# Case Study

COLUMBIA UNIVERSITY
IN THE CITY OF NEW YORK

DelAgua

**The Team —** Brinda Sivaramakrishnan a graduate student at Columbia University, New York City, working with the Catholic Medical Mission of Peru (CMMB) in Huancayo, Peru.

**Background—** This study is the first mid-year evaluation of a three-year maternal and child health program. The program is called "Healthy Mother, Healthy Child in the First 1000 Days of Life." The Lima office saw a need for this program due to the salient public health issues in this community. Therefore, a three item intervention was given funding for three years; consisting of nutrition education, promotion of breast feeding/ maternal health support and the distribution of home water treatment systems to combat chronic diarrhoea in children under five years (especially regarding the lethal comorbidity with anemia.) 500 families in the region of Azapampa have enrolled in the program. The site of Azapampa is the most economically depressed area on the margins of Huancayo. The population is largely Quechua by ethnic origin, internally displaced from higher elevation areas such as Apumaric to lower regions, such as Huancayo and Lima due to extreme violence and terrorism from a militant faction of the Peruvian Communist Party – the"Shining Path."

## Methodology

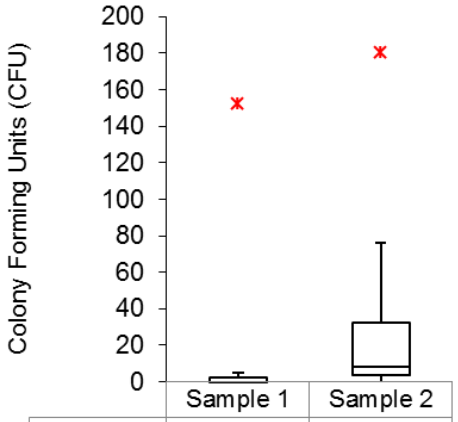
The methodology for this project was based on instruments from WHO and UNICEF. From UNICEF, the *Rapid Assessment for Drinking Water Quality* (RADWQ) targeted Assessment was referenced to design this evaluation. The protocol from RADWQ is specifically for low-resource and temporary housing settlements, and therefore applicable to this population. It is a cross-sectional method, to obtain baseline information through a systematic "snapshot" of drinking-water quality, in which the DelAgua Bacteriological Test Kit No.1 was used to analyse bacteriological, physical, and chemical parameters of the groundwater supply.

A sample size of 48 homes (approximately 10%) of the population serviced by the "First 1000 Days Program" was used. The water sampling was organized as a randomised control trial with matched controls. For each home that received an intervention, another home in the same vicinity with no intervention was selected.

| Group | Tratamiento | Inicial/ Final | |
|---|---|---|---|
| 1 – ASP 1 (Azapampa subterrana con pozo 1)<br>Homes with groundwater supply/ and with intervention; slow-sand filter + boiling. (participants of 1000 Days project) | Point Source | 12 | 12 |
| | Point of use | 12 | 12 |
| 2. – RDAZ 1 (Red Publica Domestica Azapampa 1)<br>Homes with municipal [piped] water supply from Red Publica Domestica. (participants of 1000 Days project) | Point Source | 12 | 12 |
| | Point of use | 12 | 12 |
| 3.- ASP 2 (Azapampa subterrana con pozo 2)<br>Homes with groundwater and without intervention / (NOT participants of 1000 Days project) | Point Source | 12 | 12 |
| | Point of storage | 12 | 12 |
| 4. – RDAZ 2 (Red Publica Domestica Azapampa 2)<br>Homes with municipal [piped] water supply from Red Publica Domestica/ (NOT from 1000 Days project) | ---- | 0 | 0 |
| | ---- | 0 | 0 |
| Total Samples taken: | =144 | | |

## Results

Figure 1.1 Thermotolerant coliform count; groundwater from origin and point of use

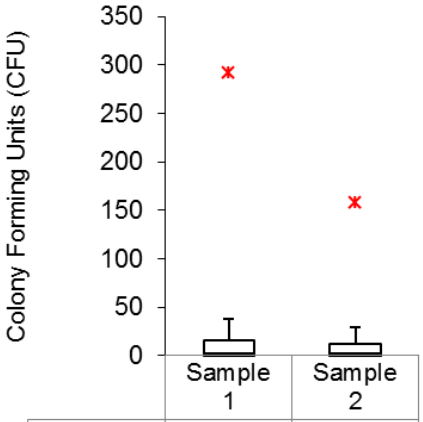



| | Sample 1 | Sample 2 |
|---|---|---|
| Q3-Q2 | 2 | 24.5 |
| Q2-Q1 | 0 | 4.5 |
| Q1 | 0 | 3.5 |
| Min Outlier | | |
| Max Outlier | 152 | 180 |

Sample 1 ~ Glass

Sample 2 ~ Well

Figure 1.2 Thermotolerant coliform count Azapampa groundwater from origin and storage

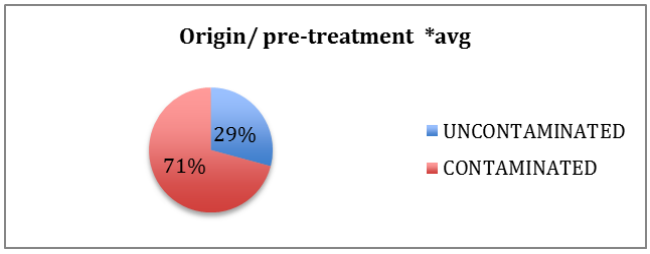


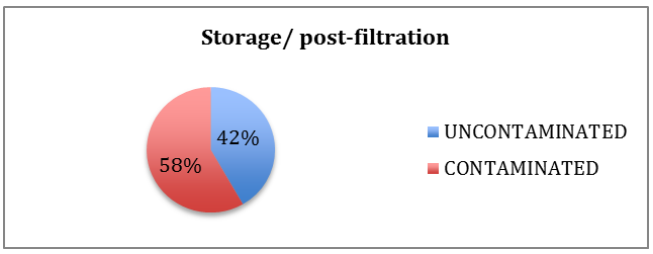

| | Sample 1 | Sample 2 |
|---|---|---|
| Q3-Q2 | 13 | 9.5 |
| Q2-Q1 | 2 | 2 |
| Q1 | 0 | 0 |
| Min Outlier | | |
| Max Outlier | 292 | 158 |

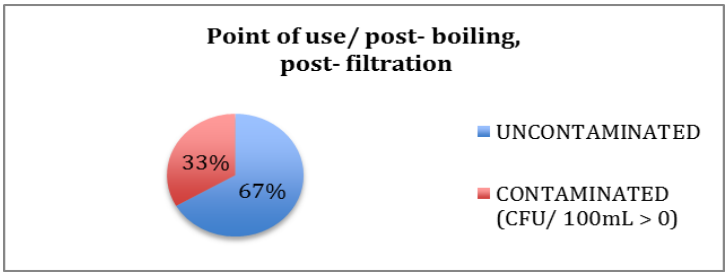
Sample 1 ~ Bucket

Sample 2 ~ Well

The above data demonstrates insignificant elimination of fecal indicator bacteria through the HWTS intervention.




## Discussion

Due to factors that could not be predicted, the study evolved in various ways from the original evaluation plan. By measuring chlorine residual in Group 2 (RDAZ 1), we were able to ascertain that chlorination is sufficient to eliminate fecal indicator bacteria in the municipal piped water supply, rendering this source safe for human consumption. It was also observed that as a cultural norm, cold water is generally not consumed; therefore boiling was a typical practice, regardless of what [other] home water treatment methods are available. As expected, the HWTS method of boiling reduced fecal indicator bacteria by 100% in most homes, and resulted in low levels of thermotolerant coliform counts (TTC) in water ready for consumption especially above temperatures of 38 degrees Celcius.

The slow-sand filters provided through Catholic Medical Mission's "First 1000 Days project," therefore did not significantly reduce TTC levels as observed from the data. According to the WHO manual for evaluation of microbiological indicators of water quality, slow sand filters are ideal for elimination of larger organisms, such as protozoa and helminthes; which is one of the salient water quality concerns in Azapampa as well. Given more resources and time, a further study using a DelAgua Kit with a continuous measure of parasitic microorganisms would provide invaluable information about the true efficacy of this intervention. Therefore, we may conclude that the home water treatment methods dealing with fecal indicator bacteria for both sources of water meet the national standard of 0 CFU/ 100mL.

The other physical and chemical parameters that were measured, such as turbidity, pH, and electric conductivity were useful in establishing patterns in groundwater supply or flow to the homes that were sampled. There were a cluster of homes with very high electric conductivity (above 2000 uS/cm.) Ion concentration decreased to approximately 100 uS/cm after boiling, and therefore was not noted as significant. It was also established that there is only one home with inorganic arsenic levels higher than 0.01 mg/L.

The most significant changes to the protocol were 1) the elimination of sampling Group Four (RDAZ 2) due to high levels of chlorine residual in the first sample of homes with piped water; and 2) the decision to change sample from point of use in Group Three (ASP 2) to point of storage. This was done due to the consistently low TTC levels in water ready for consumption. Given this adjustment in data collection, we were actually able to better evaluate the efficacy of the intervention, as the water sample was collected post-filtration and pre-boiling. The other advantage was gathering data of another possible source of contamination, one that is also considered in the literature. Through this evolution of data collection, a model where 3 possible sources of contamination, the origin, storage and point of use could all be evaluated.

The extenuating circumstance in this case was my own poor health, which did not allow me to complete 2 rounds of data collection for point of use and point of storage. Only microbiological data from the origin (groundwater source) has been averaged, which is a preferred convention in the WHO instruments referenced. The other part of the study that is missing is a qualitative appraisal of water-related concerns from the community.

## Conclusion

In conclusion, we consider the WHO evaluation criteria for home water treatment and safe storage:

Does HWTS option remove or inactivate viral/ bacterial/ parasitic pathogens in the field?

Is the HWTS option acceptable, usable, and reduce disease among users?

Is the HWTS option feasible at a large scale?

The first question was answered for bacteria with the full aid of DelAgua Bacteriological testing Kit 1, but is yet to be considered for larger microorganisms. The second question will be answered in the final evaluation of the 1000 Days project, in the next two years. The answer for the third question is yes, but not officially as there is no data on viral and parasitic indicators as of now.

The evaluation was a great success. I would like to acknowledge DelAgua for making this possible, and Enrique Naupari at CMMB Huancayo, for guiding me through the process and completing the data collection after my departure.