Latin America and Caribbean Urban and Water Unit
World Bank

IMPACT EVALUATION REPORT

Evaluating the Impacts of Access and Sustainability of Potable Water Projects: Water Access to Rural Communities in Paraguay

February 2012

1. INTRODUCTION

1.1 Water Access and Development

The Millennium Development Goals declared by the United Nations uphold sustainable and equitable access to safe water, adequate sanitation, and hygiene as recognized priorities for development, poverty reduction, and health promotion. Inadequate water supply and sanitation services however remain a major challenge for billions of poor people in the developing world. In 2004, out of every ten people, almost two had no access to safe water supply, and four had inadequate sanitation.[1] Inadequate water supply and sanitation affects several human development outcomes and children are particularly vulnerable to the use of unsafe water and sanitation.

Child morbidity and mortality rates associated with waterborne diseases in Latin America are particularly high by global comparison; in rural areas, inadequate sanitation, and wastewater disposal systems have contributed to the degradation of groundwater, rivers, and affect rural incomes whereas in urban areas, poor sanitation results in increased prevalence of water-related infections and parasitic diseases. Additionally, in families without water connections, a significant amount of time and physical effort in fetching water is devoted by women and children. Poor sanitation, lack of access to clean water, and inadequate personal hygiene are responsible for an estimated 90 percent of childhood diarrhea according to the World Health Organization (WHO). While the promotion of hand-washing reduces diarrhea (and water-based hygiene reduces diseases in general), it works best when it is part of a package of *behavior-change* interventions. However, the improvement in water supply and sanitation (WSS) and its effects on child and adult mortality - the required behavior-change being complex - have not been adequately analyzed or demonstrated. The expected impacts of such programs range from improving access and quality of services to improvements in health, nutrition, social and gender inclusion, education, as well as income generation and consumption.

Nevertheless, there are currently few rigorous scientific impact evaluation studies showing the effectiveness of WSS policies in delivering the desired outcomes.

1.2 Paraguay: Country Context

Paraguay is a middle-income country with a rapidly growing population. The fast pace of population growth (2.2 percent per year) presents a significant challenge to the provision of water and sanitation services, especially for rural areas[2] where 42 percent of the population lives. While over 80 percent of the population in urban areas is served by a network water connection, only 35 percent have similar access in rural areas. Adequate wastewater treatment is practically nonexistent. As in most developing countries, the poor in Paraguay are disproportionately affected by the lack of access to water and sanitation services; children are particularly vulnerable to the use of unsafe water and sanitation and this is reflected in the statistics since child morbidity and mortality rates associated with waterborne diseases in Paraguay are above the regional average[3]. In rural areas, inadequate sanitation and wastewater disposal systems contribute to the degradation of groundwater, rivers, and affect rural incomes. In urban areas, poor sanitation results in increased prevalence of water-related infections and parasitic diseases.

[1] The World Bank Group Program for Water and Sanitation, 2005.

[2] Rural areas in Paraguay include small towns with population of less than 10,000 inhabitants. Urban centers are defined as those with a population over 10,000 inhabitants.

[3] In 2005, 70 percent of deaths reported in children under five years of age in Paraguay was due to diarrhea, according to the World Health Organization.

1.3 Modernization Measures

Paraguay's Rural Water Supply and Sanitation Program has developed innovative mechanisms for the provision of water (– with anecdotal evidence of success). For more than 30 years, the program has been promoting and supporting sustainable access to water services in rural areas through the creation of community-based sanitation boards, the *Juntas de Saneamiento*. The World Bank (WB) and the Inter American Development Bank (IADB), in partnership with the Government of Paraguay (GoP), financed several phases of this program, and are committed to continuing to finance future ones. The comprehensive 'Water and Sanitation Sector Modernization Project' (US$60 million) was a scaling-up of this program which subsequently incorporated not only rural but also urban water and sanitation investments, support for improving sector governance, as well as planning and policy making. The National Environmental Sanitation Service, *Servicio National de Salud Ambiental* (SENASA), is the branch of the Ministry of Health of Paraguay responsible of the provision of water services through this project in rural areas.

The World Bank and the IADB, together with SENASA, aim to implement a rigorous evaluation for understanding the impacts of the water access to rural communities in Paraguay; and in the process, by establishing a strong correlation between water sanitation and health indicators, help strengthen the objective and the resolve of the government in providing access to water service in rural Paraguay.

2. PROJECT EVALUATION BACKGROUND

2.1 Rationale and Objectives

The Government and the multilateral agencies recognized the need for undertaking an impact evaluation exercise that will help to improve the program design, ultimately leading to more effective implementations in the future. A formal impact evaluation of the Rural WSS program in Paraguay is aimed to address a number of objectives:

i) Precisely measure and document the impacts of the program;
ii) Help improve the design and efficiency of the program; and
iii) Contribute to the literature on formal evaluation of WSS policies.

2.2 Team and Timeline

The Impact Evaluation team will be led by Luis Andres and Darwin Marcelo from the World Bank, with collaboration of the World Bank and the IADB project teams consisting of Miguel Vargas (Task Team Lead – TTL – of the WB project) and Klebber Machado (TTL of the IADB project). Additionally, members of the GoP, who had earlier participated in an Impact Evaluation Workshop in Buenos Aires in 2006 organized by the World Bank, are already familiar with the methodologies and have committed their support for this initiative; academics, local supervisors and other consultants will be engaged where necessary. The team will also include Sergio Urzúa (Department of Economics, Northwestern University) and Sebastian Galiani (Department of Economics, Washington University in Saint Louis) as external technical advisors.

The main source of funding was the SIEF (Spanish Impact Evaluation Trust Fund). The project has already received funding for the implementation of this evaluation from the Bank-Netherlands Water

Partnership Program in Water Supply and Sanitation. Finally, the World Bank and the IADB projects will commit budget to cost-sharing this evaluation.

The process of data collection through a baseline survey/fieldwork began in September 2010. The first follow-up to the survey will be held in Fall 2013 after results from the preliminary assessment are disseminated. The second follow-up is scheduled for Fall 2015 while the final evaluation and dissemination will be held at the end of 2015 itself.

2.3 Research Questions

The impact evaluation exercise on Paraguay's Rural Water Supply and Sanitation Program covers the following questions:

- **What has been the impact of the Water Boards, and through them, the impact from the provision of clean water and sanitation?**

- **How sustainable is the water and sanitation supply that has been established through this system of water provision?**

The first research question concerns the water boards and addresses the health impacts, particularly in children, and the time-allocation of adults and children devoted to accessing clean water. The main indicators here regarding health would be those related with diarrheal illnesses and child morbidity (which in 70 percent of the cases is caused by diarrheal illnesses in poor rural areas). The variables however go beyond health and time allocation; the team will also analyze children's development, household income, and user satisfaction from the water service.

The second question, sustainability of the water system, concerns the principal (and perhaps, simplest) indicator regarding sustainability: the presence of clean water coming out from the taps and pumps built during the first treatment. This indicator is simple yet pragmatic; in order for the water to flow through the taps and pipelines, periodic repairs and upkeep is necessary. The Impact Evaluation study seeks to identify and measure the causal relationship between the access to potable water to rural communities and a set of outcomes as shown in *Table A*. In the very short term, the access to potable water is expected to reduce child morbidity and diarrheal illnesses and to improve the time allocation of adults and children.

Above all, the impact evaluation study seeks to understand if – and, to what extent – the implementation of the Rural WSS Program actually led to better outputs and outcomes, and will aim to measure the size of the effects. As the table also indicates, the analysis goes beyond the health effects from water distribution. It considers factors such as changes in time allocation, gender issues, and productivity, among others.

Table A: Potential impacts of the Intervention in Paraguay: Water Boards/ Distribution System, Hygiene Education, and Community Training and Capacity-building		
Immediate Impacts	**Short-term Impacts**	**Medium-term**
Individual level	**Individual level**	**General outcomes**
- Less time and effort allocated to access water - Improved access to potable water - Change in hygiene habits - Development of technical skills	- Change in time allocation - Reduction in physical injuries that result from water fetching activities (i.e. back problems, miscarriages, etc.) - Reduction in the incidence of waterborne diseases and parasites (and their symptoms) - Reduction in child mortality and morbidity	- Increase in the time dedicated to income generating activities (especially for women) - Improved health and nutrition - Increase in work attendance, productivity and income generation - Improvement in school attendance and performance - Increased time dedicated to child care
Collective level	**Collective level**	**Collective level**
- Improve the organizational capacity of the community - Develop financial and managerial capacity - Develop a 'service culture'[4]	- Implement a sustainable management of water system - Generate demand for other infrastructure services	- Promote community growth - Increase in property values - Promote coordination and diversification of production activities - Promote inclusion of women in the community decisions

3. IMPACT EVALUATION METHODOLOGY

3.1 Evaluation design[5]

The impact evaluation targeted 4,490 rural households in Paraguay which consisted of a total of 22,832 individuals. The main approach consisted of a randomized trial technique. The Impact Evaluation (IE) study seeks to identify and measure the causal relationship between the access to potable water to rural communities and a set of outcomes (Table A). In the short term, the access to potable water is expected to reduce child morbidity and diarrheal illnesses and to improve the time allocation of adults and children.

In order to isolate and properly assess the effect of the access to potable water and basic sanitation it is necessary to determine what would have happened in the absence of the intervention by defining a

[4] "Services culture" is the awareness of the community regarding their roles and responsibilities in promoting, financing, and maintaining the provision of water (or infrastructure services) in general.

[5] The component on 'sustainable water and sanitation services and hygiene education for rural areas' under the Paraguayan Water and Sanitation program was one of the interventions analyzed in this impact evaluation. The GoP has additionally requested the IADB for funding an operation to help increase access to drinking water and sanitation services in Paraguay's small rural communities. Through this operation approximately 400 rural communities will be provided with water and sanitation systems over a five-year period; this is the other intervention that will be analyzed in the impact evaluation.

counterfactual or control group. This design takes into account the natural timing and logistic limitations of the water supply and sanitation projects to identify such counterfactual.

Randomization and Pairing

SENASA has already pre-selected a group of 400 communities, which will receive support in the construction and management of their water distribution systems. However, SENASA's physical and human capacity constraints limit the implementation of the program to at most, 100 communities per year. Inevitably, it would take SENASA four years to serve all the pre-selected community candidates. The counterfactual identification strategy[6] consists of using a public lottery to randomly distribute the communities into four different groups. Each group will receive the intervention in subsequent years; the 100 communities intervened during the fourth year will serve as a Control Group for the 100 communities (the Treatment Group) reached in their first year.

The IE study will be implemented as follows:

a. Firstly, the list of 400 potential localities was assessed using a local consultant that implemented a socioeconomic analysis in order to verify that these localities were eligible to participate in the program. After this review, approximately 100 communities were excluded from the list;
b. A lottery was be organized to randomly choose which of the 100 communities will be intervened first, and 100 communities that will be intervened in the fourth phase (with the construction and connection to sustainable water distribution systems). Those 100 communities selected for the first phase will be considered to be the "treatment" group and those 100 communities selected for the fourth phase will be considered the "control" group.
c. The baseline data collection started before the implementation of the first phase. Questionnaires were applied to measure various socioeconomic characteristics. Information was collected for a sample of 3,000 households belonging to the treatment and control groups.
d. Design and Construction of water distribution and basic sanitation systems: Once the construction is completed, the Sanitation Boards own the distribution systems. The distribution systems will be fully administered, operated, and maintained by the sanitation boards.
e. Two years after the completion of the first phase and just before the implementation of the phase four, a follow-up survey will be conducted to a sample of households belonging to phase one and four. This follow up survey will be conducted in the same way as described in point "b".
f. From the baseline and the follow up information, a "Differences-in-Differences" econometric analysis for measuring impacts of the access to potable water and basic sanitation will be conducted.

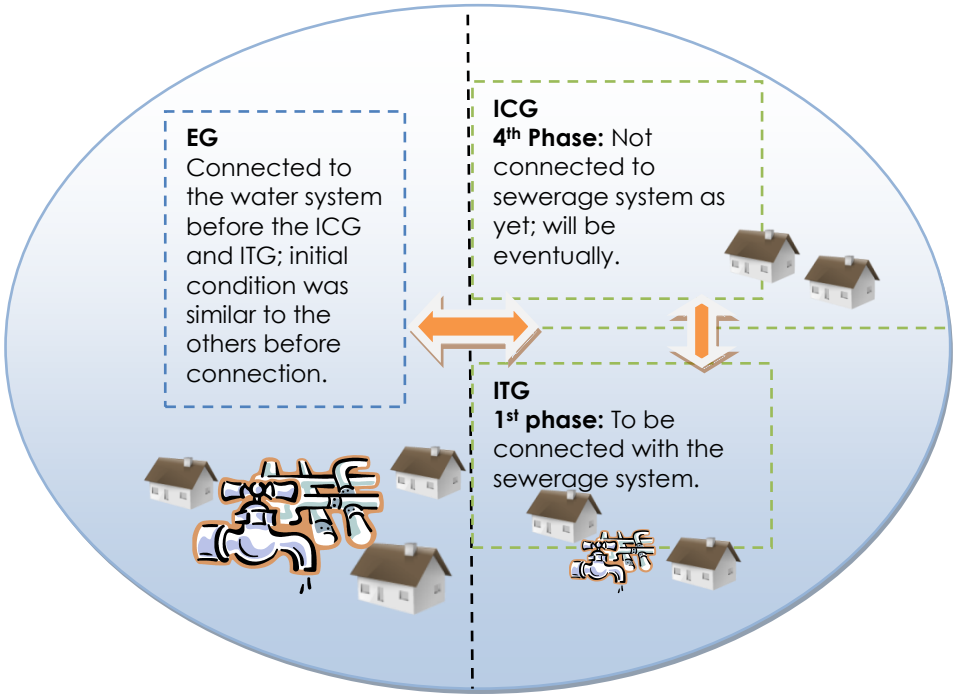
The 'External Control Group'

To obtain a preliminary result on the potential effects of the access to potable water, an "external" group was selected to be part of the baseline. This external group comprised of a sample of 1,500 households belonging to 100 communities where the water distribution systems were already implemented least two years before implementing the baseline. These communities were selected using a matching approach based on distance to the communities in the internal groups and some basic characteristics at the community level. The results of rural households that currently have

[6] See Annex One for an elaboration of the Identification Strategy

access to potable water with those who do have not received this service will be compared using matching estimators in order to understand the impact of this treatment (the water system).

Figure 1: External Group (EG), Internal Control (ICG) and Treatment Groups (ITG)



In attempting to prepare a preliminary evaluation result, the impact evaluation is pursuing two strategies that result in essentially two comparisons:

- **For the short-term and for immediate comparison to evaluate the intervention**, comparing the average EG household health and wider development indicators post-intervention to the average household indicators of ICG and ITG; and eventually,
- **Over the medium to long-term**, comparing the household health and wider development indicators between the ICG and ITG that will be indicative of the benefits from the treatment – establishment of and connection to the water system.

The premise in the approaches above is that a) The internal treatment group and internal control groups have the same socio-economic conditions at present, and b) the external group, which already has connection to the water system, had the same *initial* conditions as what the ICG and ITG have at present – before the treatment begins. In the data analysis to follow therefore, it would be crucial to establish that *ITG = ICG*.

This is at present an *ex-post* analysis comparing household groups already connected to the water system to those household groups comprising of those that now are and those that are not. Measuring impacts between the ICG and ITG through the Difference-in-Differences (DiD) methodology (Section 3.3) will be done in the final phase of this impact evaluation study.

3.2 Indicators

The main indicators regarding health are those related with diarrheal illnesses and child morbidity (that is 70 percent of the cases are caused by diarrheal illnesses in poor rural areas). Nevertheless, the team is interested in going beyond health and time allocation, analyzing child development, household income, and satisfaction with the water service. The indicators should include the following:

a) Prevalence and incidence of diarrhoea in children aged 0-5 years;
b) Prevalence and incidence of other infectious illnesses (e.g. respiratory) in children aged 0-5 years;
c) School attendance of children aged 5-16 years;
d) Time allocation of teenagers and adults;
e) Stress and quality of life standards of the mother;
f) Income of the household;
g) Expenditure in water and sanitation of the household;
h) Other expenditures of the household; and,
i) Satisfaction of the households with respect to hygiene and sanitation.

3.3 Measuring impacts: The methodology of analysis

In addition to the identification of the research questions, the sample structure, treatment and control groups, a systematic impact evaluation requires the definition of a framework of analysis: the study will implement a Difference-in-difference (DiD) approach. A DiD methodology consists of measuring the average changes in a given indicator between the periods before and after the intervention for both treatment and control groups, and then comparing the changes for the two groups. The differences between two groups reflect the isolated effect of the program.

This approach requires the existence of a base-line and post-intervention information for both groups. For this reason, this project will start with the implementation of a base-line survey collecting information about individual, household, and community characteristics of the beneficiaries. The survey will then be re-applied to the same sample just before the beginning of the last round of the program.
A difference-in-difference econometric analysis will allow verification of the effectiveness of the randomization strategy creating comparable groups and to correct some potential "contamination" of the data. The *before* and *after* difference for each group corrects for any remaining fixed difference between treatment and control, while the between groups deals with external factors that affect the target population during the interval of analysis. Assuming that those factors reach treatment and control equally, the second difference successfully isolates the true causal effect of the intervention.

4. DATA ANALYSIS, EVALUATION AND FINDINGS

4.1 Household Data Summary

The survey contains information on 4,490 households corresponding to 22,832 individuals. The table below provides the descriptive statistics for some of the relevant variables for the study.

Descriptive Statistics: Structure of the Survey

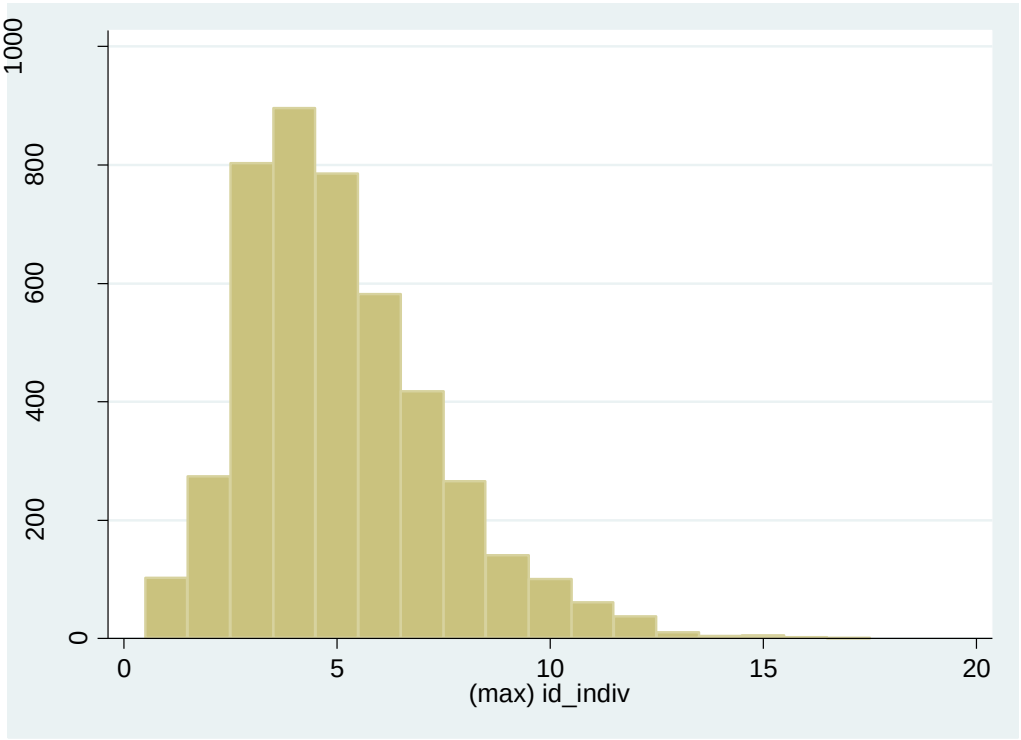
Variable	Obs.	Mean	Std. Dev.	Min	Max
Age	22825	23.72	19.64	0	104
Men (binary)	22832	.5086		0	1
Less than 13 years old (binary)	22825	.3709		0	1
Age of household head	4490	45.28	19.68	15	88

Source: Survey Data, Impact Evaluation Team, 2011.

The results indicate that 50.85% of the respondents are male while 49.14% are female. The average age of individuals in the sample is close to 24 and 37.09% are 12 years old or younger. The maximum age in the sample is 104.

The figure below shows the distribution of the number of people in the household. This information is particularly important considering the effects of the program are seen in children, making it necessary to have information on households with at least two household members.

Number of People in the Household

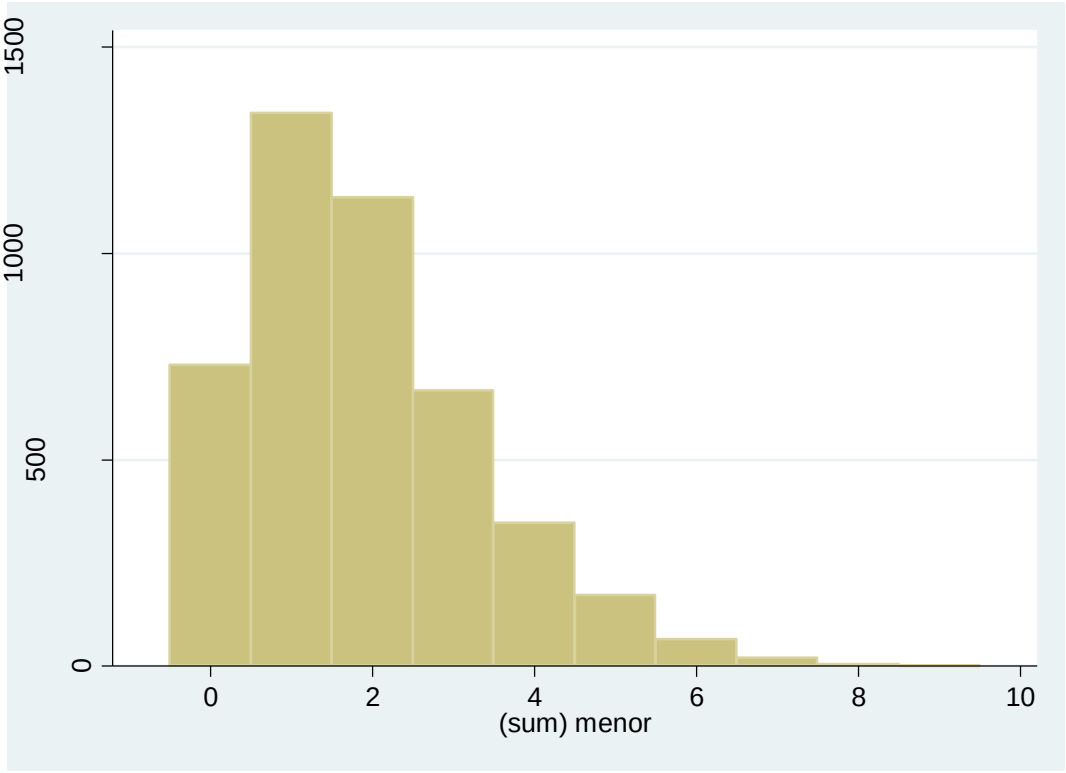


Source: **Survey Data, Impact Evaluation Team, 2011.**

The highest concentration is found in households with three, four, five and six members, the mean number of individuals within each household calculated to 5.09.

A key variable of interest of this paper is the number of children within a household. For purposes of this paper, we consider any member of the household under the age of 12 as a child. The figure below shows the distribution of the number of children in the household sample.

Number of Children per Household under the Age of 12



Source: **Survey Data, Impact Evaluation Team, 2011.**

It is observed that 16.26% of households do not have children, while 29.87% have one child, and 25.32% have two children. 28.55% of the households are seen to have more than two children. The result of the significant presence of households with more than two children can be useful to explain the result of large average number of persons within the household.

Other variables of interest to analyze are those related to the economic characteristics of respondents. The following table presents descriptive statistics on hours worked and the monthly income of respondents. Of the total sample, 2,940 household heads work one or more hours per week, the average being about 8 hours per day. The average weekly income is 215,230 *Guarani*.

Descriptive Statistics – Socioeconomic Characteristics

Variable	Obs.	Mean	Std. Dev.	Min	Max
Hours worked	2940	8.31	1.88	1	16
Weekly Income	1257	215230	189113	10000	1000000

Source: **Survey Data, Impact Evaluation Team, 2011.**

Important information also consists of health indicators in the survey (below). Only 3.53% of the respondents had been sick in the last 30 days before the survey, and only 3.33% of respondents had diarrhea during that period. Furthermore, only 34.04% of all respondents have been de-wormed at least once in their lifetime.

Descriptive Statistics – Health Indicators

Variable	Obs.	Mean	Min	Max
Sick in the past 30 days	22832	0.0353	0	1
Dewormed (binary)	22573	0.3404	0	1
Diarrhea in the past 30 days	22832	0.0333	0	1

Source: **Survey Data, Impact Evaluation Team, 2011.**

The table that follows presents information on the status of households' water, hygiene, and sanitation. With regard to a water source, only 42.72% of households receive their water through the health network. Most of the households, who do not receive their water by this method, have access through a protected well (31.89%). Almost all households use water without treating it in any way and very few boil it before use. Most households use latrines (either with or without ceiling) for sewage disposal. While the report sought an analysis of the user spending on water and sanitation, and the users' satisfaction with the services, the survey only contains these variables for water. The table shows that the average monthly cost of water is 8,918 Guarani, and that satisfaction with these services is relatively high (68.73%) for those who said they were 'satisfied' or 'very satisfied'.

Descriptive Statistics: Water, Hygiene, and Sanitation Variables

Variable	Obs.	Mean	Min	Max
Water source (in network)	4490	0.4272	0	1
Use water as obtained	4490	0.9550	0	1
Boil water	4490	0.0234	0	1
Dispose sewage through latrine	4490	0.6842	0	1
Cost of water per month	2537	534	0	8000
Satisfaction with water service (satisfied, very satisfied)	4490	.6873	0	1

Source: **Survey Data, Impact Evaluation Team, 2011.**

Finally, the following table presents the descriptive statistics on the relevant variables for the database children's population. Interestingly, there are a high percentage of children between the ages 0-5 who have been de-wormed (47.3%); it is also worth noting that the educational absenteeism rate is 22%.

Descriptive Statistics – Relevant Variables for Children

Variable	Obs.	Mean	Min	Max
Percentage of children dewormed between the ages 0-5	4490	0.473	0	1
Percentage of children with diarrhea between the ages 0-5	4490	0.059	0	1
Diarrhea incidence in the last month, children between 0-5	4490	0.104	0	8
Percentage of children between 0-5 with bloody stools	4490	0.006	0	1
Percentage of children between 0-5 with anemia	4490	0.034	0	1
Percentage of children between the ages of 6 and 14 who went to school the day before	4490	0.778	0	1

Source: **Survey Data, Impact Evaluation Team, 2011.**

4.2 Balance Statistics: Internal Control and Treatment Groups

The table below presents the differences between households that will be treated in the first phase of the Project (ITG) and those who will be treated in the second phase (ICG). The guidelines of the project indicate that both groups should be identical in order to make a valid analysis. The first two columns show the averages for each of the variables in each group respectively, while the third column shows the p-value associated with test of equality of means. This value can be interpreted as the probability of not rejecting the null hypothesis of the equality of means.

T-tests. Comparison between Treatment and Control Group

Variable	ITG (1)	ICG (2)	P-value (3)
Age	23.53	24.05	0.098
Number of persons per household	5.10	5.02	0.282
Number of children per household	0.85	0.81	0.005
Average household income	206548	163963	0.109
% sick -- last 30 days	0.347	0.347	0.897
Percentage of dewormed	0.042	0.037	0.114
Frequency of diahrrea	0.040	0.033	0.027
Percentage of men	0.510	0.511	0.959
Household head age	45.35	45.00	0.533
Hours worked per day	8.30	8.28	0.789
Use water as obtained	0.946	0.960	0.074
Boil water	0.029	0.024	0.439
Percentage owner	0.873	0.872	0.920
Percentage mud floor	0.364	0.347	0.338
Cost of water per month	6444	6612	0.852

Satisfaction with water services (satisfied, very satisfied)	0.681	0.701	0.284

Source: **Survey Data, Impact Evaluation Team, 2011.**

This table shows that the two groups are similar in most variables such as the number of persons per household, average household income, percentage of de-wormed, percentage of sick individuals in the last 30 days, percentage of men, age of household head, hours worked per day, the percentage that uses water as obtained and also those who boil water, the percentage of owners, the percentage with a mud floor, and the two variables referring to the cost of water and satisfaction with water services. Therefore, we can conclude that the two groups are not statistically different although the number of children per household and frequency of diarrhea are different for each group.

Further, the comparison below between children of the two groups confirms that there are no significant differences between the variables involving children in both groups.

Comparison of the Relevant Variables for Children between Treatment and Control Groups

Variable	ITG (1)	ICG (2)	P-value (3)
Percentage of children dewormed between the ages 0-5	0.476	0.487	0.561
Percentage of children with diarrhea between the ages 0-5	0.072	0.059	0.164
Diarrhea incidence in the last month, children between 0-5	0.129	0.091	0.046
Percentage of children between 0-5 with bloody stools	0.009	0.008	0.955
Percentage of children between 0-5 with anemia	0.042	0.033	0.209

Source: **Survey Data, Impact Evaluation Team, 2011.**

It can therefore be observed that there were no significant differences in variables associated with socioeconomic demographic structure between the internal treatment and internal control groups.

As significant as the conclusion above, the second comparison shows us significant differences.

4.3 Comparison between the Internal groups and the External Groups

The following is the comparison between the Internal Group (IG) and the External Group (EG).

Number of Observations per Group

Variable	IG (1)	EG (2)
Number of households	2990	1500
Number of persons	15276	7556
Children in the household	5635	2831

Source: **Survey Data, Impact Evaluation Team, 2011.**

The table above shows the number of individuals and households in each group. Although the number of households in the IG is greater than the EG, there are enough observations in both groups to perform the statistical analysis. There is also a similar difference in the number of people in both groups, which seems to indicate that the number of people in each household is similar for the treatment and control group. Finally, the number of children in the IG is higher than the EG, but it seems that the proportion is similar to the number of households in each group. Therefore, we can assume that there is no difference in the number of children per household between the groups.

The table below presents the differences for a set of variables of interest between households in the IG and those in the EG. The first two columns show the averages of each variable in each group, respectively. The third column shows the p-value associated with the test of equality of means. This value can be interpreted as the probability of not rejecting the null hypothesis of equality of means. As expected, the results indicate significant differences between the two groups.

T-tests. Comparison between Treatment and Control Group

Variable	IG (1)	EG (2)	P-value (3)
Age	23.80	24.35	0.110
Number of persons per household	5.10	5.02	0.282
Number of children per household	1.88	1.89	0.953
Average household income	349035	347289	0.964
Percentage of dewormed	0.347	0.328	0.006
% sick – last 30 days	0.039	0.027	0.000
Frequency of diarrhea	0.037	0.026	0.000
Percentage of men	0.511	0.503	0.259
Household head age	45.22	45.35	0.841
Hours worked per day	8.292	7.352	0.407
Use water as obtained	0.953	0.967	0.029
Boil water	0.026	0.018	0.000
Percentage of household owners	0.874	0.904	0.003
Percentage with mud floor	0.355	0.343	0.4327
Cost of water per month	6512	13634	0.000
Satisfaction with water services (satisfied, very satisfied)	0.618	0.826	0.000

Source: Survey Data, Impact Evaluation Team, 2011.

The results suggest significant differences between groups for variables such as: percentage of individuals de-wormed, percentage of individuals sick, frequency of diarrhea episodes, water processing, cost of water per month, satisfaction with the use of water, and percentage of owners. Additionally, the table shows the both groups are similar in terms of the average age of the population, number of people per household, number of children per household, average income, percentage of men, age of household head, hours work per week, and characteristics of home building (mud floor). These results are complemented by the relevant variables for the population of children below.

T-tests. Comparison of the Relevant Variables for Children between Internal and External Groups

Variable	IG (1)	EG (2)	P-value (3)
Percentage of children dewormed between the ages 0-5	0.483	0.454	0.075

Percentage of children with diarrhea between the ages 0-5	0.066	0.047	0.016
Diarrhea incidence in the last month, children between 0-5	0.110	0.092	0.264
Percentage of children between 0-5 with bloody stools	0.008	0.002	0.012
Percentage of children between 0-5 with anemia	0.037	0.028	0.110
Percentage of children between the ages of 6 and 14 who went to school the day before	0.771	0.794	0.058

Source: **Survey Data, Impact Evaluation Team, 2011.**

The results confirm that there are significant differences between the two groups for the variables associated with the intervention.

The approach to impact evaluation here would be to identify two groups of households with similar socioeconomic characteristics. The team could then assess changes in the households' respective *water and sanitation-related* welfare levels (primarily, health indicators) that could be attributed to the intervention, comparing households which were connected (the External Group) to those that were not connected (the Internal Group). In addition, the study would determine how the households' well-being would be different (or, in this case, presumably lower) if the intervention had not taken place. A case would therefore be made using the IG as the *counterfactual* while a successful comparison displayed the disparity between welfare levels (particularly, Health and other connectivity-related) in the case of connected households and those without the intervention.[7]

[7] The main purpose of an impact evaluation is to correctly identify and measure the causal effects of an intervention and its outcomes. In order to isolate and assess these effects, it is necessary to determine what would have happened in the absence of the program or what we could call the program's counterfactual.