Drinking Water Treatment in Rural Peru

Agua ParaTodos
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Agua Para Todos

- Purpose: develop effective household water purification technologies and evaluate existing efforts
Peru

Population: 28.4 million

Project Sites:
Arequipa & Tacna
The Water Problem

• Many rural residents are drinking from polluted irrigation canals
• Small water treatment plants are often inadequate

Drinking Water Sources:

Irrigation Canals
Streams

Household Taps & Storage Devices
Water Treatment Plants
Total Coliform Concentration in Source Waters - LOG Scale

<table>
<thead>
<tr>
<th>Water Location</th>
<th>CFU/100mL Log Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>CBV WTP inflow</td>
<td>2.4E+05</td>
</tr>
<tr>
<td>CBV WTP effluent</td>
<td>2.3E+04</td>
</tr>
<tr>
<td>El Triunfo WTP inflow</td>
<td>6.4E+04</td>
</tr>
<tr>
<td>El Triunfo WTP effluent</td>
<td>7.1E+04</td>
</tr>
<tr>
<td>La Joya Canal</td>
<td>3.7E+04</td>
</tr>
<tr>
<td>CBV Household Tank</td>
<td>8.4E+03</td>
</tr>
<tr>
<td>CBV Household Tap</td>
<td>1.1E+03</td>
</tr>
<tr>
<td>CBV Unfiltered</td>
<td>2.8E+02</td>
</tr>
<tr>
<td>CBV Unfiltered</td>
<td></td>
</tr>
<tr>
<td>La Joya Hospital Tap</td>
<td></td>
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</tbody>
</table>

Disaster Intervention

7.9 earthquake in Southern Peru in June 2001

Peruvian Ministry of Health & CEPIS (Center for Sanitary Engineering and Environmental Sciences)

disseminated household filtration and chlorination programs to rural villages, where water was negatively affected by the earthquake.

Source: BBC News
Some of the towns receiving the intervention program: Chucatamani, Tacna
Cerrito Buena Vista, Arequipa

Cruz de Mayo, Arequipa
Alto La Cano, Arequipa

Chlorination System
Chlorination System

- 20-L safe storage containers ("bidones")
- 0.5% chlorine solution generated at local hospital & distributed to towns in 200mL bottles of chlorine solution
- Add “half cap” of solution to 20 L of water
- Distributed free to 400 families
Small Scale Chlorine Generator

Chlorine Residual Found in Bidones
(Goal: between the red lines)
Pros & Cons of Chlorination

Pros
- Percent removal of total coliform from one household = 99.7%
- Very Inexpensive: $4 each
- Easy to use
- Local chlorine generation possible

Cons
- Turbidity & organic content of source water high (particle removal step needed)
- Chlorine residual dosing too low
- Chlorine solution sometimes difficult to obtain due to poor technical support
- People don't like the taste

Peruvian “Table Filter”
- Indigenous filter created by CEPIS
- Made of two 20-L plastic buckets
- Distributed for free to 300 families

Geotextile Cloth
Ceramic Candle Filters
Sand
Pros & Cons of the Table Filter

**Pros**

- Average percent removal of total coliform = 97%
- Average percent removal of turbidity = 93%
- Provides relatively consistent and significantly improved drinking water
- Inexpensive: $12 each
- Easy to use

**Cons**

- Broken spigots
- Cleaning is bothersome
- Fragile ceramic candles
- Parts not easily available
- Sand sifting (during filter assembly) is time-consuming
Microbial Contamination

- Initial testing indicates that filters significantly reduce the concentration of coliform.
- Coliform concentration is still too high for safe drinking water.
Average Total Coliform Before & After Filtration

LOG Scale

Peru Data

Various Sources Before Filter After Filter

Water Type

CFU/100mL

1.E+02

6.E+04

5.E+03

1.E+02

Cost versus Willingness To Pay

Filter Clorine system 20% Plant

USD $
People Affected by this Intervention & Evaluation: 

**Users**
People Affected by this Intervention & Evaluation:

*Technical Support*
Local Health Center in Arequipa
Program Support Technicians in Tacna

Local & International Engineers Evaluating the Program
Politicians working with engineers to provide clean drinking water