institutions. However, until the last few years, the sector's regulatory and institutional modernization focused only in urban areas. During the last decades, several management models have been developed in the Region, driven by international UN-led declarations. The decentralization and privatization of the service in the 1990s and the subsequent nationalization of some contracts in the 2000s illustrate diverse national frameworks, with public and private sectors and public-private partnerships sharing the same territory. The inclusion of the private sector in the operation of the water sector triggered social protests in several countries. The main criticisms were directed toward the economic approach of the water service, which had yielded negative impacts on the poorest and most isolated communities and on the service levels for those who could not pay the tariffs [Bakker, 2010]. However, several studies have shown conflicting evidence against and in favor of privatization, reflecting an unresolved debate.

Since the 1990s, the most frequently used management approach in the operation and maintenance of rural area water systems has focused on community participation. Similar to the economic approach, this approach has also been the target of both criticism and praise. Some have defended the role of the community in increasing appropriation and effectiveness of water systems [Klugman, 2002; Peltz, 2008; Marks *et al.*, 2012; Pankhurst, 2013]. Others have highlighted the requirement of external support to reinforce the role of the community in order to sustain the system in the long-term [Ermilio *et al.*, 2014; Welle *et al.*, 2014]. Still others wave the banner of the human right of access to affordable water, which for some, would mean tariff reduction and subsidy increase in order to expand service to the poorest.

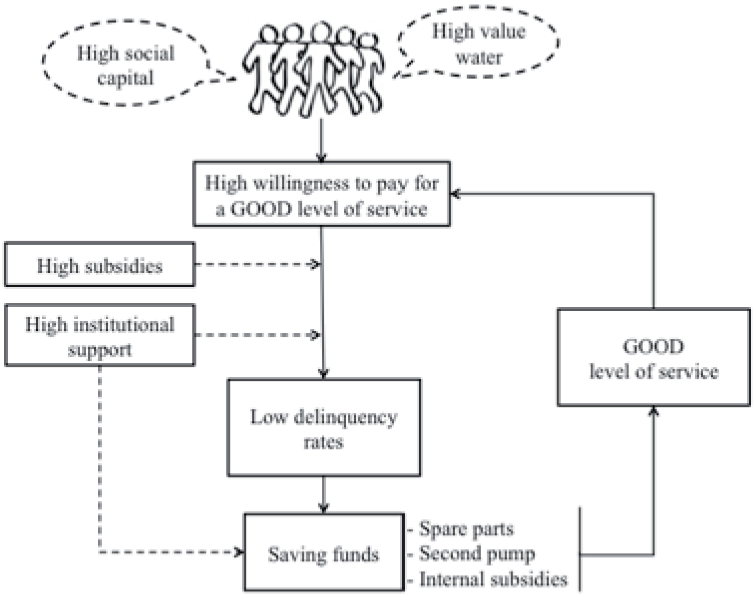
One of the biggest challenges in the water sector to ensure positive impacts on welfare lies in ensuring sustainability of the water systems. Several studies have underlined the high levels of non-functionality in rural systems – 40 percent on average and up to 70 percent in some cases – that limit the impact of programs [RWSN, 2009b; Taylor, 2009; Kumamaru, 2011; Barakzai *et al.*, 2014]. The difficulties in identifying the factors affecting each of the sustainability dimensions (environmental, institutional, management, technical, financial, and social) jeopardize the definition of indicators and evaluation methodologies for assessing and monitoring sustainability. The first approaches to measuring sustainability started in the 1980s and used the basic premises of functionality and level of service, focusing only in the technical dimension (quality of the infrastructure). The evolution of the concept brought about new dimensions. Decentralization of water management in the 1990s highlighted the institutional dimension (role of the government); community participation in the operation and maintenance of the service lent prominence to the management and social dimensions. The Dublin conference introduced the economic value of water as a core issue in the management of the resource, underlying the financial dimension of sustainability. Finally, the environmental dimension achieved relevance in the 2000s as climate change became a topic of concern. At the same time, the social dimension acquired status under the Right to Water approach. These last two dimensions have been the least developed, despite their meaningful actual and potential impacts on the sustainability of water systems.

Few quantitative studies for measuring sustainability have been developed in LAC, especially in rural areas. Furthermore, the case studies published do not follow a common approach for measuring sustainability, making frameworks and results impossible to compare. Several tools with indicators and specific methodologies have been identified as appropriate means for measuring sustainability. However, the variability in methods and indicators used is high, there are few cases in which all of them have been implemented, and to date there is insufficient data to identify lessons learned.

Among LAC countries, Paraguay has one of the highest rates of access to improved water sources and is considered as a successful case of community-based water management. This improvement occurred mainly in rural areas, where the proportion of the population with improved water access rose from zero percent in 1990 to 95 percent in 2015. There are several reasons for this remarkable improvement. First, the availability of quality water in the Panareña Region, where 97 percent of the population lives, is high. As a popular expression goes, “Anywhere you make a hole in Paraguay, you can find clear water.” Although the quality of the water has decreased in recent years due to lack of wastewater treatment and the increase of industrial and agricultural activities without proper regulation and control, the expression still holds true. Second, the Paraguayan perception of water availability has been internalized by citizens and is reflected in the high value that Paraguayans give to water for daily habits, including drinking, hygiene, cooking, and productive activities. Rural communities expressed high levels of willingness to pay for water, which reflects the perceived value of water and the need for good service, even in poor households. Finally, it should be noted that tariffs for rural systems are highly subsidized (US$3 to US$5 monthly cost in rural areas versus US$7.5 monthly cost in urban areas on average) and in some communities informal cross subsidies are implemented to provide for families without financial capacity.

Since the 1980s, the Paraguayan government has promoted the creation of sanitation boards in rural areas for communities with less than 10,000 inhabitants. This support came from an institution (SENASA) within the Health Ministry and not within the Public Works Ministry, which had traditionally housed the water sector. This distinction may have had an influence on the sector’s new focus on social aspects as opposed to its traditional focus, which was limited to infrastructure. These community-based organizations are responsible for the operation and maintenance of water service. The infrastructure is built by the government with national budget or international aid, and is highly subsidized, especially for smaller communities. In fact, subsidies incentivize the creation of sanitation boards in communities serving less than 150 households, for whom the subsidy amount is much higher, because the subsidy amount is calculated in accordance with the number of households served instead of social or economic characteristics. This situation may have the effect of isolating small, poor, and distant communities that lack the capacity to organize or to pay the minimum tariffs defined by the government. The government also provides technical and financial capacity to sanitation boards through SENASA during the first year following the system's creation, although this support decreases thereafter. Despite the limitations to sanitation boards stemming from limited public institutional support and the boards' technical and administrative weaknesses, this community-based approach has nonetheless been a success in rural Paraguay. Most of the communities assessed under this research have a savings fund, due to low tariff delinquency rates. The existence of extra funds allows the sanitation board to operate and maintain the systems – which are generally simple gravity-based water systems – by the acquisition of spare parts for repairs or the purchase of a second pump for ensuring the reliability of the service. Thus, the level of service offered to users is high, and users are willing to pay for good service. Figure 38 summarizes the main building blocks of this rather successful story.

Figure 38. Diagram. Hypothesis regarding sustainability in rural areas in Paraguay.



Source: author, 2015

Despite the significant progress in access to improved water sources and the success of community-based management in LAC, there are still important challenges to face. First, the expansion of the service to achieve universal access to improved water services under the right to water approach. Second, the sustainability of the existing systems with need of massive investment to replace the systems that have reached the end of their natural lives. Third, the maintenance of the groundwater and surface water quality, considering impacts associated with climate change and other environmental factors. Finally, the commitment of governments at the local and national level to define and implement integrated water management policies that include broad participation of water users and consider all dimensions of sustainability.

B. Looking forward

Better definitions of concepts, such as sustainability and each of its dimensions, will help to create a common framework to assess rural water programs. However, tools need to be flexible in order to adapt the indicators to specific technological and social contexts, and to the human and financial capacity of the institutions and organizations in charge of its operation and management.

Some progress has been made in defining indicators and their characteristics, as reflected in the EASSY indicators (Easy to get at local level, Accurately defined, Standard and internationally applicable, Scalable at all administrative levels, and Yearly updatable), but they are not yet established as a collective methodology [Jimenez, 2010]. Other initiatives, as the Information System about Rural Water and Sanitation (*Sistema de Información sobre Agua y Saneamiento Rural,* SIASAR), promote a common framework of indicators to measure access to improved water and sanitation services in Honduras, Panama and Nicaragua, expanding to other countries in LAC with success [SIASAR, 2015].

The support of the UN and international programs in defining appropriate indicators, as well as the clear definition of international common goals such as the SDGs, is essential for driving comparative methodologies. However, these goals should differentiate among geographical areas and socioeconomic groups in order to reach the universal access to improved water sources. The participation of all stakeholders, including the government, private sector, and the community with clear roles defined is also imperative for developing new methodologies with data that is broad and of high quality, especially in the rural sector.

Climate change directly affects water quality accessibility and reliability. Furthermore, it adds complexity and uncertainty to the management of the resource due to lack of appropriate data. The environmental dimension of sustainability must be highlighted in the different approaches of water management in order to ensure the availability and quality of the resource and to monitor its evolution. In this regard, the use of simple technological tools like micrometers and macrometers to measure water consumption, or the contemporary monitoring methods like cellular data collection, will contribute to better understand the current access to water sources.

Social factors are also essential for developing the water sector in the rural areas, where community-based organizations are responsible for water operation and management. The understanding of the social capital of the community, the real demand of services, and community willingness to participate in the project through financial and non-financial contributions need to be assessed from the outset of the design process. As seen in Paraguay, the fact that users highly value both the resource and the service may facilitate the social appropriation of the water system under a proper institutional context with subsidies and technical capacity training. More educational programs and inclusion of local governments in water programs could improve user perception regarding the importance of a quality water service and the potential impacts to their welfare. Regardless of the nature of the public sector's presence and role (whether at different institutional levels or with different grades of presence) it is essential to the expansion of systems, to the assurance of affordability (e.g. definition of subsidies), and to the guarantee of long-term sustainability.

The availability of data would help institutions better define policies and strategies for increasing access to improved water sources and achieving universal access. Assuring affordability, equality, and sustainability of the services must also be a primary goal. More quantitative studies and impact evaluations would facilitate a better understanding of the sector and its limitations, which would in turn facilitate the ability to propose improvements to and innovative alternatives for expanding services.

Finally, knowledge regarding sustainability in rural water systems needs to be shared among public and private institutions, organizations and users in order to increase collective capacity to ensure the sustainability of the systems, to scale-up successful experiences and to regulate the water sector to move forward universal, affordable and sustainable water services.

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Appendices

A. GDP per capita per country and rural access to improved water sources

Table 20. GPD per capita (2014) and rural access to improved water sources (2015).

Country Name	GDP per capita (US$)	Rural access to improved water sources (%)
Antigua and Barbuda	13,961	98
Argentina	12,922	100
Aruba	25,355	98
Bahamas, The	22,246	98
Barbados	15,199	100
Belize	4,894	100
Bolivia	3,151	76
Brazil	11,613	87
Chile	14,520	93
Colombia	7,720	74
Costa Rica	10,035	92
Cuba	6,848	90
Dominican Republic	6,076	82
Ecuador	6,291	76
El Salvador	3,951	87
Grenada	8,299	95
Guatemala	3,703	87
Guyana	4,017	98
Haiti	833	48
Honduras	2,347	84
Jamaica	5,290	89
Mexico	10,361	92
Nicaragua	1,914	69
Panama	11,771	89
Paraguay	4,479	95
Peru	6,594	69
St. Lucia	7,437	96
St. Vincent and the Grenadines	6,663	95
Suriname	9,826	88
Trinidad and Tobago	18,219	95
Uruguay	16,811	94
Venezuela, RB	16,530	78

Source: World Bank [2015] and WHO/UNICEF [2015].

B. GINI index data per country versus access

Table 21. GINI Index (2014) and rural access to improved water sources (2015).

Country Name	GINI Index	Rural access to improved water sources (%)
Argentina	43.57	100
Belize	53.13	100
Bolivia	46.64	76
Brazil	52.67	87
Chile	50.84	93
Colombia	53.53	74
Costa Rica	48.61	92
Dominican Republic	45.68	82
Ecuador	46.57	76
El Salvador	41.8	87
Guatemala	52.35	87
Guyana	44.54	98
Haiti	59.21	48
Honduras	57.4	84
Jamaica	45.51	89
Mexico	48.07	92
Nicaragua	45.73	69
Panama	51.9	89
Paraguay	48.01	95
Peru	45.33	69
St. Lucia	42.58	96
Suriname	52.88	88
Trinidad and Tobago	40.27	95
United States Virgin Islands		100
Uruguay	41.32	94
Venezuela, RB	44.77	78

Source: World Bank [2015] and WHO/UNICEF [2015].

C. List of tools

Table 22. Tool for measuring sustainability.

Tool	Organization / Reference
WASH Sustainability Assessment Tool (SAT)	AGUASAN Group; Boulenouar *et al.*, 2013.
Gender Analysis Snapshot (GAS)	CARE International; CARE, 2014.
Governance into Functionality Tool (GiFT)	CARE International; CARE, 2013.
Local Government IWRM Support Assessment	CARE International; CARE, 2009.
WASH Life-cycle Assessment	Chalmers University of Technology/ University of South Florida; McConville J., 2006.
Sustainability Monitoring Framework. FIETS approach.	Dutch WASH Alliance, 2014.
WASHCost Tool	International Water and Sanitation Centre; IRC, 2013b
Planning-Oriented Sustainability Assessment (POSAF)	Starkl et al., 2013.
Sustainability Check (SC)	UNICEF, 2008.
Sustainability Index Tool (SIT)	USAID/Rotary International; USAID, 2013.
Tool for Planning, Predicting & Evaluating Sustainability (ToPPES)	Water and Sanitation for Africa; Ryan *et al.*, 2013
Methodology for Participatory Assessment (MPA)	Water and Sanitation Program; Dayal *et al.*, 2000
WASH Sustainability Sector Assessment Tool	International Water and Sanitation Centre; IRC, 2002.
Water, Sanitation & Hygiene Bottleneck Analysis Tool (WASH-BAT)	UNICEF; Kouassi-Komlan, 2014
Sub-sector scorecard	Water and Sanitation Program. World Bank, 2006.
Enabling Environment Assessment	Water and Sanitation Program; World Bank, 2008.
Sector Wide Investment and Financing Tool (SWIFT)	Water and Sanitation Program; Virjee, 2007.
Rural Water and Sanitation Information System (SIASAR)	Water and Sanitation Program/National Governments; SIASAR, 2015.
Check Up Program for Small Systems (CUPPS)	Environmental Protection Agency (US-EPA); EPA, 2013.
Financing for Environmental, Affordable and Strategic Investments that Bring on Large-scale Expenditure (FEASIBLE)	OECD/EAP Task Force and COWI; OECD, 2014.
Technology Applicability Framework (TAF) & Technology Introduction Process (TIP)	Skat Foundation; Olschewski *et al.*, 2013.
Road – map for Integrated Water Resource Management (IWRM) in River Basins	CARE International; CARE, 2009.
Sustainability Snapshot	WaterAid; Sudgen, 2003.
Water for Life Sustainability Rating	Improve International, 2011.
Sustainability Self-Assessment	SustainableWASH, 2013.
Service Delivery Indicators	International Water and Sanitation Centre. Lieshout, 2014.
AtWhatCost	Water for People; Water for people, 2014.
WASH/NTD Toolkit	McGuire, 2014.
Composite indicator	Rivera *et al.* 2004.

Source: author, 2015.

D. List of communities and location

Figure 39. Communities beneficiaries of the program.

Department	District	Community	Number of connections
Alto Paraná	Minga Guazú	Km. 30 Ruta 6 y 7	618
Caaguazú	C. Oviedo	San Librada	104
Caaguazú	San Joaquín	Piropoty	87
Caaguazú	C. Oviedo	Bo. Gral. Díaz	144
Caaguazú	San José de los Arroyos	San Patricio	76
Caazapá	Caazapá	San José / Centro	105
Caazapá	Tava'i	Toranzo 1	86
Caazapá	Yuty	Capiitindy	109
Canindeyú	Corpus Christi	Colonia Gral. Bernardino Caballero -Ybyrarobana	215
Canindeyú	Corpus Christi	Colonia Yhovy	135
Central	Aregua	Villa del Maestro / Villa Virgen de Fátima	70
Central	Guarambare	Typychaty	97
Central	Itá	Itá centro II / San Antonio	121
Central	Ypané	Col. Thompson	247
Cordillera	Altos	Tucanguá Cañada	197
Cordillera	San Bernardino	Pirayu ´i	115
Guaira	Borja	Agustín Molas	82
Guaira	E. A. Garay	Potrero Ybaté	140
Guaira	Itapé	Itapé Jhugua	138
Guaira	Iturbe	Cande´a Guazú	117
Guairá	Villarrica	Bo. Navidad/ Bo. Obrero	93
Itapuá	Gral. Delgado	San Isidro	88
Itapuá	Jesús	Bº 8 de diciembre / San Ramón	123
Itapuá	San Pedro Del Paraná	Potrero Ybate	107
Paraguarí	La Colmena	Punta Guazú / Mbocayaty	79
Paraguarí	Yaguarón	Ñuatí Calle	71
Paraguarí	Ybytymi	Ramón P. Delmás	85
San Pedro	Capiibary	9 de Junio	100
San Pedro	Choré	San Luis	149
San Pedro	Gral. Aquino	Bº San Juan	97
Central	Itaugua	Santa Librada / Aldama Cañada	139
Alto Paraná	Juan León Mallorquín	Paz del Chaco	83
Caaguazú	Caaguazú	Asentamiento San Pedro	119
Caaguazú	Dr. J. E. Estigarribia	La Fortuna y Virgen Serrana	139
Caaguazú	Dr. Juan Manuel Frutos	Calle 7 / Ramonita	128
Caaguazú	Dr. Juan Manuel Frutos	San Isidro / Calle 3	138
Caaguazú	J. E. Estigarribia	Torin	133
Caaguazú	Yhu	Deposito Cue 1ª Línea	140
Caaguazú	Yhu	Deposito Cue 2ª Línea	108
Caaguazú	C. Oviedo	Calle Guazú	106

Department	**District**	**Community**	**Number of connections**
Caaguazú	C. Oviedo	Calle Jiménez	147
Caaguazú	C. Oviedo	Cangai / Bo. Gral. Díaz	131
Caaguazú	C. Oviedo	Cayguá Cocué	87
Caaguazú	C. Oviedo	Costa Conavi	99
Caaguazú	C. Oviedo	J. Ma. Alfonso Godoy	142
Caaguazú	C. Oviedo	San Luis	87
Caaguazú	Cnel. Oviedo	Ñu Ruguá	139
Caazapá	S. J. Nepomuceno	San Benito Pindo´i	92
Caazapá	S. J. Nepomuceno	San Gerardo	64
Caazapá	S. J. Nepomuceno	San Ramón / Boquerón	106
Caazapá	S. J. Nepomuceno	Santa Rosa Pindo´i	118
Caazapá	Yuty	Mª Auxiliadora y Vera Cué	100
Caazapá	Tava'i	YvytyCorá	72
Caazapá	Yuty	Cerrito	94
Caazapá	Yuty	Guazucai	122
Caazapá	Yuty	Lima 1ª línea	76
Caazapá	Yuty	Mbocayaty / San Vicente	109
Caazapá	Yuty	San Juan Bautista	139
Caazapá	Yuty	Yaguareté Cora	126
Caazapá	Yuty	Yarati'i	120
Canindeyú	Corpus Christi	Colonia Anahi	197
Canindeyú	Corpus Christi	Colonia Santo Domingo	93
Canindeyú	Nueva Esperanza	1º Marzo Marangatu	86
Canindeyú	Nueva Esperanza	Colonia Itambey	71
Central	Aregua	Santa Rita / Santa Catalina	141
Central	Capiatá J. A. Saldivar.	Ybyrero /Coé Pyahu / Rojas Cañada	146
Central	Itá	30 de Agosto	149
Central	Itá	Potrero Po´i 1	234
Central	Itá	Potrero Po´i 2	94
Central	Itá	Valle Yo´a	137
Central	Itaugua	Salvador Del Mundo	138
Central	Luque	Ycuá Karanday	120
Central / Paraguarí	Itá / Yaguarón	Itá Potrero / Senda	78
Cordillera	Piribebuy	Cañada	94
Cordillera	San Bernardino	Viila Real	106
Guaira	Cnel. Martínez	Costa´i	89
Guaira	Itapé	Loma Jhovy	149
Guaira	Ñumi	Cerro Corá	95
Guaira	Ñumi	San Luis	94
Guaira	Yataity	Loma Barreto	111
Guaira	Yataity	Potrero Benegas	96
Guairá	Itapé	Costa Jhú	67
Guairá	Itapé	Potrero Ramírez	92
Guairá	Villarrica	Rincón 1	139
Itapuá	Edelira	Pirapey Km. 50/54	117

Department	District	Community	Number of connections
Itapuá	Gral. Delgado	Santa librada / San Blas	112
Itapuá	Itapuá Poty	Arroyo Claro	127
Itapuá	Natalio	Natalio 14 / Bº San José	279
Itapuá	Nueva Alborada	Nueva Alborada	75
Itapuá	San Pedro Del Paraná	Santa Cruz / Las Mercedes	94
Itapuá	San Rafael del Paraná	Colonia Naranjito	272
Paraguarí	Quiindy	Valle Apu'a	162
Paraguarí	Ybytymi	Héctor L. Vera	96
San Pedro	Capiibary	Calle 1º de Marzo Este / San Eugenio	95
San Pedro	Capiibary	Calle 1º de Marzo Este / San Vicente	98
San Pedro	Capiibary	Primero de Marzo - Oeste	84
San Pedro	Chore	Calle Rosarina	119
San Pedro	Gral. Aquino	1º de marzo	89
San Pedro	Gral. Aquino	Colonia Ñandejara	96
San Pedro	Gral. Aquino	Jhugua Guazú del Yetyty	95

Source: author, 2015.

E. Questionnaires, follow-up survey

Figure 40. Questionnaires – Follow-up Survey – Sanitation Boards.

Universidad Católica "Nuestra Señora de la Asunción"

Instituto Desarrollo

Estudio de sostenibilidad de las intervenciones del BID en el Suministro de agua potable en comunidades rurales de Paraguay

CUESTIONARIO PARA JUNTA DE SANEAMIENTO

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Buenos días/tardes. Mi nombre es ______________________ y vengo del Instituto de Desarrollo. Estamos realizando un estudio sobre la sostenibilidad de las intervenciones de SENASA en agua potable con comunidades rurales. Su comunidad participó del proyecto del BID, con el que se construyó el sistema de agua potable. Nos gustaría hacerle una breve entrevista para conocer su experiencia con el sistema de agua y aprender cuáles son los principales desafíos. De antemano le agradecemos su colaboración.

MÓDULO 0. Identificación del cuestionario

1 Número de cuestionario

2 Fecha de la encuesta (d d m m a a)

3 Hora de inicio   4 Hora final

5 Localización geográfica del hogar (UTM)
Coordenadas gerreferenciado (GPS)   x   y

6 Número de GPS

7 Orden del punto (referenciado en el GPS)

8 Dpto. ____________   9 Distrito ____________

10 Localidad ____________

11 Dirección y N° ____________

12 Nombre del entrevistado ____________

13 Sexo del entrevistado
1 Mujer
6 Hombre

14 Teléfono del entrevistado ____________

15 Cargo del entrevistado en la JS ____________

16 Antigüedad en el cargo ____ años

17 Antigüedad en la comunidad ____ años

MÓDULO 1.Características institucionales/Gobernananza de la JS

1.1. ¿La JS cuenta con una comisión directiva elegida en Asamblea?
1 Sí
6 No

1.2. ¿Tienen acta de la sesión donde se eligió la actual directiva?
1 Sí
6 No

1.3. Actuales miembros de la comisión

	1.3. Actuales miembros de la comisión	1.4. Sexo H	1.4. Sexo M	1.5. Años en la JS		1.6. Puesto renovado Si	1.6. Puesto renovado No
1	Presidente/a:	1	6			1	6
2	VicePresidente/a:	1	6			1	6
3	Tesorero/a:	1	6			1	6
4	Secretario/a:	1	6			1	6
5	Síndico/a:	1	6			1	6
6	Rep. Municipal:	1	6			1	6
7	Otro	1	6			1	6
8	Otro	1	6			1	6

1.7. Si no hubo renovación de algún puesto, ¿por qué motivo fue?
1 Por mayoría de votos continuó siendo el mismo
2 No hay quienes tienen capacidad para ser miembros directivos
3 La gente no participa en las reuniones
4 Los presenten no quieren asumir las responsabilidades
5 Otros (Especificar: ____________)
6 No sabe

1.8. ¿Existe alguna vacante en la JS?
1 Sí
6 No (pasar a P.1.10.)

1.9. ¿Qué posición está actualmente vacante? ____________

1.10. ¿Por qué está la posición vacante?
1 A nadie le interesa tomar esa posición
2 Nunca ha habido nadie que ocupe esa posición
3 La posición no es necesaria para el funcionamiento de la JS
4 Había alguien antes pero se fue y no se ha reemplazado todavía
5 Otro (Especificar: ____________)

1.11. ¿Los actuales miembros de la comisión formaban parte de la comisión anterior en algún otro puesto?

		Si	No	Puesto que ocupaba
1	Presidente/a:	1	6	
2	VicePresidente/a:	1	6	
3	Tesorero/a:	1	6	
4	Secretario/a:	1	6	
5	Síndico/a:	1	6	
6	Rep. Municipal	1	6	
7	Otro: ______	1	6	
8	Otro: ______	1	6	

1.12. ¿Quienes de los miembros de la actual Junta son miembros directivos de otras organizaciones? (Puede indicar varias organizaciones)

		Sí	No	Organización	Cargo
1	Presidente/a	1	6		
2	VicePresidente/a	1	6		
3	Tesorero/a	1	6		
4	Secretario/a	1	6		
5	Síndico/a	1	6		
6	Rep.Municipal	1	6		
7	Otro______	1	6		
8	Otro______	1	6		

1.13. ¿Cuántas personas actualmente trabajan en la JS? (no contar los miembros directivos de la Junta)?
____ personas

1.14. ¿Cuántas hora smensuales le dedicanareuniones los miembros de la directiva de la JS?

		Horas/mes	
1	Presidente/a		
2	VicePresidente/a		
3	Tesorero/a		
4	Secretario/A		
5	Síndico/a		
6	Otro______		
7	Otro______		

1.15. ¿Cuántas veces se reúnen al mes, normalmente?
____ veces

1.16. Los Miembros de la junta directiva tienen salario asignado o remuneraciones?

		Sí	No	¿Cuánto? (Gs)							
1	Presidente/a	1	6								
2	VicePresidente/a	1	6								
3	Tesorero/a	1	6								
4	Secretario/a	1	6								
5	Síndico/a	1	6								
6	Repr. Municipio	1	6								
7	Otro______	1	6								
8	Otro______	1	6								

1.17. Si cobra, ¿con qué frecuencà cobra su salario? (en la primera fila, el número del 1 a 8 corresponde a los Miembros directivos en la pregunta anterior)

	Miembros de la Junta								
		1	2	3	4	5	6	7	8
1	Cada fin de semana								
2	Cada mes								
3	Por trabajo realizado								
4	No tenemos establecido								
5	No sabe								

1.18. Los trabajadores no miembros directivos de la Junta tienen salario asignado?

| 1 | Sí |
| 6 | No |

1.19. Con qué frecuencia cobran su salario?
Indicar entre paréntesis la persona (operario de mantenimiento, limpiadora, etc.)

1	Cada fin de semana ( )
2	Cada mes ( )
3	Por trabajo realizado ( )
4	No está establecido ( )
5	No sabe

1.20. ¿Qué monto mensual se dedica a los sueldos de las personas que NO son miembros de la Junta? (total)

Gs [| | | | | | | | | |]

1.21. ¿Ha aumentado el número de personas que trabaja en la JS desde su creación?

1	Sí
2	No
3	No sabe (pasar P.1.23)

1.22. Inicialmente, ¿cuánta gente trabajaba en la JS?

[| |] personas

1.23. Si hay representante del municipio en la JS, ¿quién es?

1	Funcionario del municipio
2	Vecino seleccionado por el municipio
3	Otros (Especificar: ______________________________)
4	No tiene (pasar a 1.26.)
5	No sabemos (pasar a 1.26.)

1.24. ¿Con qué frecuencia se realizan reuniones con el representante municipal en caso que haya?

1	Una vez al mes
2	Cada seis meses
3	Cada año
4	Otros (Especificar)

1.25. ¿Cuándo fue la última reunión con el representante de la municipalidad?

1	Hace una semana
2	Hace un mes
3	Hace un año
4	Nunca
5	Otro (Especificar__________________)
6	No sé

1.26. ¿Conoce de alguna Asociación de JS en su Departamento?

| 1 | Sí |
| 2 | No (pasar a P.1.30) |

1.27. ¿Esta JS es miembro de la Asociación de JS del Departamento?

| 1 | Sí |
| 2 | No (pasar a P.1.30) |

1.28. En caso que no, ¿por qué?

1	No nos invitó SENASA, tampoco ERSSAN
2	Es muy cara la tasa inicial
3	Es muy cara la tasa mensual
4	No sabemos qué beneficios tendríamos si fuéramos miembros
5	Estamos en proceso de unirnos a la Asociación de JS
6	Otros (Especificar: ______________________________)
7	No sabe

1.29. Si participan, ¿cuáles creen que son los beneficios de pertenecer a una asociación de JS?

1	Compartimos gastos de materiales para mantenimiento
2	Compartimos gastos para la reparación del sistema (técnico)
3	Tenemos más poder para pedir cosas a SENASA y ERSSAN
4	Nos reunimos y compartimos problemas e ideas
5	Otros (Especificar: ____________________________)
6	No sabe

1.30. Esta Junta de Saneamiento forma parte de alguna otra red o asociación?

| 1 | Sí |
| 6 | No (pasar a la P.1.32) |

1.31. Nombre de la red o asociación

____

1.32. La Junta ha presentado a SENASA, ERSSAN o Municipio u otra organización proyectos que buscan contribuir al funcionamiento del sistema de agua?

1	Sí
2	No
3	No sabe

1.33. ¿Cuántos proyectos han presentado en el último año?

[| |] proyectos

1.34. De esa cantidad que presentaron ¿Cuántos proyectos les han adjudicado?

[| |] proyectos

1.35. ¿En qué año fue el último proyecto/solicitud presentado?

[| | |]

1.36. Observaciones (tipo de proyecto que presentaron la última vez):

____
____
____

MÓDULO 2. Gestión administrativa de la JS

2.1. ¿Esta JS tiene acta de constitución?¿ Está legalmente constituida?

| 1 | Sí (pasar a P.2.3.) |
| 6 | No |

2.2. ¿Por qué no está legalmente constituida?

1	SENASA no gestionó ese paso
2	SENASA no orientó para cumplir ese paso
3	No es requisito
4	No queremos
5	Otros (Especificar: ______________________________)
6	No sabe

2.3. ¿La JS tiene Registro Único del Contribuyente (RUC), está inscripta ante el Ministerio de Hacienda como contribuyente?

| 1 | Sí N° De RUC: ____________________ |
| 6 | No |

2.4. ¿Esta Junta cuenta con estatutos sociales aprobados?

1	Sí
2	No (pasar a P.2.8.)
3	No sabe (pasar a P.2.9.)

2.5. ¿Los estatutos están protocolarizados?

1	Sí
2	No
3	No sabe

Foto de 1ra.hora de los estatutos

2.6. Camara N° [|] 2.7. Orden de foto [| |]

2.8. ¿Por qué no cuenta con estatutos?

____
____
____

2.9. Las personas de la junta directiva de la JS, ¿conocen cuáles son sus funciones específicas según los estatutos?

1	Sí
2	No todas
3	No
4	No sabe

2.10. ¿Existe un manual de procedimientos y operaciones?
- 1 Sí
- 2 No (pasar a 2.12.)
- 3 No sabe (pasar a 2.12.)

2.11. ¿Se utiliza usualmente el manual de procedimientos y operaciones?
- 1 Sí
- 2 No
- 3 A veces
- 4 No sabe

2.12. ¿La Junta de Saneamiento cuenta con un seguimiento de su gestión?
- 1 Sí
- 2 No (pasar a 2.14.)
- 3 No sabe (pasar a 2.14.)

2.13. ¿Cuáles son las formas de hacer el seguimiento?
(puede marcar mas de una categoria)
- 1 Actas de reuniones
- 2 Informes semestrales
- 3 Informes anuales
- 4 Rendición de cuentas anual
- 5 Otros (Especificar: ______________________________)
- 6 No sabe

2.14. ¿Se ha registrado el pozo de la JS en la Secretaría del Ambiente? (SEAM)
- 1 Sí
- 2 No
- 3 No sabe

2.15. ¿Se cuenta con el registro de ERSSAN?
- 1 Sí
- 2 No
- 3 No hace falta porque la JS tiene menos de 200 conexiones

2.16. ¿Existe un contrato entre SENASA y la JS?
- 1 Sí
- 2 No
- 3 No sabe

2.17. ¿Cada cuánto se reúnen los directivos de la JS?
- 1 Una vez al mes
- 2 Dos veces al mes
- 3 Una vez al año
- 4 Casi nunca (ver P.2.14)
- 5 Cada vez que hay un problema con el sistema
- 6 Otros (Especificar: ____________________)
- 7 No sabe

2.18. En caso que casi nunca, porqué?
- 1 Los miembros no participan
- 2 No se requiere muchas reuniones
- 3 Siempre que se hace no se llega a ningun acuerdo
- 4 Otros (Especificar: ______________________________)
- 5 No sabe

2.19. Qué tipo de decisiones se toman en una sesión de la CD?

____

____

____

____

____

2.20. ¿Cómo se realizan las convocatorias de las reuniones de la CD?
- 1 Vía telefónica
- 2 Aviso por hogar
- 3 Convocatoria por nota
- 4 Se tiene preestablecido las fechas de convocatoria
- 5 Otros (Especificar: ______________________________)
- 6 No sabe

2.21. ¿Cuándo fue la última reunión de la directiva de la JS?

d	d	m	m	a	a

2.22. ¿Todos los miembros directivos de la JS participan en las sesiones de la directiva?
- 1 Siempre
- 2 Regularmente
- 3 Algunas veces
- 4 Casi nunca
- 5 No sabe

2.23. ¿Por qué no participan todos los miembros directivos?
- 1 No tiene tiempo
- 2 No le avisaron
- 3 No estaba en la comunidad
- 4 Estaba en su trabajo
- 5 Otros (Especificar: ___________________________)

2.24. ¿Cada cuánto tiempo hay rotación de los miembros directivos de la Junta de Saneamiento?

Cada [|] años

2.25. ¿Cuántos miembros se cambian cada año?
- 1 Todos
- 2 Algunos, según los estatutos
- 3 Algunos, según si los que están quieren seguir o no
- 4 Otros (Especificar: ___________________________)

2.26. ¿Cómo se elige a los miembros de la comisión directiva de la JS?
- 1 Por votos en Asamblea
- 2 Por nominación
- 3 Voluntario
- 4 Otros (Especificar: ______________________________)

2.27. ¿Cuántas personas participaron en la última asamblea?

[| |] personas

2.28. ¿La JS cuenta con registro de usuarios?
- 1 Sí
- 2 No (pasar a P.2.30.)
- 3 No sabe

2.29. ¿Cuántos usuarios tienen ahora?

[| |] usuarios

2.30. ¿Por qué no se cuenta con registro de datos de usuarios?
- 1 No se requiere porque no son muchos
- 2 No hay quien lo haga
- 3 A nadie le interesa
- 4 Otros (Especificar: ______________________________)

Foto registro de usuarios actual

2.31. Camara N° [|]

2.32. Orden de foto

MÓDULO 3 Gestión financiera

3.1. ¿Cuánto contribuyó SENASA para la creación de este sistema de agua

[| | | | | | | |] Gs.

3.2. Si no sabe el monto aproximado, ¿qué porcentaje de la creación del sistema cubrió SENASA?

[|] %

3.3. La Junta de Saneamiento tiene todavía deuda con el SENASA por la construcción de este sistema?

- 1 Sí
- 6 No (pasar a P.3.6.)

3.4. En caso que sí, cuántos años les falta para pagar toda la deuda?

[ ][ ] años

3.5. ¿Han refinanciado o piensan refinanciar el crédito que les queda en deuda?

- 1 Sí
- 2 No
- 3 No sabe

3.6. ¿La Junta de Saneamiento recibió ayuda financiera de SENASA en los ultimos 12 meses?

- 1 Sí
- 6 No (pasar a P.3.8.)

3.7. ¿Cuánto recibió?

[ ][ ][ ][ ][ ][ ][ ][ ][ ] Gs.

3.8. ¿Qué otro tipo de ayuda reciben de SENASA? (se puede señalar más o una opción)

- 1 Subsidio a la conexión
- 2 Dinero en efectivo para arreglo
- 3 Asistencia técnica
- 4 Materiales para construcción y/o reparación
- 5 Otros (Especificar: ______________________________)
- 6 Nada (pasar a P.3.10.)

3.9. ¿Con qué frecuencia lo recibe?

- 1 Sólo una vez
- 2 Cada vez que necesitamos
- 3 Una vez al año
- 4 Otros (Especificar: ______________________________)
- 5 No sabe

3.10. ¿La Junta de Saneamiento recibió ayuda financiera de otras organizaciones en los últimos 12 meses?

- 1 Sí
- 6 No (pasar a P.3.12.)

3.11. ¿Cuánto recibió?

[ ][ ][ ][ ][ ][ ][ ][ ][ ] Gs.

3.12. ¿Qué otro tipo de ayuda reciben de otras organizaciones?

- 1 Subsidio a la conexión
- 2 Dinero en efectivo para arreglo
- 3 Asistencia técnica
- 4 Materiales para construcción y/o reparación
- 5 Otros (Especificar: ______________________________)
- 7 Nada (pasar a P.3.14.)

3.13. ¿Con qué frecuencia lo recibe?

- 1 Sólo una vez
- 2 Cada vez que necesitamos
- 3 Una vez al año
- 4 Otros (Especificar: ______________________________)
- 5 No sabe

3.14. ¿Han realizado otras actividades para recaudar fondos para mantener u operar el sistema en los últimos 12 meses?

- 1 Sí (pasar a P.3.16.)
- 6 No

3.15. ¿La JS paga al ERSSAN un canon (2% sobre gastos)?

- 1 Sí
- 2 No
- 3 No es necesario porque la JS tiene menos de 200 conexiones
- 4 No sabe

3.16. ¿Han tenido alguna orientación del SENASA sobre el reglamento tarifario, de cómo calculan las tarifas y otros temas al respecto?

- 1 Sí
- 2 No
- 3 No sabe

3.17. ¿La Junta tiene un libro de control de ingresos-egresos (planilla de movimiento, etc.)? ¿Me la podría enseñar?

- 1 Sí, mostró documento
- 2 Sí, no mostró documento
- 3 No tiene

3.18. ¿Qué registro utilizan? (pueden marcar más de una)

- 1 Libro de caja (compra-venta)
- 2 Libro diario
- 3 Libro mayor
- 4 Inventario
- 5 No sabe

3.19. ¿Cuándo fue el último mes que presentó el IVA?

[ ][ ] (número del mes)
Si no presentó, anotar 00

3.20. ¿La tarifa para usuarios es fija?

- 1 Sí
- 2 No (pasar P.3.22)

3.21. ¿Cuál es la tarifa fija mensual?

[ ][ ][ ][ ][ ][ ][ ][ ] Gs (pasar a P.3.27)

3.22. ¿Por qué recurren a la tarifa variable?

- 1 Porque hay viviendas que consume más
- 2 Porque hay vivienda que puede pagar más
- 3 Otros (Especificar: ______________________________)

3.23. ¿Cuál es el mínimo que los usuarios pagan?

[ ][ ][ ][ ][ ][ ][ ] Gs

3.24. ¿Cuál es la cantidad de litros que pueden gastar por el mínimo facturado?

[ ][ ][ ][ ][ ][ ] litros

3.25. ¿Cuántos usuarios pagan la cantidad mínima? (el último mes)

[ ][ ][ ] usuarios

3.26. Cómo se calcula la tarifa variable?

1 ______________________________
2 ______________________________
3 ______________________________
4 ______________________________

3.27. ¿La tarifa que cobran está definida por SENASA-ERSSAN?

- 1 Sí
- 2 No, porque la tarifa que ERSSAN nos autorizó es alta y no se aplica aquí
- 3 No, porque no sabemos que ERSSAN nos tiene que fijar la tarifa
- 4 No, sabemos pero no le consultamos sobre el monto que cobramos
- 5 No, porque nosotros fijamos nuestra propia tarifa de acuerdo con la posibilidad de los vecinos
- 6 No responde
- 7 Otros (Especificar: ______________________________)

3.28. ¿Se ha aumentado alguna vez la tarifa mínima de pago?

- 1 Sí
- 2 No (pasar a 3.30.)

3.29. ¿Hace cuántos años se dio el último aumento de tarifa?

[ ][ ] años (si es este año, poner 00)

3.30. Existen usuarios que no tienen la obligación de pagar (por ejemplo, como ayuda por su estado económico, la iglesia, etc.)

- 1 Sí
- 2 No (pasar P.3.32.)

3.31. ¿Quiénes no pagan?

____

____

____

3.32. ¿Hay personas que pagan un monto extra al habitual?
(por ejemplo, por un uso especial, como hospitales, escuelas, casas con piscina, etc.)

1 Sí
6 No

3.33. ¿Existen otros cobros adicionales al usuario?

1 Sí
6 No (pasar a la 3.35)

3.34. ¿En qué conceptos?

	Conceptos	Monto (Gs)								
1	Derecho a conexión									
2	Corte									
3	Reconexión									
4	Instalación de medidor									
5	Multa por mora									
6	Otros (_________)									

3.35. ¿Se ha realizado durante el último año la desconexión de servicios por falta de pago en la comunidad?

1 Sí
6 No (pasar a P.3.37.)

3.36. ¿Cuántas desconexiones hicieron en el último año?

[ ][ ][ ][ ] desconexiones

3.37. ¿Cuál es la frecuencia de cobro o emisión de factura?

1 Mensual
2 Trimestral
3 Semestral
4 Anual
5 Otros (Especificar: __________________________)

3.38. ¿Cuál es el monto promedio de la factura de agua por hogar?

1 Menos de 10 mil gs
2 Entre 10 mil y 20 mil gs
3 Entre 20 mil y 30 mil gs
4 Entre 40 mil y 50 mil gs
5 Más de 50 mil gs

3.39. ¿La Junta de Saneamiento emite algún comprobante a los usuarios por el pago del agua?

1 Sí
6 No (ir a P.3.41)

3.40. Especifique tipo de comprobante

1 Factura legal
2 Recibo común
3 Otro (especificar: ____________________)

3.41. ¿Por qué no emite comprobante?

1 No tenemos para pagar impresión de la factura
2 No queremos gastar en impresiones
3 Anotamos en acta/cuadernillos
4 Otros (Especificar)

3.42. ¿Cuál fue el monto total de ingresos en el 2013?

[ ][ ][ ][ ][ ][ ][ ][ ][ ] Gs.

3.43. ¿Por tarifas cobradas a los usuarios cuánto fue el ingreso de la Junta de Saneamiento en el 2013?

[ ][ ][ ][ ][ ][ ][ ][ ][ ][ ] Gs.

3.44. ¿Cuál fue el total de gastos en el 2013?

[ ][ ][ ][ ][ ][ ][ ][ ][ ][ ] Gs.

Gastos mantenimiento									Gs
Gastos alquiler del local									Gs
Gastos sueldos									Gs
Gastos reparaciones									Gs
Gastos materiales									Gs
Gastos ANDE									Gs
Otros: _________									Gs

Fotografía del balance de gastos de 2013, si existe

3.45. Camara N° [ ][ ]   3.46. Orden de foto [ ][ ][ ]

3.47. ¿Los ingresos cubren los gastos?

1 Sí
6 No

3.48. La Junta de Saneamiento cuenta con fondos (dinero ahorrado)?

1 Sí
6 No

3.49. ¿Cuánto dinero tuvo el fondo a final de 2013?

[ ][ ][ ][ ][ ][ ][ ][ ][ ] Gs.

3.50. ¿Cuál ha sido la evolución de los fondos en los últimos años?

1 Ha aumentado
2 Disminuido
3 Se ha mantenido

3.51. Observaciones

____

____

____

3.52. En qué caso se utiliza ese fondo?

1 Para arreglar equipos descompuestos (bomba, motor, etc.)
2 Para pagar a personales
3 Para pagar gastos de servicios básicos
4 Para pagar imprevistos
5 Otros (especificar: _______________)
6 No sabe

3.53. ¿Cuánto esperaba recaudar en el último mes cerrado? (Recaudación teórica)

[ ][ ][ ][ ][ ][ ][ ] Gs.

3.54. ¿Cuánto realmente recaudó en el ultimo mes cerrado? (real)

[ ][ ][ ][ ][ ][ ][ ][ ][ ] Gs.

¿Cuántos usuarios están con una mora de

3.55. Un mes [ ][ ][ ] usuarios
3.56. Dos o tres meses [ ][ ][ ] usuarios
3.57. De cuatro a un año [ ][ ][ ] usuarios
3.58. Hace más de un año que no paga [ ][ ][ ] usuarios

3.59. ¿Qué monto de mora se tiene actualmente?

[ ][ ][ ][ ][ ][ ][ ][ ][ ] Gs

3.60. ¿Tienen a un contador para la realización del balance financiero?

1 Sí
6 No

3.61. El contador presta sus servicios a otras JS?

1 Sí
2 No
3 No sabe

3.62. ¿Cada cuánto informan a los usuarios de los movimientos contables registrados?

1 Cada mes
2 Cada seis meses
3 Cada año
4 No se informa
5 Otros (especificar: ______________)
6 No sabe

3.63. ¿Cuánto pagó por la electricidad el último mes?
(sin contar retrasos)
[ ][ ][ ][ ][ ][ ][ ][ ] Gs.

Fotografía de la factura, si existe

3.64. Camara N° [ ][ ]   3.65. Orden de foto [ ][ ][ ]

3.66. ¿Están incritos a la tarifa industrial especial de electricidad?
[ ] Si
[ ] No
[ ] No sabe

MÓDULO 4. Capacidad técnica

4.1. ¿SENASA le ha ofrecido curso de capacitación durante la operación del sistema sobre su mantenimiento y operación en los últimos 3 años?
1 Si
2 No (pase a P.4.3.)
3 No sabe (pase a P.4.3.)

4.2. ¿Usted participó en dicho curso?
1 Si
6 No

4.3. ¿Cuál es la razón por la cual no se participó?
1 No cubre gasto de traslado
2 No cubre gasto de alimento
3 No cubre gasto de estadía
4 Otros (Especificar: ______________________________)

4.5. ¿Los miembros directivos de la JS han recibido algún tipo de capacitación en los últimos 12 meses de otras instituciones o entidades?
1 Si
2 No
3 No sabe

4.6. ¿Cuántas personas han participado en la última capacitación?
[ ][ ][ ] personas

4.7. Tipo de capacitación que han recibido
1 Operación y Mantenimiento
2 Gestión Empresarial
3 Procedimientos
5 Manual de Funciones
4 Manual Técnico para Plomeros
5 Finanzas
6 Temas jurídicos
7 Otros (Especificar: ______________________________)

4.8. ¿Utilizan lo aprendido en la capacitación en su trabajo con la JS?
1 Todo
2 Poco
3 Nada

4.9. Cómo calificaría el contenido de la capacitación recibida?
1 Malo
2 Regular
3 Bueno
4 Muy bueno

4.10. ¿Existe transferencia de conocimientos entre los miembros de la JS (antiguos a nuevos) durante el período de transición?
1 Sí (P.4.12)
6 No

4.11. ¿Porqué no se hace la tranferencia de conocimientos?
1 No tienen interés en aprender
2 No tenemos capacidad para enseñarle lo que aprendimos
3 No hay tiempo para capacitarles
4 Otros (Especificar: ______________________________)

4.12. Cómo se realiza esa transferencia?
1 A través de curso de capacitación
2 A través de charla y orientaciones
3 A través de folletos
4 Otros (Especificar: ______________________________)

4.13. ¿La JS tiene un Plan de Mantenimiento del Sistema por escrito?
1 Sí
6 No (pasar P.4.17.)

4.14. ¿El plan se sigue y utiliza?
1 Sí
2 No
3 A veces

4.15. ¿Qué temas abarca el plan de mantenimiento de la JS?
1 Plan de revisión semestral de los equipos de bombeo
2 Plan de revisión de instalación de cañerías viales
3 Plan de revisión del equipo de cloración
4 Plan de limpieza del tanque
5 Plan de limpieza del área del sistema (malezas)
6 Otros (especificar: ______________)

4.16. ¿Hace cuántos meses se revisó?
[ ][ ] meses

4.17. ¿Quiénes participan de la revisión/mantenimiento del sistema?
(Puede marcar más de una opción)
1 Comisión directiva
2 SENASA
3 Técnicos de la JS
4 Vecinos
5 Otros (especificar: ______________)
6 No sabe

4.18. Frecuencia real de mantenimiento del tanque
Cada [ ][ ][ ] meses

4.19. Frecuencia real de mantenimiento del motor de la bomba
Cada [ ][ ][ ] meses

4.20. ¿Cuántos litros de cloro consumen anualmente?
[ ][ ][ ][ ] litros

4.21. Con qué frecuencia se presentan fallas técnicas que paralizan el sistema?
Cada [ ][ ][ ] meses

4.22. ¿Quién se ocupa de reparar/arreglar las fallas del sistema?
1 Técnicos contratados por la Junta
2 Vecinos
3 Algunos usuarios
4 Miembros de la JS
5 SENASA
6 Municipio
7 Otros (especificar: ______________)
8 No sabe

4.23. ¿Quién cubre los costos de reparación/arreglo?
1 Junta de Saneamiento
2 Vecinos
3 Algunos usuarios
4 SENASA
5 Municipio
6 Otros (especificar: ______________)
7 No sabe

4.24. Comparten con otras JS (o con la Asociación de JS) los costos de suministro o los técnicos?
1 Sí
2 No
3 No sabe

¿Con que frecuencia provee la JS agua a los hogares?

	4.25. Verano	4.26. Invierno
1 Las 24 horas		
2 Entre 12 y 24 horas al día		
3 Menos de 12 horas al día		
4 Día de por medio		
5 Otros: ____________		

4.27. Cuando hay corte del servicio, ¿cuántos días suelen quedarse sin proveer agua a los usuarios?

- 1 Menos de un día
- 2 De uno a dos días
- 3 De dos a tres días
- 4 Más de tres días

4.28. En el último año, se han dado fallas mayores que afecten la continuidad del servicio?

- 1 Sí
- 6 No

4.29. ¿Cuáles han sido las fallas principales?

- 1 Problema del motobomba
- 2 Rotura de caños
- 3 Oxidación de tanque de almacenamiento de agua
- 4 Falta de presión de agua para llegar a las casas
- 5 Corte de energía eléctrica
- 6 Otros (especificar: ________________)

4.30. Se lleva un registro de las fallas del sistema?

- 1 Sí
- 2 No
- 3 No sabe

4.31. Realizarón alguna inversión al sistema despues de su puesta en operación

- 1 Sí
- 6 No (pasar a P.4.34.)

4.32. ¿Cuánto fue el gasto de inversión aproximado?

[| | | | | | | |] Gs

4.33. ¿En qué fue el gasto de inversión?

____

____

4.34. Han recibido alguna visita del Ministerio de Salud (DIGESA) para revisión de calidad del servicio de agua?

- 1 Sí
- 6 No

4.35. ¿Cuándo fue el último análisis de calidad que se realizó al agua suministrada por la JS?

m m a a

[| | |]

4.36. ¿Quién realizó el último análisis de calidad del agua?

- 1 ERSSAN
- 2 SENASA
- 3 DIGESA
- 4 Empresa privada
- 5 Otros (especificar: ________________)

4.37. ¿Los análisis salieron satisfactorios (agua sin problemas)?

- 1 Sí
- 6 No

4.38. ¿Tienen certificado del último análisis?

- 1 Sí
- 6 No

4.39. ¿Saben cuánta agua se gastó el año pasado en todo el sistema?

- 1 Sí
- 2 No (pasar a módulo 5)
- 3 No sabe (pasar a módulo 5)

4.40. ¿Cuántos litros se consumieron el año pasado?

[| | | | | |] litros

MÓDULO 5. Servicio

5.1. ¿En qué año se puso en marcha el sistema de agua potable?

[| | |]

5.2. ¿Con cuántas conexiones se inició el sistema de agua?

[| |] conexiones

Foto registro de usuarios original (si tiene)

5.3. Camara N°

[|]

5.4. Orden de foto

[| |]

5.5. ¿Cuántas conexiones tiene hoy el sistema de agua?

[| |] conexiones

5.6. ¿Cuántas conexiones tenían en 2012?

[| |] conexiones

5.7. ¿Es el mismo sistema que fue creado por SENASA para el programa del BID gerenciado a través de TYPSA (Entidad Gerenciadora del Programa)?

- 1 Sí
- 2 No
- 3 No sabe

5.8. Si dejó de funcionar el sistema, ¿por qué?

____

____

____

____

5.9. Los usuarios de esta Junta de Saneamiento tienen medidores del consumo de agua instalado en sus viviendas?

- 1 Sí, se instalaron desde el inicio de la Junta
- 2 Sí, se instalarón despúes de operar la Junta
- 3 No, porque SENASA no instaló cuando se habilitó la Junta
- 4 No, porque salía más caro el sistema y no podiamos pagar
- 5 Otros (Especificar: ______________________________)

5.10. ¿Cuántos medidores tienen instalados en esta JS?

[| |] unidades

5.11. ¿Existe un límite de conexiones que el sistema puede asumir?

- 1 Sí
- 6 No

5.12. ¿Cuál es el número máximo de conexiones que puede asumir el sistema?

[| |] conexiones

5.13. ¿Existen hogares que quisieran conectarse al sistema pero no pueden?

- 1 Sí
- 2 No (pasar a P.5.15.)
- 3 No sabe

5.14. ¿Cuál es la limitación que existe para incorporar más hogares?

____

____

____

____

____

5.15. ¿Qué valoración de 1 (menor valoración) a 10 (máxima) le dan al funcionamiento del sistema de agua en la comunidad?

1	2	3	4	5	6	7	8	9	10

5.16. ¿Cuáles creen que serían las mejoras a realizar en la gestión de la JS?

- 1 Más apoyo técnico de SENASA
- 2 Más apoyo financiero de SENASA
- 3 Más apoyo del municipio
- 4 Que los vecinos paguen el servicio (menos mora)
- 5 Aumentar la capacidad de bombeo del sistema
- 6 Aumentar las conexiones
- 7 Un tanque de almacenamiento más grande
- 8 Poner medidores en las casas
- 9 Otros (Especificar: ______________________________)
- 10 Otros (Especificar: ______________________________)

5.17. ¿Ud. cree que el servicio de Agua Potable en esta comunidad en el estado actual en que se encuentra va a permanecer funcionando en los próximos años?

| 1 | Sí (Pase a P.5.19) |
| 6 | No |

5.18. ¿Por qué no va a permanecer funcionando?

1	Pocos usuarios pagan por el servicio
2	No hay dinero para mantener/operar el sistema
3	El mantenimiento está caro
4	No recibe ayuda ténica ni financiera del gobierno
5	Problemas técnicos del sistema
6	Otros (Especificar: ________________________)

5.19. Cómo califica la presión del servicio de agua

1	Mala
2	Regular
3	Buena

5.20. Cómo califica la calidad del agua en cuanto a turbidez

1	Mala
2	Regular
3	Buena

5.21. Cómo califica la calidad del agua en cuanto al olor

1	Mala
2	Regular
3	Buena

5.22. Cómo califica la calidad del agua en cuanto al sabor

1	Mala
2	Regular
3	Buena

5.23. Cuáles serían los puntos a mejorar para un funcionamiento más eficiente de las Juntas de Saneamiento? (más de una opción)

1	Más capacitación de personal técnico
2	Más capacitación de los miembros directivos de la JS
3	Voluntad de usuarios para pagar el servico
4	Apoyo financiero del Estado para mantenimiento
5	Otros (Especificar)

5.24. Si algún usuario tiene una queja, ¿cómo la puede tramitar?

1	En las reuniones de juntas mensuales
2	Directamente a un representante de la JS por teléfono
3	Existe un buzón de quejas
4	Otros (Especificar: ________________________)

MÓDULO 6. Capital Social

Para complementar la encuesta tenemos algunas preguntas en relación a su comunidad

6.1. En la actualidad, ¿Qué tipo de asociaciones tiene mayor número de asociados? (marcar las dos principales)

1	Asociación de agricultores
2	Asociación de negociantes
3	Club deportivo
4	Asociación de la iglesia
5	Asociación de jóvenes
6	Otros (Especificar: ________________________)
7	Otros (Especificar: ________________________)

6.2. Cuando alguien de la comunidad tiene algún problema, en general, ¿a quién acude? (marcar las dos opciones más frecuentes)

1	Familiares
2	Amigos
3	Vecinos
4	Políticos
5	Sacerdotes o pastores
6	Miembros de la comunidad
7	Prestamista
8	Cooperativas
9	Otros (Especificar: ________________________)
10	No sabe

6.3. La población, generalmente, ¿participa de las actividades que se organizan en la comunidad?(fiestas patronales, torneos deportivos, kermeses, etc.)

1	La mayoría sí
2	Sólo unos pocos
3	En general, no
4	Otros (Especificar: ________________________)

6.4. ¿Qué relación existe con las comunidades vecinas?

1	Muy buena, se colabora en algunas actividades
2	Buena, se conocen pero no se realizan actividades conjuntas
3	Normal
4	Mala, existen problemas de convivencia
5	Otros (Especificar: ________________________)

6.5. ¿Cree que se puede confiar en lo que la gente de la comunidad dice?

1	Siempre
2	La mayoría de las veces
3	A veces
4	Nunca

6.6. En los últimos años, ¿Se han mudado a vivir aquí muchas personas? o ¿Se han ido otras?

1	Sí, hay mucho movimiento de personas
2	No, somos los mismos hace muchos años
3	Otros (Especificar: ________________________)

6.7. ¿Si surge alguna necesidad en la comunidad, se realizan actividades para ayudar?

| 1 | Sí |
| 6 | No |

6.8. ¿Quiénes participan en estas actividades? Marcar las dos opciones más frecuentes

1	Los familiares de la persona que necesita ayuda
2	Los vecinos de la persona que necesita ayuda
3	La iglesia
4	Los líderes de la comunidad
5	Las instituciones
6	Toda la comunidad

6.9. En la actualidad, ¿con qué asociaciones o comisiones participa voluntariamente? (marcar dos)

1	Asociación de agricultores
2	Asociación de negociantes
3	Club deportivo
4	Asociación de la iglesia
5	Asociación de jóvenes
6	Otros (Especificar: ________________________)
7	Otros (Especificar: ________________________)

6.10. ¿Qué rol cumple en estas asociaciones y comisiones?

1	Como miembro de la comisión o asociación
2	Como asesor de la comisión o asociación
3	No participa
4	No responde

6.11. Por favor, anotar otros comentarios

____
____
____
____
____
____
____
____
____

7.1. Firma del encuestador ________________________

7.2. Nombre del encuestador ________________________

7.3. Firma del Supervisor ________________________

7.4. Nombre del Supervisor ________________________

Figure 41. Questionnaires – Follow-up Survey – Users

Universidad Católica "Nuestra Señora de la Asunción"

Instituto Desarrollo

centro de tecnología apropiada
Facultad de Ciencias y Tecnología
Universidad Católica "Nuestra Señora de la Asunción"

Estudio de sostenibilidad de las intervenciones del BID en el Suministro de agua potable en comunidades rurales de Paraguay
CUESTIONARIO PARA BENEFICIARIO DE JS

Buenos días/tardes. Mi nombre es ______________________ y vengo del Instituto de Desarrollo. Estamos realizando un estudio sobre la sostenibilidad de las intervenciones de SENASA en agua potable con comunidades rurales. Su comunidad participó del proyecto del BID, con el que se construyó el sistema de agua potable. Nos gustaría hacerle una breve entrevista para conocer su experiencia con el sistema de agua y aprender cuáles son los principales desafíos. De antemano le agradecemos su colaboración.

MÓDULO 0. Identificación del cuestionario

1 Número de cuestionario [ ][ ][ ][ ][ ][ ][ ]

2 Fecha de la encuesta [d][d][m][m][a][a]

3 Hora de inicio [ ][ ]:[ ][ ]   4 Hora final [ ][ ][ ][ ]

5 Localización geográfica del hogar (UTM)
Coordenadas gerreferenciado (GPS) x [ ] y [ ]

6 Número de GPS [ ][ ][ ]

7 Orden del punto [ ][ ][ ] (referenciado en el GPS)

8 Dpto. ____________ 9 Distrito ____________

10 Localidad ____________

11 Dirección y N° ____________

12 Nombre del jefe de familia ____________

13 Edad del jefe de familia [ ][ ][ ] años

14 Sexo del jefe de familia
1 Mujer
6 Hombre

15 Nombre del entrevistado ____________

16 Teléfono del entrevistado ____________

17 Relación de parentesco del entrevistado con el jefe de familia
1 El entrevistado es el jefe de familia
2 Esposo/a o compañero/a del jefe de familia
3 Hijos/as , hijastros/as
4 Otros parientes
5 Otros no parientes

MÓDULO 1. Características socio-económicas

1.1. Total de personas en el hogar [ ][ ] (suma de hombres y mujeres)
1.2. Nº hombres [ ][ ]
1.3. Nº mujeres [ ][ ]
1.4. Menores a 18 años [ ][ ] (suma de hombres y mujeres)
1.5. 18 años y más [ ][ ] (suma de hombres y mujeres)

1.6. Nivel educativo máximo alcanzado por el jefe de familia
¿Hasta qué curso estudió?

		Grado
1	Sin instrucción	
2	EEB incompleta	
3	EEB completa	
4	Educación Media incompleto	
5	Educación Media completo	
6	Superior no universitario incompleto	
7	Superior no universitario completo	
8	Superior universitario incompleto	
9	Superior universitario completo	
10	No responde	

1.7. ¿Cuál es la principal ocupación económica del jefe de familia?
____

1.8. Si tiene, ¿cuál es la ocupación secundaria del jefe de familia?
____

1.9. En el trabajo principal el jefe de familia es...
1 Empleado/a sector público
2 Empleado/a sector privado
3 Obrero/a sector público
4 Obrero/a sector privado
5 Empleador/a o patrón/a
6 Trabajador/a por cuenta propia / independiente
7 Trabajador /a familiar no remunerado/a
8 Empleado/a domestico/a
9 Otro (especificar: ______________________)
10 Inactivo

1.10. ¿Cuenta con aves de corral? (Gallinas, pollos, pavos, patos)
1 Si
6 No (pasar P.1.12)

1.11. ¿Cuántos animales de estos tienen? [ ][ ][ ] unidades

1.12. ¿Cuenta con cabras, ovejas o caballos?
1 Si
6 No (pasar P.1.14)

1.13. ¿Cuántos animales de estos tienen? [ ][ ][ ] unidades

1.14. ¿Cuenta con chanchos?
1 Si
6 No (pasar P.1.16)

1.15. ¿Cuántos animales de estos tienen? [ ][ ][ ] u

1.16. ¿Cuenta con vacas, toros, bueyes o terneras?
1 Si
6 No (pasar P.1.18)

1.17. ¿Cuántas vacas, toros, bueyes o terneras tiene? [ ][ ][ ] unidades

1.18. ¿Tiene huerta (lechuga, cebolla, tomate, locote, otras verduras) en su vivienda?
1 Sí (pasar a P.1.24)
6 No

1.19. ¿Por qué no tiene huerta?
1 No tenemos espacio físico
2 No tenemos recursos económicos para mantener la huerta (es muy caro)
3 No hay personas que puedan atenderla
4 El agua es muy cara (regar es muy caro)
5 Otros (especificar ______________________)

1.20. ¿Cuál es el principal cultivo de su huerta? ____________

1.21. ¿Su huerta es principalmente para autoconsumo?
1 Sí
6 No

1.22. ¿Cuáles son las dimensiones de su huerta?
[ ][ ][ ] Metros en largo
[ ][ ][ ] Metros en ancho

1.23. ¿Qué tipo de regadío usa?
1 Agua de pozo
2 Río, arroyo o tajamal
3 De la red de SENASA
4 Otros (______________________)

1.24. ¿Tiene pileta en su hogar?
1 Sí
6 No (pasar a P.1.26)

1.25. ¿De qué tamaño es la pileta? [ ][ ][ ] m3

1.26. Ingresos promedios mensuales (TOTAL de todos los miembros)

Incluye salarios, rentas por alquiler, envío de familiares, ayudas del gobierno, etc.

1 Menos de 200.000
2 De 200.001 a 300.000
3 De 300.001 a 400.000
4 De 400.001 a 500.000
5 De 500.001 a 600.000
6 De 600.001 a 700.000
7 De 700.001 a 800.000
8 De 800.001 a 900.000
9 De 900.001 a 1.000.000
10 De 1.000.001 a 1.100.000
11 De 1.100.001 a 1.200.000
12 De 1.200.001 a 1.500.000
13 De 1.500.001 a 2.000.000
14 Más de 2.000.000
15 No responde

1.27. Egresos mensuales (por rangos) contando alimentos y servicios básicos (agua, luz, teléfono-celular). ¿Cuánto gasta al mes?

1	Menos de 200.000
2	De 200.001 a 300.000
3	De 300.001 a 400.000
4	De 400.001 a 500.000
5	De 500.001 a 600.000
6	De 600.001 a 700.000
7	De 700.001 a 800.000
8	De 800.001 a 900.000
9	De 900.001 a 1.000.000
10	De 1.000.001 a 1.100.000
11	De 1.100.001 a 1.200.000
12	De 1.200.001 a 1.500.000
13	De 1.500.001 a 2.000.000
14	Más de 2.000.000
15	No responde

1.28. ¿Participa el jefe de familia en la Junta de Saneamiento?

1 Sí (pase P.1.30.)

6 No

1.29. Si no participa en la Junta de Saneamiento, ¿por qué no lo hace?

____

____

____

1.30. ¿Participa el jefe de familia en otra organización en la comunidad?

1 Sí

6 No (pase P.1.32.)

1.31. ¿En cuál organización participa? (puede marcar más de una respuesta)

1	Junta de Saneamiento de Agua
2	Comisión de Escuela
3	Comisión de Iglesia
4	Comisión Campesina o asociación de productores
5	Club deportivo
6	Otra (Especificar: __________________)
7	No responde

1.32. ¿Cuál es el rol dentro de la organización donde participa?
(Si se elige más de una opción en la pregunta anterior, especificar entre el la institución la institución a la que se refiere)

1	Presidente/a	( )
2	Vicepresidente/a	( )
3	Tesorero/a	( )
4	Secretario/a	( )
5	Síndico/a	( )
6	Delegado	( )
7	Operador/técnico	( )
8	Miembro activo	( )
9	Otro (__________)	( )

1.33. Cuántos años hace que Ud. Y su flia. viven en esta comunidad?

[ ][ ] años

MÓDULO 2. Servicio de agua en el hogar

2.1. ¿Está conectado a la red de agua de la JS creada por SENASA?

1 Sí (pasar a P.2.15.)

6 No

Para hogares que NO reciben agua de la JS

2.2. ¿Recibió alguna vez servicio de agua de la Junta de Saneamiento?

1 Sí

6 No Pasar a P.2.5

2.3. ¿Por cuánto tiempo recibió el servicio de agua de la JS?

1	Por menos de un año
2	Un poco más de un año
3	Más de dos años
4	Otros (Especificar: __________________)

2.4. ¿Por qué ya no recibe el servicio de la Junta de Saneamiento?

1	Porque me proveo de otra fuente más barata
2	Es cara la tarifa y no podemos pagar
3	El sistema de la Junta dejó de funcionar
4	Mala calidad del servicio (olor, color, sabor, frecuencia)
5	Necesito más agua de la que SENASA me puede dar
6	Otros (Especificar: __________________)

2.5. ¿De dónde obtiene el agua para uso en la vivienda?

1	ESSAP
2	Red Privada
3	Comisiones Vecinales
4	Aguatero (sin cañería)
5	Pozo artesiano
6	Pozo con bomba
7	Pozo sin bomba
8	Arroyo, río, ykua o manantial
9	Otros (Especificar: __________________)

2.6. Cual es el medio de abastecimiento del agua que utiliza en la vivienda

1	Cañería fuera de la vivienda pero dentro del terreno
2	Cañería dentro de la vivienda
3	Canilla pública
4	Vecino
5	Aguatero (sin cañería)
6	Otros (Especificar: __________________)

2.7. ¿Cuánto paga por obtenerla?

1	No paga
2	Menos de 10 mil guaraníes
3	De 10 a 20 mil guaraníes
4	De 21 mil a 30 mil guaraníes
5	De 31 mil a 40 mil guaraníes
6	De 41 mil a 50 mil guaraníes
7	Más de 50 mil guaraníes
8	No sabe

2.8. Si paga ¿cuál es la frecuencia de pago?

1	No paga
2	Mensual
3	Trimestral
4	Semestral
5	Anual
6	Otros (Especificar: __________________)

2.9. Si extraen agua del pozo sin bomba ¿quién hace esa tarea? (con mayor frecuencia)

1	No se extrae agua de pozo sin bomba
2	Madre
3	Padre
4	Niño/niña menor de 18 años
5	Otro adulto mayor de 18 años

2.10. Si transportan el agua desde fuera de la propiedad, ¿quién lo hace con mayor frecuencia?

1	No transportan agua desde fuera de la propiedad
2	Madre
3	Padre
4	Niño/niña menor de 18 años
5	Otro adulto mayor de 18 años

2.11. ¿Cuántas veces al día van en busca del agua? Frecuencia

1	No van a buscar agua, la tienen o se la llevan a casa
2	Una vez al día
3	Dos veces al día
4	Tres veces al día
5	Más de tres veces al día

2.12. ¿Qué distancia camina (en metros) para acarrear el agua a su casa?

[ ][ ][ ][ ] metros

2.13. ¿Le gustaría tener acceso al agua corriente en su hogar?

1 Sí (Pasar a P.2.15)

6 No

2.14. En caso que no, ¿por qué?

- 1 No tiene cómo pagar
- 2 No quiere gastar su dinero en pago de agua
- 3 Tiene su propio pozo artesiano/bomba/sin bomba
- 4 Otros (Especificar: ______________________________)

(Para los no usuarios, que no tienen agua de la JS, fin de la entrevista)

Si recibe el servicio de la Junta de Saneamiento de SENASA

2.15. Normalmente la JS le provee agua al hogar ¿con que frecuencia?

- 1 Las 24 horas
- 2 Más de 12 horas diarias pero menos de 24 horas
- 3 Menos de 12 horas al día
- 4 Día de por medio
- 5 Otros (Especificar: ______________________________)

¿Cada cuanto tiempo hay corte del suministro de agua? (marcar con una cruz)

		2.16. en verano	2.17. en invierno
1	Casi cada día		
2	Cada tres días		
3	Cada semana		
4	Una vez por mes		
5	Casi nunca		
6	Nunca		

Cuando hay corte del servicio, ¿cuántos días suelen quedarse sin agua en su casa?

2.18. ☐☐ días en verano

2.19. ☐☐ días en invierno

2.20. ¿Cómo califica la presión del servicio de agua?

- 1 Mala
- 2 Regular
- 3 Buena

2.21. ¿Cómo califica la calidad del agua en cuanto al color (turbidez)?

- 1 Mala
- 2 Regular
- 3 Buena

2.22. ¿Cómo califica la calidad del agua en cuanto olor?

- 1 Mala
- 2 Regular
- 3 Buena

2.23. ¿Cómo califica la calidad del agua en cuanto al sabor?

- 1 Mala
- 2 Regular
- 3 Buena

2.24. ¿Tuvieron algún problema en los últimos 12 meses con el suministro de agua?

- 1 Sí
- 6 No (pase a P.2.27)

2.25. ¿Cuántas veces tuvieron problemas en los últimos 12 meses con la provisión de agua de la Junta de Saneamiento?

☐☐ veces

2.26. ¿Cuáles fueron los tres problemas más frecuentes? (marcar TRES máximo)

- 1 Rotura de caño
- 2 Motor descompuesto
- 3 Corte de energía eléctrica
- 4 No tiene suficiente presión
- 5 Agua turbia, con color marrón
- 6 Agua con olor desagradable
- 7 Agua con sabor extraño
- 8 Otros (Especificar: ______________________________)

2.27. ¿Existen en esta comunidad personas capacitadas para arreglar problemas de red de agua?

- 1 Sí
- 2 No
- 3 No sabe

2.28. Cuando se rompe una cañería en su casa, ¿cuánto tiempo tarda en arreglarla?

- 1 Un día o menos
- 2 Entre dos a tres días
- 3 Más de tres días
- 4 Semanas
- 5 Otros (Especificar: ______________________________)

2.29. ¿A quién acude cuándo tiene un problema técnico con el sistema de agua en su vivienda?

- 1 Plomero particular local
- 2 Mismo miembro del hogar intenta solucionar el problema
- 3 Vecinos que conocen de las instalaciones de agua
- 4 Junta de Saneamiento
- 5 Municipio
- 6 Otros (Especificar: ______________________________)

2.30. ¿A quién acude cuándo tiene un problema técnico con el sistema de agua en la calle?

- 1 Junta de Saneamiento
- 2 Vecinos
- 3 Plomero particular
- 4 SENASA
- 5 ERSSAN
- 6 Municipio
- 7 Gobernación
- 8 Políticos del pueblo
- 9 Otros (Especificar: ______________________________)

2.31. Cuando se rompe una cañería en la calle, fuera de su casa, ¿cuánto tiempo tarda en arreglarla?

- 1 Un día o menos
- 2 Entre dos a tres días
- 3 Más de tres días
- 4 Semanas
- 5 Otros (Especificar: ______________________________)

2.32. ¿Quién paga en caso que se requiera reparación/mantenimiento de la instalación fuera de su propiedad?

- 1 Junta de Saneamiento
- 2 Vivienda particular
- 3 Vecinos
- 4 SENASA
- 5 ERSSAN
- 6 Municipio
- 7 Gobernación
- 8 Políticos del pueblo
- 9 Otros (Especificar: ______________________________)
- 10 No sabe

2.33. ¿Tiene instalado un medidor de consumo de agua en su vivienda?

- 1 Sí
- 6 No (pasar a P.2.36)

2.34. ¿En qué año se instaló el medidor?

☐☐☐☐

2.35. ¿Cuánto pagó por la instalación del medidor? (si no pagó, indicar 0)

☐☐☐☐☐☐☐☐ Gs

2.36. ¿Ud. cree conveniente o estaría de acuerdo que tuviera instalación de medidores para controlar el consumo de Agua Potable y pagar sobre eso?

- 1 Sí (pasar a P.2.38.)
- 6 No

2.37. Si no está de acuerdo, ¿por qué?

____

____

____

____

____

____

2.38. Cuando paga por el servicio de agua, ¿recibe comprobante o factura?

- 1 Sí
- 6 No

2.39. ¿A quién paga por el consumo de agua?

- 1 Presidente/a de Junta de Saneamiento
- 2 Vicepresidente/a de Junta de Saneamiento
- 3 Secretario/a de la Junta de Saneamiento
- 4 Tesorero/a de Saneamiento
- 5 Persona designada por la CD de la JS
- 6 Otros (Especificar: ______________________)

2.40. ¿Dónde paga su factura/consumo de agua?

- 1 Vienen a cobrar en la casa
- 2 Usted va hasta el local de la JS a pagar
- 3 Usted va a la casa del tesorero de la JS a pagar
- 4 Otros (Especificar: ______________________)

2.41. ¿Cuál es la frecuencia de pago? Según lo establecido por la JS

- 1 Mensual
- 2 Trimestral
- 3 Semestral
- 4 Anual
- 5 Otros (Especificar: ________)

2.42. ¿Cuanto pagó de agua la última vez? |_|_|_|_|_|_|_| Gs.

2.43. ¿Hace cuánto que pagó su última factura?

- 1 Hace un mes
- 2 Hace tres meses
- 3 Hace seis meses
- 4 Hace un año
- 5 Más de un año
- 6 Otros (Especificar: ________)

2.44. ¿Cuál es su percepción sobre la tarifa que paga por el agua?

- 1 Baja
- 2 Regular
- 3 Suficiente
- 4 Alta
- 5 Muy alta

2.45. ¿Usted cree que lo que paga por la tarifa de agua es suficiente para cubrir los costos de administración, operación y mantenimiento del sistema de la JS?

- 1 Sí
- 2 No
- 3 No sabe
- 4 No responde

2.46. ¿Se paga por algún otro concepto a la Junta de Saneamiento?

- 1 Sí
- 6 No (Pasar a P. 2.48.)

2.47. ¿En concepto de qué pagan?

- 1 Mantenimiento
- 2 Reparación
- 3 Reconexión
- 4 Otros (Especificar: ______________________)

2.48. En los últimos 12 meses, ¿hicieron algún pago extra para reparaciones o compras o actidades especiales?

- 1 Sí
- 6 No No (Pasar a P. 2.50.)

2.49. ¿Para qué se hizo el pago extra?

____

____

____

2.50. ¿Cuándo fue el último aumento por el servicio de agua?

- 1 Este año
- 2 El año pasado
- 3 Hace más de dos años
- 4 Nunca (pasar a módulo 3)

2.51. ¿Por qué aumentó la tarifa de agua?

____

____

____

____

____

2.52. ¿Son comunicados por la CD de la JS cuando se va a aumentar la tarifa?

- 1 Sí
- 6 No

2.53. ¿Cuándo fue la última reunión con la JS?

- 1 Dentro de la semana
- 2 Dentro del mes
- 3 Este año
- 4 El año pasado
- 5 Nunca
- 6 No sabe, no recuerda

2.54. ¿Participó en la ultima reunión?

- 1 Sí (pasar a P.2.56.)
- 6 No

2.55. ¿Por qué no participó?

____

____

____

____

2.56. Cuántas personas participaron de la reunión la última vez |_|_|_|

MÓDULO 3. Valoración del servicio

3.1. ¿Está satisfecho con el servicio de agua que recibe?

- 1 Insatisfecho/a
- 2 Poco satisfecho/a
- 3 Satisfecho/a
- 4 Muy satisfecho/a

3.2. ¿Cómo podría mejorarse el sistema de agua?

- 1 Más horas al día de conexión
- 2 Mejor calidad de agua
- 3 Más mantenimiento del sistema
- 4 Mejores características del sistema (por ejemplo, mejores conexiones)
- 5 Menos costoso (tarifa más baja)
- 6 Más costoso para poder pagar mejor mantenimiento (más tarifa)
- 7 Mejor gestión por parte de la JS
- 8 Más comunicación de la JS con los usuarios
- 9 Otros (Especificar: ______________________)
- 10 Otros (Especificar: ______________________)

3.3. Usa el agua de la Junta de Saneamiento para beber?
- 1 Sí (pasar a P.3.5)
- 6 No ¿Por qué?

3.4. ______

3.5. Usa el agua de la Junta de Saneamiento para cocinar?
- 1 Sí (pasar a P.3.7)
- 6 No ¿Por qué?

3.6. ______

3.7. Usa el agua de la Junta de Saneamiento para el aseo personal?
- 1 Sí (pasar a P.3.9)
- 6 No ¿Por qué?

3.8. ______

3.9. Usa el agua de la JS para regar sus plantas?
- 1 Sí (pasar a P.3.11)
- 6 No ¿Por qué?

3.10. ______

3.11.Usa el agua de la JS para regar su huerta?
- 1 Sí (pasar a P.3.13)
- 2 A veces
- 3 No tiene huerta
- 4 No ¿Por qué?

3.12. ______

3.13.Usa el agua de la JS para regar sus plantaciones en la chacra?
- 1 Sí (pasar a P.3.15)
- 2 A veces
- 3 No tiene chacra
- 4 No ¿Por qué?

3.14. ______

3.15. Usa el agua de la JS para animales?
- 1 Sí (pasar a P.3.17)
- 2 A veces
- 3 No tiene animales
- 4 No ¿Por qué?

3.16. ______

3.17. El agua que utilizan los miembros de su hogar llega a través de...
- 1 Cañería dentro de la vivienda?
- 2 Cañería fuera de la vivienda, pero dentro del terreno?
- 3 Ambas (cañería dentro y fuera de la vivienda)

3.18. ¿El agua que recibe es suficiente para las actividades en las que la utiliza o ha de complementarla de otro lado?
- 1 Si es suficiente (Pasar a P. 3.13)
- 6 No es suficiente, he de conseguir agua de otro lado

3.19. En caso que no sea suficiente el agua que recibe, ¿de dónde se complementa?
- 1 ESSAP
- 2 Red Privada
- 3 Comisiones Vecinales
- 4 Aguatero (sin cañería)
- 5 Pozo artesiano
- 6 Pozo con bomba
- 7 Pozo sin bomba
- 8 Arroyo, río, ykua o manantial
- 9 Otros (Especificar: ______)
- 10 Otros (Especificar: ______)

3.20. ¿Cuánto pagó por el uso del agua complementaria el último mes?
Gs. ______

3.21. ¿Para qué usa el agua complementaria?
- Para beber
- Para cocinar
- Para aseo personal
- Para regar las plantas
- Para los animales
- Para la huerta o chacra
- Para la piscina
- Otros (Especificar: ______)

3.22. Si busca agua de otro lado, ¿cuántas veces al día va por el agua?
- 1 Una vez al día
- 2 Dos veces al día
- 3 Más de tres veces
- 4 Una vez a la semana
- 5 Otros (Especificar: ______)

3.23. ¿Qué distancia camina (en metros) para acarrear el agua complementaria a su casa?
______ metros

3.24. ¿Cómo califica la presión del servicio de agua en comparación al de la Junta de Saneamiento?
- 1 Mejor
- 2 Igual
- 3 Peor

3.25. ¿Cómo califica la turbidez (color) del agua en comparación al de la JS?
- 1 Mejor
- 2 Igual
- 3 Peor

3.26. Cómo califica el olor del agua en comparación al de la JS?
- 1 Mejor
- 2 Igual
- 3 Peor

3.27. Cómo califica el sabor del agua en comparación al de la JS?
- 1 Mejor
- 2 Igual
- 3 Peor

MÓDULO 4. Valoración de la gestión

4.1. ¿Cómo califica a la JS en cuento a cómo se gestiona? (miembros, reuniones, asambleas, etc.)
- 1 Mala
- 2 Regular
- 3 Buena

4.2. ¿Cómo califica a la JS en cuanto al mantenimiento del sistema?
- 1 Mala
- 2 Regular
- 3 Buena

4.3. ¿Cómo califica a la JS en cuanto a la atención al usuario? (cuendo hay problemas)
- 1 Mala
- 2 Regular
- 3 Buena

4.4. En general, ¿cómo valora a la JS?
De 1 como peor valoración al 10 como máxima valoración

1	2	3	4	5	6	7	8	9	10

4.5. ¿Ha sido miembro de la Comisión Directiva de la JS?
- 1 Sí (Pase a P.4.7.)
- 6 No

4.6. ¿Por qué no ha sido miembro de la JS?
- 1 No me interesa estar en la JS
- 2 No se me ha dado la oportunidad
- 3 Sólo hay personas relacionadas con la política
- 4 No tengo tiempo
- 5 Me postulé pero no me escogieron
- 6 Otros (Especificar: ______)
- 7 Otros (Especificar: ______)

4.7. ¿Qué rol cumplió?
- 1 Presidente/a
- 2 Vicepresidente/a
- 3 Secretario/a
- 4 Tesorero/a
- 5 Síndico/a
- 6 Otros

4.8. Periodo (De qué año a qué año)? año ______ al año ______

4.9. ¿Cómo cree que podría mejorar la JS de su comunidad?
- 1 Teniendo más fondos para hacer reparaciones
- 2 Que la gente esté más interesada y participe más en la JS
- 3 Que haya menos intereses políticos en la JS
- 4 Que SENASA dé más apoyo
- 5 Más capacitación para las personas de la JS
- 6 Otros (Especificar: ______)

4.10. ¿Cómo valora el servicio de agua potable de su comunidad?
De 1 como peor valoración al 10 como máxima valoración

1	2	3	4	5	6	7	8	9	10

4.11. ¿Ud. cree que el servicio de Agua Potable en esta comunidad como está actu va a durar y funcionar bien en los próximos años?
- 1 Sí
- 6 No

4.12. ¿Pagaría más por el servicio que recibe para asegurar que el sistema siga funcionando en los próximos años y a futuro?
- 1 Sí (pase a P. 4.14.)
- 6 No

MÓDULO 5. Vivienda

5.1. Condición de ocupacion del terreno donde está construida la vivienda
- 1 Propia o en condominio o heredada
- 2 Pagando en cuotas
- 3 Alquilada
- 4 Cedida
- 5 Ocupada de hecho
- 6 Otro (Especif. ____________________)

5.2. Tipo de techo
- 1 Teja
- 2 Paja
- 3 Fibrocemento (eternit), zinc
- 4 Tablilla de madera
- 5 Hormigón armado, loza o bovedilla
- 6 Tronco de palma
- 7 Cartón, hule, madera de embalaje
- 8 Otro (Especif. ____________________)

5.3. Tipo de pared
- 1 Estaqueo-Adobe
- 2 Madera
- 3 Ladrillo, bloque de cemento
- 4 Tronco de palma
- 5 Cartón, hule, madera de embalaje
- 6 Otro (especificar)
- 7 No tiene pared

5.4. Tipo de piso
- 1 Tierra
- 2 Madera
- 3 Ladrillo
- 4 Lecherada
- 5 Baldosa común
- 6 Mosaico, cerámica, granito
- 7 Parquet
- 8 Otro (Especif. ____________________)

5.5. ¿Tiene baño?
- 1 Sí
- 6 No (Pase a P.5.8.)

5.6. ¿El baño está dentro de su vivienda?
- 1 Sí
- 6 No

5.7. ¿Qué tipo de desagüe tiene su baño?
- 1 Con red de alcantarillado sanitario
- 2 Con cámara séptica y pozo ciego (absorbente)
- 3 Con pozo ciego (absorbente)
- 4 En la superficie de la tierra, hoyo abierto, zanja, arroyo
- 5 Letrina ventilada de hoyo seco (común con tubo de ventilación)
- 6 Letrina común de hoyo seco (con losa, techo, paredes y puertas)
- 7 Letrina común sin techo o puerta
- 8 Otro (Especif. ____________________)

5.8. ¿Cuenta con ducha?
- 1 Sí
- 6 No

5.9. ¿Cuenta con Energía eléctrica?
- 1 Sí
- 6 No (pase a Módulo 6)

5.10. ¿Cuánto pagó el último mes por la electricidad?

|_|_|_|_|_|_| Gs.

MÓDULO 6. Estado de Salud

6.1. Durante los ultimos 90 días, algún miembro de su familia tuvo...
- 1 Diarrea
- 2 Vómito
- 3 Diarrea y vómito
- 4 No, ninguno (pase a P.

6.2. ¿Consultó a algún médico, curandero, y/o algún profesional de la salud en el caso más
- 1 Si (Pase a P.6.4.)
- 6 No

6.3. ¿Por qué no consultó a algún profesional de la salud?
- 1 La dolencia no era grave
- 2 No hay atención cercana
- 3 La atención es mala
- 4 Las consultas son caras
- 5 Se automedicó
- 6 No tuvo tiempo
- 7 Otros (Especificar: ______________________________)

6.4. ¿Cuánto tuvo que gastar durante los últimos 90 días en medicamento, consulta, hospital, transporte, otro?

|_|_|_|_|_|_|_| Gs.

6.5. ¿Ha dejado de trabajar algún miembro de su hogar por dicho problema de salud en los últimos 90 días?
- 1 Sí
- 6 No (Pase a P.6.7)

6.6. ¿Cuántos días dejó de trabajar en los últimos 3 meses por dicho problema de salud?

|_|_| Días

6.7. ¿Ha dejado de ir a la escuela algún miembro de su familia por dicho problema de salud en los últimos 90 días?
- 1 Sí
- 6 No (Pase a P.6.9)

6.8. ¿Cuántos días dejó de ir a la escuela por dicho problema de salud en los últimos 90 días?

|_|_| Días

6.9. Ha muerto algún miembro del hogar por diarrea/vómito en los últimos 12 meses?
- 1 Sí
- 6 No

6.10. Cree Ud. beneficioso contar con agua de la JS
- 1 Sí (pase a P.6.12.)
- 6 No

6.11. En caso que no, Por qué?

____

____

____

Hábitos de limpieza en el hogar en las siguientes instalaciones

	Nivel de limpieza			
	Malo	Regular	Bueno	No aplica
6.12. Estado de la ducha	1	2	3	4
6.13. Estado del baño	1	2	3	4
6.14. Estado del recipiente para guardar agua destinada al consumo humano	1	2	3	4

MÓDULO 7. Capital social

Para complementar la encuesta hay algunas preguntas en relación a su comunidad

7.1. Cuando usted necesita ayuda con alguna cuestión relativa a su salud o la de su familia (p.e. alguien se enferma, necesita consejo), en general, ¿A quién recurre? (marcar las dos opciones mas frecuentes)
- 1 Familiares
- 2 Amigos
- 3 Vecinos
- 4 Políticos
- 5 Sacerdotes o pastores
- 6 Miembros de la comunidad
- 7 Prestamista
- 8 Cooperativas
- 9 Otros (Especificar: ______________________________)
- 10 No sabe

7.2. Cuando usted necesita que le presten un poco de dinero. ¿A quién recurre?
(marcar las dos opciones más frecuentes)

1	Familiares
2	Amigos
3	Vecinos
4	Políticos
5	Sacerdotes o pastores
6	Miembros de la comunidad
7	Prestamista
8	Cooperativas
9	Otros (Especificar: ______________________)
10	No sabe

7.3. ¿Cree que se puede confiar en lo que la gente de la comunidad dice?

1	Siempre
2	La mayoría de las veces
3	A veces
4	Nunca

7.4. En los últimos años, ¿Se han mudado a vivir aquí muchas personas? o ¿Se han ido otras?

1	Sí, hay mucho movimiento de personas
2	No, somos los mismos hace muchos años
3	Otros (Especificar: ______________________)

7.5. ¿Si surge alguna necesidad en la comunidad, se realizan actividades para ayudar?

1	Sí
6	No

8.1. Firma del encuestador ______________________

8.2. Nombre del encuestador ______________________

8.3. Firma del Supervisor ______________________

8.4. Nombre del Supervisor

7.6. ¿Quiénes participan en estas actividades?
(Marcar las dos opciones más frecuentes)

1	Los familiares de la persona que necesita ayuda
2	Los vecinos de la persona que necesita ayuda
3	La iglesia
4	Los líderes de la comunidad
5	Las instituciones
6	Toda la comunidad

7.7. Actualmente, ¿con qué asoc. o comisiones participa voluntariamente? (marcar 2)

1	Asociación de agricultores
2	Asociación de negociantes
3	Club deportivo
4	Asociación de la iglesia
5	Asociación de jóvenes
6	Otros (Especificar: ______________________)
7	Otros (Especificar: ______________________)

7.8. ¿Qué rol cumple en estas asociaciones y comisiones?

1	Como miembro de la comisión o asociación
2	Como asesor de la comisión o asociación
3	No participa
4	No responde

7.9. Por favor, anotar otros comentarios

____

Figure 42. Questionnaires – Follow-up Survey – Systems

Universidad Católica "Nuestra Señora de la Asunción"

Instituto Desarrollo

centro de tecnología apropiada
Facultad de Ciencias y Tecnología
Universidad Católica "Nuestra Señora de la Asunción"

Estudio de sostenibilidad de las intervenciones del BID en el Suministro de agua potable en comunidades rurales de Paraguay
FICHA DE REVISION TECNICA
A realizar al operador o técnico de la Junta de Saneamiento

Buenos días/tardes. Mi nombre es ______________________ y vengo del Instituto de Desarrollo. Estamos realizando un estudio sobre la sostenibilidad de las intervenciones de SENASA en agua potable con comunidades rurales. Su comunidad participó del proyecto del BID, con el que se construyó el sistema de agua potable. Nos gustaría realizar una breve revisión técnica del equipo que se contruyó (tanque, caseta, etc.) y hacerle unas preguntas sobre su funcionamiento. Al final de la revisión, con su permiso, haremos algunas fotos generales al sistema. Muchas gracias por su colaboración.

A. PERSONA ENCUESTADA

1 Nombre: ______________________
2 Cargo en la JS: ______________________
3 Profesión: ______________________
4 Teléfono: ______________________

B. LOCALIZACIÓN DEL SISTEMA DE AGUA

5 Localización
x
y

6 **Número de GPS**
7 **Orden del archivo en el GPS**

C. FUENTE DE AGUA

8 Fuente de agua o tipo de pozo (marcar 1 o varias)
1 Río, arroyo
2 Pozo excavado (somero, común)
3 Pozo tubular profundo (arteriano)
4 Recarga artificial (aljibe, agua de lluvia, tajamares, etc)
5 Otro. Especificar: ______________________

9 Cantidad fuentes o de pozos
unidades

10 Accesibilidad al pozo/fuente de agua
¿Se llega fácilmente?¿Es accesible?

1	Si	(pasar a P.12)
6	No	

11 Si no, ¿cuáles son los principales problemas?
____

12 Todas las fuentes de agua se utilizan

1	Si
6	No

13 Se observan deterioros o contaminación de la fuente de agua?

1	Si
6	No

Observaciones
____

D. TANQUE

14 Cantidad de tanques
unidades

15 Tipo de tanque principal
1 Fibra de vidrio
2 Mampostería (ladrillo)
3 Hormigón Armado
4 Metálico
5 Otro. Especificar: ______________________

16 Capacidad del tanque principal
(Encuestador: atento a las unidades de medida)
litros

17 Estado del tanque
(fisuras, vegetación, etc)

1	Bueno
2	Regular
3	Malo

Observaciones
____

E. CASETA
(donde está la bomba, sistema de cloración, tablero, etc.)

18 Cantidad de casetas unidades

19 Estado de la caseta
(Puerta, ventana, techo, instalación, etc.)

1	Bueno
2	Regular
3	Malo

Observaciones
____

F. TANQUE DE CLORACIÓN

20 ¿Tiene tanque de cloración?
1 Sí
2 No (pasar a P.24)

21 Tipo de tanque de cloración
1 Fibra de vidrio
2 Mampostería
3 Hormigón Armado
4 Otro (especificar)
5 No tiene

22 ¿Se utiliza el sistema de cloración?
1 Sí
2 No
3 A veces ______
6 No sabe

23 Estado del tanque de cloración (tapa, fisura...)
1 Bueno
2 Regular
3 Malo
6 No tiene tanque
Observaciones
______
______
______

G. CERCADO PERIMETRAL

24 ¿Tienen cercado perimetral

	Dónde	Si	No
1	en el pozo?	1	6
2	en la caseta?	1	6
3	en el tanque?	1	6

25 Estado del cercado perimetral en general
(roturas, daños, etc.)
1 Bueno
2 Regular
3 Malo
Observaciones
______
______
______

H. BOMBA PARA LA IMPULSIÓN DE AGUA

26 Número de bombas que usan para impulsión de agua
☐☐ unidades

27 Número de bombas de reserva
☐☐ unidades

28 ¿La bomba tiene potencia suficiente para suministrar agua a todos los conectados con una presión adecuada?
1 Sí
2 No
3 A veces ______
Observaciones
______
______
______

I. SISTEMA ELÉCTRICO

29 Tipo de extensión eléctrica
1 Monofásica
6 Trifásica

30 ¿Tiene transformador de la extensión eléctrica?
1 Si
2 No
6 No sabe

31 ¿Tiene tablero eléctrico?
1 Si
2 No (pasar a P.33)

32 Estado del tablero eléctrico
(cables sueltos, suciedad, etc.)
1 Bueno
2 Regular
3 Malo
Observaciones
______
______
______

J. SISTEMA DE DISTRIBUCIÓN

33 Metros lineales de cañerías de la red de distribución
(si no sabe, indicar todo ceros)
☐☐☐☐☐ **metros**

34 ¿Se tienen llaves zonales para sectorizar el sistema?
1 Si
6 No

35 ¿Las llaves funcionan correctamente para sectorizar? (para manejar fugas periódicas)
1 Si
6 No
Observaciones
______
______
______

36 ¿Existen pérdidas visibles en las principales cañerías?

	Sí	No
1 Sistema de conducción (entra al tanque)	1	6
2 Sistema de aducción (sale del tanque)	1	6
3 Otras fugas ______	1	6

K. PREDIO

37 Estado del predio en general
(limpieza, escombros, etc.)
1 Bueno
2 Regular
3 Malo

Observaciones
______
______
______

L. FOTOS DE LA REVISIÓN TÉCNICA

38 Camara N°
☐☐

39 Orden de fotos

1	General del sistema			
2	General del sistema			
3	Fuente de agua			
4	Tanque			
5	Caseta			
6	Tablero			
7	Tanque de cloración			
8	Pérdidas del sistema			
9	Otros			
10	Otros			

Nota: no es necesario tomar TODAS las fotos. Indicar sólo las que se tomaron en la visita. Si no se tomaron, dejar en blanco

M. OBSERVACIONES GENERALES

40 Anotar comentarios generales sobre la revisión técnica, si existe algo que destacar
______
______
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______
______
______
______
______
______

41 Firma del encuestador ______

42 Nombre del encuestador ______

43 Firma del Supervisor ______

44 Nombre del Supervisor ______