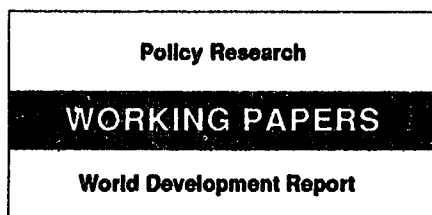


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Office of the Vice President  
Development Economics  
The World Bank  
August 1992  
WPS 959

*Background paper for World Development Report 1992*

# Waterborne Diseases in Peru

Sheila Webb and Associates

The cost of constructing easy-access water facilities (a standpipe less than 1,000 meters from each house) and latrines is an estimated \$30 per capita. In Lima's peri-urban areas the cost of not providing them is about \$40 per capita. Providing those facilities would relieve the urban poor of devoting (directly and indirectly) an average 23 percent of their income to meeting their water needs.

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Policy Research

WORKING PAPERS

World Development Report

WPS 959

This paper — a product of the Office of the Vice President, Development Economics — is one in a series of background papers prepared for the *World Development Report 1992*. The *Report*, on development and the environment, discusses the possible effects of the expected dramatic growth in the world's population, industrial output, use of energy, and demand for food. Copies of this and other *World Development Report* background papers are available free from the World Bank, 1818 H Street, NW, Washington, DC 20433. Please contact the *World Development Report* office, room T7-101, extension 31393 (August 1992, 17 pages).

The cholera epidemic in Peru brought to light the miserable state of local water and sanitation conditions. Webb discusses the relationship between waterborne diseases and water and sewerage conditions in Peruvian peri-urban areas, or *pueblos jóvenes*.

These diseases are associated with poor living conditions. In 1989, only 52 percent of the population had access to piped water, and only 39 percent to sewerage. About 52 percent of schools lack light, water, and sewerage. In Lima, 2 million people daily eat meals from street vendors who lack access to fresh water or toilet facilities — 90 percent of a sample of their food was fecally contaminated.

Webb estimates the per capita costs of providing in-house water and sewerage facilities in urban areas to be \$150 in urban areas and

\$180 in rural areas. The cost of constructing easy-access water facilities (a standpipe less than 1,000 meters from each house) and latrines in urban and rural areas is an estimated \$30 per capita.

In contrast, she estimates the annual per capita cost borne by urban households without in-house continuous water connections (that is, households that buy water from vendors) to be \$40.

In short, the total cost borne by the urban poor over four years is equivalent to the cost of providing them with permanent water and sewerage facilities. Providing those facilities would relieve the urban poor of devoting (directly and indirectly) an average 23 percent of their income to meeting their water needs.

The Policy Research Working Paper Series disseminates the findings of work under way in the Bank. An objective of the series is to get these findings out quickly, even if presentations are less than fully polished. The findings, interpretations, and conclusions in these papers do not necessarily represent official Bank policy.

**Waterborne Diseases in Peru**

**Background Paper Prepared for the  
1992 World Development Report**

**Sheila Webb and Associates  
Cuanto S.A.**

The World Development Report 1992, "Development and the Environment," discusses the possible effects of the expected dramatic growth in the world's population, industrial output, use of energy, and demand for food. Under current practices, the result could be appalling environmental conditions in both urban and rural areas. The World Development Report presents an alternative, albeit more difficult, path - one that, if taken, would allow future generations to witness improved environmental conditions accompanied by rapid economic development and the virtual eradication of widespread poverty. Choosing this path will require that both industrial and developing countries seize the current moment of opportunity to reform policies, institutions, and aid programs. A two-fold strategy is required.

- First, take advantage of the positive links between economic efficiency, income growth, and protection of the environment. This calls for accelerating programs for reducing poverty, removing distortions that encourage the economically inefficient and environmentally damaging use of natural resources, clarifying property rights, expanding programs for education (especially for girls), family planning services, sanitation and clean water, and agricultural extension, credit and research.

- Second, break the negative links between economic activity and the environment. Certain targeted measures, described in the Report, can bring dramatic improvements in environmental quality at modest cost in investment and economic efficiency. To implement them will require overcoming the power of vested interests, building strong institutions, improving knowledge, encouraging participatory decisionmaking, and building a partnership of cooperation between industrial and developing countries.

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**Sheila Webb and Associates, "Waterborne Diseases in Peru"**

**Background papers in the World Bank's Discussion Paper series include:**

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## Introduction

The cholera epidemic in Peru has brought to light the miserable state of local water and sanitation conditions. This report discusses the relationship between waterborne diseases and water and sewerage conditions in Peruvian peri-urban areas, or pueblos jóvenes. As water and sewerage conditions in Peru have deteriorated in the past decade, the incidence of waterborne diseases has increased, implying a correlation between the two. Like other waterborne diseases, cholera is most prevalent among the poor, who thus bear a disproportionate share of the costs of inadequate water and sewerage services. This suggests that social investment in public services is a priority in terms of fighting poverty, improving living conditions, and increasing productivity in Peru.

In addition to drawing upon the results of previous studies, this study is based on interviews carried out by Cuanto in October 1991 in pueblos jóvenes in all four of Lima's "cones"<sup>1</sup> (see Appendix 1). These interviews were not meant to prove or disprove any particular hypothesis; the objective was rather to gather information which would increase our understanding of the ways in which families "cope" with a limited and/or laborious water supply, particularly in terms of the resulting costs to the family. Although the interview results generally corroborated findings of studies on related topics, the anecdotal information gathered from conversations and open questions has been valuable in helping to contextualize the facts.

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<sup>1</sup> Greater Lima is divided into four cones: North, South, East, and Center.

### Background: The Nature of the Problem

As in many parts of the world, waterborne diseases (WBD) continue to figure significantly in overall morbidity and mortality rates in Peru. WBD prevalent in Peru include gastroenteritis, bacterial dysentery, infectious hepatitis, tuberculosis, typhoid, paratyphoid, salmonellosis, shigellosis, and most recently, cholera. Between 1980 and 1988, the last year for which reliable statistics are available,<sup>2</sup> WBD were responsible for more deaths than any other transmissible disease.<sup>3</sup>

The prevalence and intensity of these diseases are directly associated with poor living conditions. In 1989, twelve million Peruvians were unable to satisfy minimum daily protein and calorie requirements; more than sixty percent of the population lives at or below subsistence level, and nearly forty percent of children are malnourished.<sup>4</sup> Fifty-two percent of the population has access to piped water; only thirty-nine percent, to sewerage.<sup>5</sup> Sixty-four percent of schools lack the basic services of light, water, and sewerage.<sup>6</sup> In Lima, 2 million people daily eat meals from street vendors who lack access to toilet facilities or fresh water.<sup>7</sup> A survey in April of this year found that 90 percent of sampled food and drink sold

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<sup>2</sup> Employees in the public health sector have been on strike intermittently since 1989, which has interrupted normal data collection.

<sup>3</sup> APIS, 1990.

<sup>4</sup> UNICEF, 1991.

<sup>5</sup> INAPMAS, 1991.

<sup>6</sup> UNICEF, 1991.

<sup>7</sup> This is because laborers and informal workers cannot afford to eat in restaurants, or to go home for lunch given the distance and cost of transportation.



by street vendors was fecally contaminated.<sup>8</sup>

Living conditions have worsened partly as a result of increased migration to the cities. This migration has several causes. Rural social service spending has been virtually eliminated.<sup>9</sup> Ten of twenty-four geographical departments, encompassing more than half of the total population, are under a total state of emergency as a result of terrorist activity. The agricultural and mining sectors have both faltered. As a result, marginal urban communities, or pueblos juvenes, have swollen to a third of the total population, forty-six percent of the total urban population,<sup>10</sup> and 58 percent of Lima's population.<sup>11</sup>

Poor migrants, the majority of whom are employed in the informal sector or as unskilled workers, move into an existing pueblo joven, or "invade" a vacant plot of land with the intention of establishing a permanent residential community. Although wood or cement comes in time to replace straw as construction material, permanent water and sewerage services are extremely slow in coming. Despite the fact that 60 percent of Lima's recognized pueblos juvenes were established before 1980, only twenty-seven percent have in-house water and sewage facilities.<sup>12</sup>

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<sup>8</sup> El Comercio "Ambulantes de Lima venden alimentos contaminados," August 2, 1991.

<sup>9</sup> Rural illiteracy rates are some 40%; urban rates, only 8%.

<sup>10</sup> Ministry of Housing and Construction, Office of Statistics, 1989.

<sup>11</sup> Glewwe and Hall, 1991.

<sup>12</sup> Webb and Fernandez Baca, 1991. Note: Land surrounding Lima has become increasingly scarce. As a result fewer "invasions" are officially recognized, which means they are often excluded from population counts and, significantly, their "illegal" status is given as justification for avoiding the provision of permanent facilities and services. The most recent data from the Ministry of Housing and Construction is from 1987, and was only published in 1989.

Accelerated migration has combined with the drastic reduction in public investment levels that has resulted from eight years of severe fiscal crisis, to produce a chronic lag in the provision of basic services to marginal settlements. Public social expenditures per capita declined from \$40 to \$14 between 1981 and 1989.<sup>13</sup> Government expenditure on water and sewerage infrastructure, fell to an average of 0.8 percent of gross national product in the period 1983 to 1990; from 1970 to 1982, it averaged to 0.27 percent.<sup>14</sup>

### Water Supplies

Households in pueblo jovenes obtain their water from a variety of sources: the city network, either through public standpipe or in-house connection; tanker truck water vendors; private wells (of which there are very few due to the depth of the water table); neighboring communities; and finally, streams. Although most pueblo joven households use predominantly one source, either tanker trucks or public standpipes, these services cannot be relied on and supplementary sources are also used.

A city network water connection does not guarantee the fulfillment of a household's water needs because in many areas, particularly in pueblos jovenes, water is supplied only a certain number of hours per day or days per week. Of 730-765,000 service connections in Lima (authorized and unauthorized), only 400,000 receive regular service,

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<sup>13</sup> Lago, 1990.

<sup>14</sup> The Ministry of Housing and Construction has responsibility for expanding water and sewerage infrastructure.

twenty-four hours a day, seven days a week.<sup>15</sup>

Lima's peripheries, where the pueblos juvenes are located, receive less water through the city network because of the expense of pumping water that distance through the decimated state of the municipal water system. Sedapal, Lima's water authority, can account for only fifty-three percent of the water it produces because of the widespread absence of metering, as well as broken or leaking pipes, wasteful use, and an inadequate billing system.<sup>16</sup> Another reason pueblos juvenes receive less water is that water intended for residential use is sometimes sold to nearby farms, stables, or industries by local Sedapal operators. In October 1991 residents of Ventanilla, a pueblo joven in the northern cone of Lima, took control of the local Sedapal office because its operators were selling water to nearby farms instead of supplying the community.

### Water Costs

Both the direct cost of water and the indirect costs of insufficient water are higher for the poor than for the rich. A cubic meter of water from a vendor costs about \$3, while from an in-house connection to the city network it costs about \$.15.<sup>17</sup> Moreover, the current pattern of relative water costs in Lima is almost identical to that of nearly twenty

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<sup>15</sup> USAID, 1991.

<sup>16</sup> DelAgua, 1991.

<sup>17</sup> DelAgua, 1991.

years ago.<sup>18</sup> Of the thirty households we interviewed, the average weekly expense for water for those using trucks as a primary or secondary source, was just over \$3, representing six percent of average weekly income for these households.<sup>19</sup>

Direct water costs for the poor vary considerably. Communities that are not connected or receive only a few hours of water through the city network are dependent on vendors. Although some vendors are affiliated with the city water authority, most are privately owned and operated. There is no price regulation. The price of water from a vendor depends on: distance to the pumping station (where the truck fills its tank), ease of access, (pueblos jovenes do not have paved roads and the poorer houses are on sloped, sandy foothills), season (demand for water increases in summer), gasoline prices, and availability of municipal water supply. Many interviewees commented on the abusiveness practices of truck operators, which included charging high rates, not filling cylinders all the way, not coming to their lots unless given a special "tip", and charging double in summer.<sup>20</sup>

Seventy percent of those buying water from vendors do so in order to supplement city network supplies. Despite the high direct cost of vendor-supplied water, many households use this source because of the high indirect cost of the main alternative, public standpipes. Queuing times at public standpipes are often more an hour. Residents sometimes wait in vain because the water runs out before their turn; fights break out in

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<sup>18</sup> Adrianzen and Graham, 1974, p. 315. "The actual amounts spent are two to six times greater than those spent by the families that are economically most advantaged, and more important, for this amount they are getting as little as one-seventh the volume of water, the unit cost being 16.7 times greater."

<sup>19</sup> Instituto Cuanto, 1991.

<sup>20</sup> Instituto Cuanto, 1991.

consequence, especially during the summer. One mother complained of having to collect water from the public standpipe seven times a day, and it being a problem because of the time it takes, when she has so many other things to do.<sup>21</sup>

### High Indirect Costs: Health and Hygiene

The cost, inconvenience of collecting, and infrequent public supply of water are factors limiting access to water among the poor. As a result they consume less. Pueblo joven households consume an average of 75 liters per day, while households with 24 hour in-house water consume an average of over 1000 liters per day.<sup>22</sup> Hygiene necessarily decreases.

One in-depth, in-house investigation of domestic water use in a Lima pueblo joven revealed that "low amount of water overrides knowledge of good sanitation practices."<sup>23</sup> Reduced hygiene, in other words, is a cost of insufficient water, not of insufficient knowledge. Furthermore, the quality of water from vendors was observed as being higher than that of stored water, suggesting that contamination occurs during storage and use in the household.<sup>24</sup> Water is stored in uncovered or partially covered metal drums,

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<sup>21</sup> Instituto Cuanto, 1991.

<sup>22</sup> Gilman and Marquis, 1987. Daily per capita water consumption in the pueblo joven of Huascar was measured at 13.5 liters, one of the lowest per capita consumptions reported.

<sup>23</sup> Gilman and Marquis, 1991.

<sup>24</sup> Even so, the quality of vendor-supplied water is not high; although sanitary inspections are officially required of all operators, a recent study found only twenty-seven percent of truck operators interviewed could present sanitary badges, and only fifty-seven percent could present

cement tanks, or plastic tubs, easily permitting contamination to occur. Moreover, water is also susceptible to contamination by dust during the process of collection at the public standpipe. Comments made by respondents on this subject included having to "treat water like gold", and not being able to wash clothes frequently because water for cooking was more important.

Poor hygiene results in higher rates of water-borne disease. Lima's pueblos jovenes have one of the highest diarrhea rates in the world (eight episodes per person per year)<sup>25</sup>. The costs of being sick include medications, which unlike consultations are not subsidized for unsalaried workers, and lost wages. Since, they work predominantly in the wage or informal sector, the poor do not receive benefits like sick leave; being sick in bed therefore causes substantial income loss. Of those who responded affirmatively to having missed work on account of being sick with diarrhea or an intestinal infection in the last six months (34 percent of total interviewed), losses were significant. The average number of days missed from either work or school was 4.8, and five heads of households lost at least an entire week's wages.<sup>26</sup>

The health ramifications of poor water and sanitation have been exacerbated by Government spending on the health sector, which between 1970 and 1989 increased at an average annual rate of 0.6 percent.<sup>27</sup> Moreover, the current distribution of health

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certification of disinfection.

<sup>25</sup> Lopez de Romana, Brown, and Black, 1987.

<sup>26</sup> Instituto Cuanto, 1991.

<sup>27</sup> In per capita terms, this amounts to an average annual decrease of two percent.

expenditures is skewed, with the smallest proportion of expenditures reaching the poorest households. The lowest 20 and 40 percent of households in terms of income received 3 and 10 percent, respectively, of public expenditure on health services, while the highest decile of the income strata received 45 percent.<sup>28</sup>

The full cost of inadequate water supplies, is illustrated by the recent cholera epidemic. In its first ten weeks, it cost Peru \$1 billion in emergency health expenditures and lost earnings from exports and tourism. This is four times the amount spent by Peru on water and sewerage between 1981 and 1988.<sup>29</sup> The government's response to the cholera outbreak has been widely criticized for lack of coordination as well as for insensitivity to the poor. As part of its mass education and cholera-prevention campaign, the Ministry of Health has urged citizens to boil water for ten minutes before consuming it. For the majority of the poor who use kerosene for cooking, this represents a heavy financial burden (the annual household cost of which is calculated at 29 percent of the average pueblo joven annual income).<sup>30</sup> The poor were additionally burdened by the government's warning against eating fish, without providing an alternative, low-cost food, since fish are one of the principal low-cost sources of protein for these families.

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<sup>28</sup> Banco Central de Reserva del Peru, 1991.

<sup>29</sup> UNICEF, 1991.

<sup>30</sup> Given: boiling 1 lt. of water for ten minutes consumes .10 lt. of kerosene, the average family boils 4 lts. water/day, the price of kerosene, \$.35/lt. and average annual pueblo joven income, \$171.

### Conclusion: A Cost-Benefit Assessment

The estimated per capita costs of providing in-house water and sewerage facilities in urban areas is \$150, while for rural areas it is \$180. The estimated per capita cost of constructing "easy access" water facilities (standpipe less than 1000 meters from each house) and latrines in urban and rural areas is \$30.<sup>31</sup> In contrast, we estimate the annual per capita cost borne by urban households without in-house continuous water connections (i.e. those that buy water from vendors) at \$40.<sup>32</sup>

Therefore, the total cost borne by the urban poor over four years is equivalent to the cost of providing them with permanent water and sewerage facilities. Provision of these facilities would relieve the urban poor of devoting, directly and indirectly, an average 23 percent of their income to the fulfillment of their water needs.

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<sup>31</sup> UNICEF, 1991.

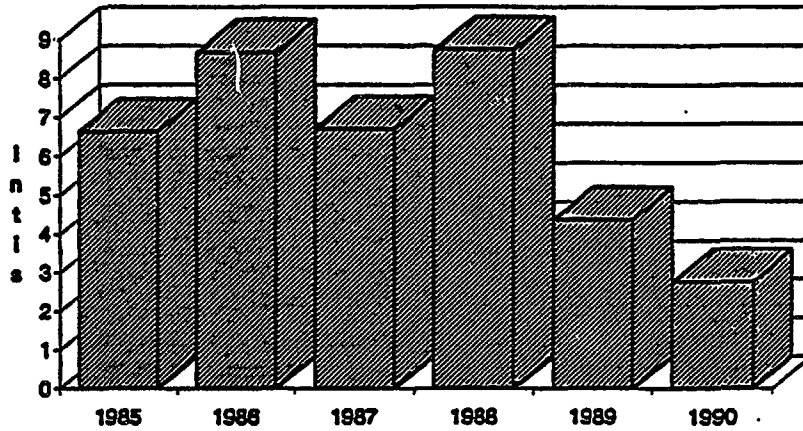
<sup>32</sup> Given the following per capita values: cost of buying water = \$12.50 Cost of medication = \$6.85 Cost of boiling water for drinking = \$10.00 Cost of container = 4.00 Cost of work days lost = \$6.07.



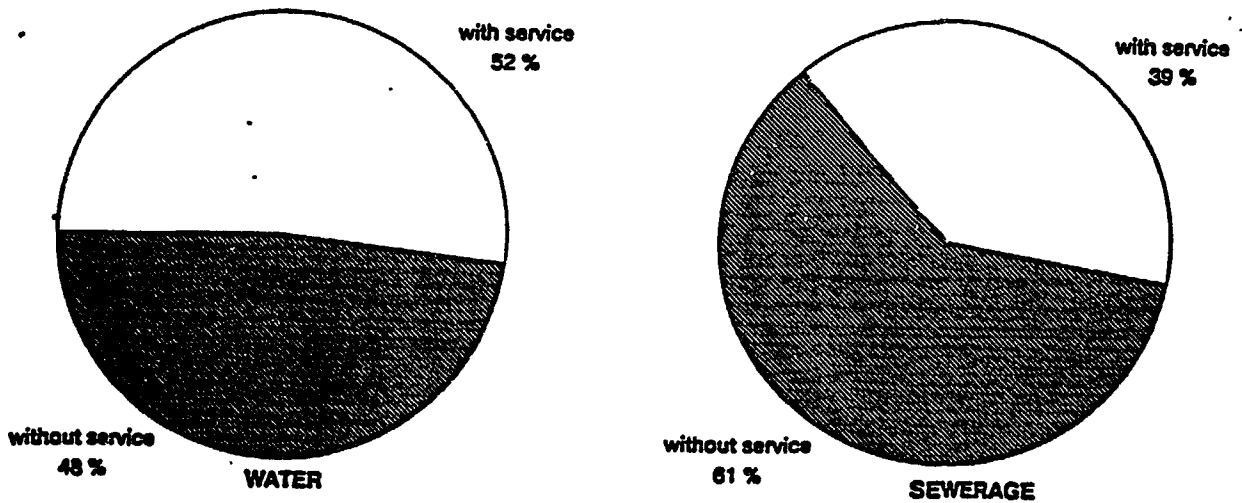
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## Appendix 1

### Interviews

Fifty households were selected; twenty used public standpipes, another twenty used tanker trucks, five had in-house connections, and another five used wells. These proportions were chosen in order to detail the ways in which the high water costs (direct and indirect) impact on households. Public standpipe and tanker truck are the most expensive sources of supply. They are also the most prevalent in Peruvian pueblos jóvenes.

The following factual information was gathered: source of water, method of storage, toilet facility, weekly income, amount of water boiled daily exclusively for drinking, type and cost of fuel used, unit and frequency of purchase or collection, incidence of waterborne diseases, number of work or school days missed, amount of income lost, cost of medication, etc.

In addition, anecdotal information was gathered from open questions on general attitudes about the particular water system and its impacts, as well as the ways in which water is used and/or reused in households. This information is presented in Appendix 2.

Appendix 2  
Responses to Open Questions

The following are responses to questions asked by interviewers on the impacts that the household's water supply system represents, and the way water is used and/or reused in the household.

We don't have confidence in some tanker trucks that come in bad conditions sometimes.

In summer we hope more tanker trucks will come so we can keep the diseases out.

To cook we use water from the public standpipe. To wash we buy from the truck.

We have one cylinder for washing and another for cooking and drinking.

It's a bother having to carry the water.

Now the water comes every two days ... in summer it comes once a week. That's when we have to buy from the truck, and they charge double the normal price for a cylinder.

We use the water then throw it away. In the summer when the tanker truck doesn't arrive, we borrow water to be able to keep the children clean.

I buy San Luis mineral water to drink every fifteen days (\$1.35), but not always because it's expensive. I buy from the truck to clean with.

We pay (for use of the public standpipe) but do not take water from it because there is not enough water because it only comes for two hours.

We have to watch the water very carefully. We only buy one cylinder a week.

In the summer water costs twice what the water vendor usually charges.

As we have to fetch the water from the public standpipe, we have to restrict its use, even for cooking we have to measure carefully. We don't trust the quality of the water from the trucks.

It affects us in the sense that, as the water only comes for hours at a time, we have to take turns, since there is only one standpipe for two blocks. We don't have a latrine because, as our lot is small, it can't be inside the house. The lot next door has one, and the bad odor reaches our house.

There's not enough water to do the washing. I can only use a small amount so that there will be enough as the cleaning requires a lot.

I have to go to the standpipe seven times a day to pick up water. For me it's a problem because it takes so much time and since I work I don't have a lot of free time. That's why sometimes I have to send my mother to collect water.

Any minute now we will get sick because even when we fill our cylinders, it remains open and flies come and the sickness begins.

It is a waste of time because there are long lines and waits to receive water. When less water comes the lines are even longer and you have to wait even more.

They should do something so that we don't have this problem with Sedapal. They should do something for us.

It takes a long time because you have to get in line because there is only one public standpipe for the whole community. The water doesn't come out very strong, that is, only a small amount comes out. We don't wash the clothes regularly, we save the water for cooking, we save it exclusively for eating.

We can't wash clothes or baths regularly because we need to save water for cooking. It's not like having water from the faucet to use whenever you want.

When we transport the water from the standpipe, it tends to get filled with dust, which can cause sickness. We have to wait, sometimes a whole hour. This is way in the mountains, when one has so many things to do.

The water that we use to rinse the washing we reuse to wash our hands and feet.

Lots of times the water vendors do not fill the cylinder all the way, but they charge us as if they were full. Lots of times we have to pay additional charges, especially in summer.

We're asking that the authorities oblige the water vendors to disinfect the water they sell every certain amount of time.

The problem is having to wait so much, more or less two hours. Besides waiting it's tiring having to walk so much.

In the morning we bring water to cook, then in the afternoon we collect more to do washing. In the evening we have to get more for the night.

We are asking for help in building a well. The water that Sedapal sends is not enough. That's why we need to buy from water vendors.

If the water is fairly clean we through it in front of the house. If it is dirty, we dump it far away. The price of the water is too high. Most of my children suffer from intestinal

problems.

If any of my children get sick, I won't take them to the doctor because it is too expensive. I will cure them with home remedies.

Lots of times the Medical Post doesn't attend us, and they make us wait in vain. Saturdays the Municipality (Chorrillos) gives us free water from the vendor.

We have to travel very far to get water.

We don't have enough money to buy the medications that are prescribed to us. The water vendors charge too much. When the vendors do not come we have to get water from neighboring communities.

We have to tell the people at the standpipe not to take so long.

The water vendors charge however much they feel like charging.

At our public standpipe we have to fight to fill our tanks. You can see yourself how everyone is trying to get water. The tanker trucks don't want to come all the way out here. We have to treat water like gold.

The people actually fight for water.

Water vendors are abusive in charging.

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