37th WEDC International Conference, Hanoi, Vietnam, 2014

SUSTAINABLE WATER AND SANITATION SERVICES
FOR ALL IN A FAST CHANGING WORLD

Factors impacting sustainability in rural drinking-water: an integrated approach in Paraguay

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BRIEFING PAPER 1873

The research assesses the sustainability of a program intervention in drinking-water supply in 100 rural communities in Paraguay and identifies the main factors and good practices that could correlate with higher levels of sustainability for drinking-water supply systems. The research includes an integrated assessment of the technical systems, the governance of the community-based provider, and the user's participation. A total of 100 drinking-water systems built between 2006 and 2010 were technically and operationally revised. Surveys were conducted to 100 community-based sanitation boards (SB) and 450 beneficiary households, using systematic random sampling in 30 rural communities. Preliminary results suggest that participation of the users, the institutional capacity of the SB, the external support of a public institution – as SENASA in this case - and the reinforcement of maintenance activities seem to be key aspects to keep sustainability in rural water systems in the medium and long term.

Introduction

In the last two decades, Latin America and the Caribbean (LAC) have done a significant progress to expand drinking-water access. By the end of 2011, 92% of the population in LAC had access to an improved drinking-water source by having the highest rate on piped-water supply on premises (88%) than any other region in the world (WHO/UNICEF, 2013). Actually, LAC has already met the Millennium Development Goal target for water access for 2015. In this effort, the Official Development Assistance (ODA) has had an important role by investing in water infrastructure and social programs to provide drinking-water to underserved populations. The ODA total amount to support drinking-water programs in LAC increased to over US$618 million in 2010, 30% targeted to rural areas. The Interamerican Development Bank (IDB) is the main contributor in the region, providing more than US$3 billion loans for water programs from 2007 to 2013.

Nevertheless these figures mask important inequalities both geographically and income-related. Access to drinking-water remains insufficient and quality of the service is unsatisfactory particularly in rural areas and for the urban-poor. More than 30 million inhabitants in LAC rural areas still do not have access to an improved drinking-water source. Paraguay reveals one the lowest levels of rural drinking-water coverage with 65% of its rural population drinking water from unprotected wells, unprotected springs, or surface water. The negative impact of this situation in the communities' health conditions has been extensively demonstrated in the literature.

Low sustainability of the water systems jeopardizes the successful results of international interventions to increase access to drinking-water, especially in rural communities. Sustainability, understood as the long term maintenance of the water systems regarding quality of the service at technical, financial, and operational levels, is still a challenge. Several studies across the region show that up to 70% of rural drinking-water systems built stopped working properly a few years after the project completion (Madrigal, 2011; Smits et al, 2012; SNV, 2012; Villacorta, 2004). In addition, in cases where rural supply systems still work, many are in disrepair, do not function properly, or the service is not sufficient for all the community served.

Sustainability of drinking-water services is a multidimensional subject that depends on several factors. Resource quality and availability, technical adequacy of the systems, community's ownership of the project, governance of the management institutions, financial capability of the community, access to financials subsidies, among others, are some of the factors hindering long term sustainability in rural water-drinking systems. Sustainability is compromised when the effectiveness of one or several of these factors fails, or they cease to even exist (Jansz, 2011).

Rural areas have specific limitations to achieve economies of scale to maintain and sustain water supply systems, to raise the capital needed for water infrastructure, and to manage the operation and maintenance of the water system (Da Silva et al, 2012). Community isolation, small size of the communities, limited access to new technologies and to financing resources, low technical and managerial capacities of the operators, or lack of supervision and support from public institutions, increase the cost and restricts sustainability (Smith, 2011). The vast array of providers of drinking-water in rural areas has increased the coverage, although their inclusion in a commonly fragmented water regulatory framework is still a challenge.

In Paraguay, since 1972, the management of water supply in rural areas has been the responsibility of the communities through community-based organizations named sanitation boards, created to involve communities in the design, execution, and management of the water and sanitation local systems. Since then, they have had a key role to keep sustainability of the drinking-water systems and to create incentives to community ownership and participation.

The objective of this research is to measure sustainability in 100 water supply systems that were part of a program for drinking-water supply and to identify factors and good practices that could correlate with higher levels of sustainability of built drinking-water supply systems in rural areas. This paper summarizes the results of a survey of 100 sanitation boards and 450 beneficiary households of the Drinking Water Supply and Sanitation in Small Communities program in Paraguay financed by the Interamerican Development Bank. This analysis provides an integrated perspective of sustainability for drinking-water programs considering preliminary results focused mainly on the technical factors of the system, the governance of the provider, and the participation and perception of the final user.

Drinking water supply in rural Paraguay

Paraguay is one of the countries in LAC region with the lowest access to improved water with more than 1.7 million people in rural areas with no access (UN, 2012). The lack of access to drinking-water impacts the already high levels of poverty - more than 35% of Paraguayans live under poverty conditions in rural areas – and worsens community health conditions (WHO/UNICEF, 2004).

The water sector in Paraguay presents distinctive characteristics among other countries in the region. First, Paraguay is one of the countries with more water resources available, with good physicochemical quality but unequal distribution in its territory. The management of the drinking-water supply is decentralized and there are multiple public, private, and community-based operators, especially in rural areas. The fragmentation of supply operators is a challenge in terms of regulation and supervision but also an opportunity to develop the sector and expand service in remote areas and for the poorest. In 2010 there were 2,400 community-based sanitation boards that served 3.2 million inhabitants and almost 1,000 other operators in the country.

In 2000, Paraguay introduced changes to the water sector organizational structure. The Government established the Sanitation Services Company of Paraguay (ESSAP) as the operator in urban centres with more than 10,000 inhabitants. The National Environment Sanitation Service (SENASA) was reinforced as the provider of drinking-water in rural areas and small urban communities. SENASA supports the creation of community-based organizations to deliver and manage drinking-water services in rural areas, named sanitation boards (*juntas de saneamiento*). The sanitation boards (SB) are entities under private law whose members are elected by the community, and have to agree with SENASA to decide the type of system that should be built and the funding scheme and service rates that should be pay by consumers (IDB, 2009). This service management model has been promoted in Paraguay since the seventies. The World Bank and the Interamerican Development Bank have since then financed several projects led by the government for water and sanitation supply in rural areas under this framework with successful results in terms of increasing the coverage and strengthening the SB.

Although there have been significant improvements in coverage, sustainability remains a challenge. SENASA identifies ownership and the technical capacity of the sanitation board as some of the key factors for full sustainability of rural services. Another important challenge is linked to the capacity of agglomeration that the sanitation boards have to be able to build economies of scale to mobilize greater

investment, to pool resources together to share fixed costs (as technical assessment, training, equipment purchases related to maintenance), and to improve research on technology adapted to the needs and conditions of the users, among others.

The project

In 2001 the Interamerican Development Bank financed the Drinking Water Supply and Sanitation in Small Communities program in Paraguay. Funded with US$12 million, the program was executed by SENASA. The objective of the program was to improve sanitary conditions in rural communities through the adequate provision of drinking-water supply and sanitation services. The program financed the construction of water systems and sanitation facilities in 100 rural communities and 10 indigenous communities, and it also strengthened the provision of services of the SB and the SENASA. This research paper is limited to the rural drinking-water supply component.

At project completion in 2010, 100 water supply facilities had been provided to 100 rural villages to serve an estimated of 57,700 beneficiaries. All of them are managed through a SB. The project completion report noted limitations in 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 in the long-term the quality of the system at technical, financial and operational levels was also brought up as a constraint for the sustainability of the program.

Materials and methods

Study area

The research was conducted in 100 rural communities, located in 50 Districts in eastern Paraguay. All the rural communities were beneficiaries of the Drinking Water Supply and Sanitation in Small Communities program and none of them had piped-service before the program implementation. Drinking-water systems were built between 2006 and 2010. All the drinking-water systems built are managed by a SB that was already in place or created through the same program.

Previous information

This research benefits from studies prepared during the program implementation and at completion stage. Information linked to the program design was available, in particular documents about operation manuals. During the preparation, execution, and completion of the project, the execution agency conducted several surveys and created a baseline, a midterm and final evaluations. The level of detail in each case was different, and some of the information was missing or recorded in an inappropriate format to be compared over time. Information available through surveys includes: i) baseline survey conducted in 2004 at community level in the 100 rural communities beneficiaries of the program (8,931 households); ii) midterm survey, conducted in 2008 in 30 SB and 30 communities, focused in SB' governance and at household level (149 households); and iii) completion program survey, conducted in 2010 to 100 SB and 100 rural communities (8,570 households), and focused in SB' governance and users' perception of drinking-water systems built. Evidence collected is related to socioeconomic characteristics of the community households, drinking-water supply characteristics, and regulation and operational characteristics of the SB. In the midterm and final evaluation a technical and operational assessment of the drinking-water systems was also conducted.

Methodology

The research used a combination of qualitative and quantitative data collection and analysis methods. The research reviewed existing secondary data through an exhaustive literature review about sustainability and rural drinking-water supply in LAC. Structured interviews were conducted to key informants at the IDB, who were involved in the design, implementation, and evaluation of the program, as well as to technicians of SENASA, sanitation boards, and associations of SB in Paraguay. These interviews were focused on institution governance, financial and managerial constraints, economies of scale opportunities, and service quality perception.

Drinking-water systems were technically and operationally checked through a questionnaire answered by the technical personnel of the SB and verified in situ by engineers from the research team. The main features

checked for the 100 drinking-water systems were related to the maintenance of the system and to the basic operational features such as pressure and flow.

Two different surveys were conducted, for the 100 SB in the 100 rural communities beneficiaries of the program, and a sample of 450 household beneficiaries. For the SB, chief and technical personnel were surveyed in their own premises. Data and information requested in the survey were primarily focused on organizational, financial, and operational characteristics of the SB as a proxy of governance and community participation factors impacting sustainability.

The research selected 30 rural communities to conduct household surveys to user beneficiaries of the program. The 30 communities selected are the ones that were surveyed in the midterm evaluation in 2008. A total of 450 households' beneficiaries were selected through a pseudo-random statistic process. The survey was conducted to the head of the household. The information requested added a section of user's assessment on SB and questions about social capital to address some of the hypothesis defined in the research.

The analysis of survey data includes a review of the main descriptive statistics of the main variables in order to characterize the sample and the population. Regression analysis is conducted to estimate the conditional expectations of technical sustainability based on multiple covariates representing governance and community ownership, financial characteristics, and basic community demographics. Whenever possible, methods to correct for reverse causality or endogeneity will be applied (e.g. Instrumental Variables, Quasi Experimental Approach).

Results and discussion

In the first stage of the survey, completed in 2004 before the water systems were built, 8,931 households in 100 rural communities representing 41,829 people were surveyed. Of the population interviewed 76% reported to get water from a dug well and 21% fetched water from other sources, primarily from a neighbor well (59%), from a spring, stream or river (32%) or from a public well (9%). Only 2% of people indicated they had access to piped-water. About 90% of the interviewees reported to want piped-drinking water, although just 35% stated to prefer water within premises and the rest agreed to just have the service in the patio. Only a 4% of the households did not approve the proposal of a new water system.

Between 2006 and 2010 water systems were built in 100 rural communities. In 2008 a midterm survey was conducted in 30 communities (96% already with access to the new water system). Almost 99% of the users agreed with the decisions that the SB made during the project planning, although 67% agreed with the tariff. The remaining 33% pointed that the tariff was insufficient to cover expenses. However, only 65% were willing to pay more to cover operational and maintenance expenses. Regarding sustainability of the system, 20% of the population didn't believe that the system, as then, would last in the medium term, as some of the infrastructure (pump, pipes) was already not working properly. Water service worked in 91% of the households for 24h, and quality of service and resource (pressure, smell, taste) was considered good for almost the whole surveyed population. Finally, 35% of the users did not agree with the incorporation of a meter system, as it would increase their bills. Almost 20% of the users did not answer and nearly 32% agreed, as they believed it was a fairer system.

In 2010, after the project completion, 8,570 households were surveyed in the 100 communities representing 37,479 people covered by the project. Although all these households had access to the new water system built, only 57% of the population was connected (Figure 1). More than 30% of the population still obtained water from a dug well inside their premises and 13% fetched water from other sources (52% from a neighbor dug well, 39% from a spring, stream or river and 9% from a public well). The analysis showed no links between type of water source and family income, being the choice more linked to the access to a dug well within the premises. In 2010 almost 100% of people approved the new water system although contrary to 2004 - but also logically after the system was already built -, just 4% reported to prefer the water source in the patio instead of within the house (96%).

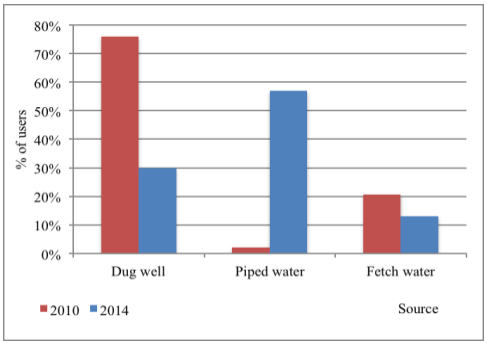

Figure 1. Type of source

In 2014 a follow-up survey was conducted to the 30 communities surveyed in the midterm evaluation. Preliminary results indicate that 70% of the sample is satisfied with the service, although almost half of the interviewees (46%) pointed water shut-offs almost daily during the summer (in winter, the percentage

decreases to 18%). Being conducted in winter season – May/June – the perception of the interviewee could be biased as the systems work better during that period. Preliminary results show a slight correlation between users' assessment of the service and level of default of payment, although more analysis is still needed. The main problems reported were the pump breaks - linked to problems with the energy service (frequent cut-offs) – and water pipes break. This situation is reflected in 29% of the users accounting problems with water pressure. Although 75% of the households pointed that tariffs were enough to keep the service, 86% also would be willing to pay more. According to users, the main actions needed to improve the system were having the system functioning more hours per day and improving its maintenance, closely related needs. The general valuation of the SB is quite positive (68% answers 7 points or more out of 10), noting down a more active participation of the community as the main factor to improve SB management, follow by more training for the SB employees and more income to be able to better maintain the system.

Only 18% of the SB did not have users with default of payments in 2010, percentage that drops to 7% in 2014. Income analysis didn't show any correlation between level of income and default of payment. Preliminary results revealed that total percentage of users with default of payments was higher in 2014 (93%) than 2010 (82%). In 2010, 16% of the SB has from 11 to 20% payment defaults, 16% of SB with 21 to 30%, and finally 15% with more than 31% of people with default of payment (4 SB have more than 50% of their users without paying fees). In 2014 these numbers worsened, with almost 40% of users with more than 31% of default of payment (Figure 2). Preliminary data show that default of payment is slightly inversely linked with willingness to pay, with communities with higher percentage of default of payment less willing to pay more for the water service. However, half of the SB with saving funds (almost 50% of the total SB interviewed) confirms that saving funds have increased in the last year, while just 29% indicates that amount of these funds have dropped.

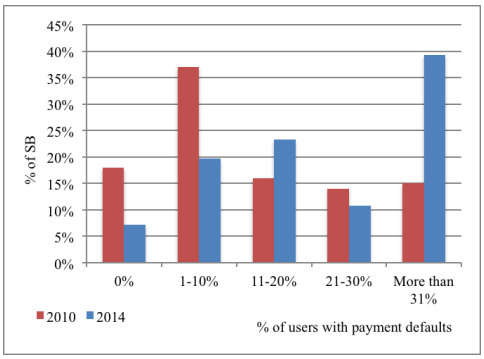

Figure 2. Default of payment in SB, 2004-2008

In 2010 only the SB with less than 20% of people with default of payments (9%) were part of an association of SB. In 2014 the number of SB that joined an association of SB increased to 21%. The involvement of a SB in an association of SB may allow achieving economies of scale, sharing resources (technical assessment, equipment, purchases) or mobilize greater investment.

Asking about the main difficulties to manage efficiently the system, in 2010 80% of the SB that reported no difficulties were the ones with none or less than 5% defaults of payment. Difficulties with the electric systems (tension drop, cuts, etc.) was the most common problem (41%), accounting more than 40% of the answers in SB with default of payment higher than 31% and SB with default of payment between 1-10%. Breaks of pipes and lack of extra motor follow with 9% of the answers, respectively. Other problems were related with quality of the resource (bad smell, taste) (8%), quality of the construction (7%) and motor breaks (6%) often related with tension drops. Also a 6% of the SB interviewed underlined in 2010 management problems inside the SB as the main difficulties. Asked for the same question in 2014, preliminary data suggest that the two main problems to keep the system working properly were the break of water pipes (43%) and pump breaks (28%), linked with power outrages. These results from SB agree with users' responses that underlined having the system functioning more hours per day and improving its maintenance, as the main needs. This lack of maintenance seems to be one of the main reasons to limit the expansion of the system. Almost half of the SB report in 2014 to be unable to connect more users, despite the existing demand. The survey also reports the technical support from SENASA (40%) and financial support from SENASA or other organizations (25%) as the main needs to guarantee sustainability of the systems.

Concluding remarks

Sustainability is a complex concept that entails interrelated factors: environmental, social, technical, institutional and economic. The results of the study underline this complexity and present some interesting correlations among some of these factors. Preliminary results suggest that participation of the users, institutional capacity of the SB, external support of a public institution – as SENASA in this case - and reinforcement of maintenance activities seem to be key aspects to keep sustainability in rural water

systems in the medium and long term. Furthermore, preliminary data show that income does not have a clear correlation with other factors affecting sustainability of the systems, as type of source, level of default of payment of the communities, existence of a discretionary income for the SB or appreciation of the system.

This exercise can be extrapolated to other rural areas in LAC and help in the design and implementation of programs to foster factors affecting sustainability. Deeper analysis and more applied studies are needed to understand links among different factors – social, technical, institutional and economic – affecting sustainability in rural water systems. The role of external support, - as associations of SB - and public institutions – as SENASA – to reinforce the institutional and technical capacity of SB need more inquiry and testing.

Acknowledgements

The authors would like to extend thanks to the Office of Evaluation and Oversight of the Interamerican Development Bank, which financed the study, especially to Juan Manuel Puerta who contributed with accurate comments to this paper. The authors would also like to thank Dr. David Sauri and the PhD Program of Environmental Science and Technology of the Autonomous University of Barcelona for the support and comments to the paper.

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