Peru

Lima-Callao Water Supply and Sewerage Systems Development Project

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1. Project Profile and Japan's ODA Loan

Map of the Project Area

Water distribution pump
(Rimac District, Lima)

1.1 Background

The water supply and sewerage services in most parts of the Lima-Callao Metropolitan Area (population of some seven million in 1995) are provided by *Servicio de Agua Potable y Alcantarillado de Lima* (Lima Water and Sewerage Service Company, SEDAPAL). As of 1996, the coverage ratio of 74% for the water supply service and 72% for the sewerage service was relatively high. In regard to the water supply service, however, the unaccounted-for water ratio was as high as 47% because of leakage due to the aging of the facilities and virtual absence of water charge collection based on meter readings, resulting in a serious water shortage particularly in the emerging districts where the population was rapidly growing. In case of the sewerage service, the aging facilities, contamination of drinking water and groundwater as well as overflow of sewage onto the streets worsened the sanitation conditions while untreated sewage was discharged to rivers and the sea, causing serious pollution to the water systems. As in the case of the water supply service, the emerging districts lacked sufficient sewerage facilities.

To solve these problems, the Lima-Callao Water Supply and Sewerage Systems Development Project was implemented in the period from 1996 to 2004 as a co-financing project with the World Bank for such purposes as the efficient utilisation of limited water resources, reduction of the pollution caused by sewage and expansion of the service area in emerging districts.

1.2 Objective

To improve the water supply and sewerage services of Lima-Callao Metropolitan Area by (i) (in regards to the water supply system) realizing the efficient use of water resources through the rehabilitation of deteriorated primary and secondary networks, installing water meters, and reinforcement and installation of water mains, (ii) (in regards to the sewerage system) rehabilitating the deteriorated sewerage network, and (iii) expanding the water supply and sewerage services to emerging districts, thereby contributing to improvement of the sanitation conditions.

1.3 Borrower/Executing Agency

Borrower: Government of the Republic of Peru
Executing Agency: *Servicio de Agua Potable y Alcantarillado de Lima* (Lima Water and Sewerage Service Company, SEDAPAL)

1.4 Outline of Loan Agreement

Approved Amount/Disbursed Amount	¥8,427 million/¥8,420 million
Exchange of Notes/Loan Agreement	July 1995/March 1996
Terms and Conditions	Interest Rate: 3.0% Repayment Period (Grace Period): 30 years (10 years) Procurement: General untied
Final Disbursement	August 2006
Main Contractors (contract amount of ¥1 billion or more)	10 companies, including Corefic and GYM S.A.)
Main Consultant (contract amount of ¥100 million or more)	Montgomery Watson; PYV; Safege Consulting
Feasibility Study (F/S)	1994

2. Evaluation Results (Rating: A)

2.1 Relevance (Rating: a)

This project has been highly relevant with the country's national policies and development needs at the times of both appraisal and ex-post evaluation, therefore its relevance is high.

2.1.1 Relevance at Appraisal

As described earlier, the water supply and sewerage facilities of SEDAPAL were severely deteriorated as of 1996 and the unaccounted-for water ratio was as high as 47%. This caused serious water shortage, worsening sanitation conditions and growing severity of water pollution in some urban areas. Improvement of these services was urgently required in the Lima-Callao Metropolitan Area which was experiencing rapid and continuous increase in population. Therefore, the Project was highly relevant at appraisal.

2.1.2 Relevance at the Time of Ex-Post Evaluation

Although the coverage ratio of the water supply and sewerage services in the urban areas of Peru grew during the period from 1994 to 2005, the overall levels are still relatively low compared to those of neighbouring countries. The current Garcia Administration has adopted a policy of "Agua para Todos" (Water for Everyone) which aims at providing access to safe water for all Peruvians by 2011 when its current term of office comes to an end, designating the water supply and sewerage sectors as one of the priority sectors for Peru's development.[1]

In the Lima-Callao Metropolitan Area, while the coverage rates of the water supply and sewerage services exceed 90% with average daily water supply hours of 21.5 hours as of 2008, the unaccounted-for water ratio of 37% is still very high. Meanwhile, the water demand in 2015 is expected to exceed the present water supply level of 21.0m^3/sec by some 30%, making it an urgent issue to secure new water sources and to reduce the unaccounted-for water supply ratio. The sewage treatment ratio of 14.6% (2008) is still low, falling far short of the national target of 100% by 2015. In short, as the water supply and sewerage services in the Metropolitan Area must tackle such important issues as the securing of new water sources, reduction of the unaccounted-for water and improvement of the

[1] The National Environmental Sanitation Plan 2006 - 2015 aims at improving the coverage rates of the water supply service and sewerage service in urban areas to 89% and 84% respectively by 2015.

sewage treatment ratio, it is judged that the Project is highly relevant for the situation in the project area at present.

Manhole for the underground water distribution valve chamber at a public park

Remotely controlled water distribution valve

2.2 Efficiency (Rating: b)

Although the project cost was mostly as planned, the project duration exceeded the original plan, therefore the efficiency of this project is fair.

2.2.1 Outputs

The JICA loan portion of the project covered rehabilitation of existing water supply and sewerage networks and extension of the existing water mains in seven districts of the Lima-Callao Metropolitan Area (Jesus Maria, Lince, La Victoria, San Isidro, Miraflores, Rimac and Callao). The World Bank portion covered the rehabilitation of existing water supply and sewerage networks in an additional five districts, rehabilitation of water mains, distribution reservoirs, wells, extension of the water mains a metering program in all districts and improvement of the water supply and sewerage networks in emerging districts. All of the 12 districts in which rehabilitation of the existing water supply and sewerage networks was conducted are central districts with medium or high income. Priority was given to these districts on the grounds that reduction of unaccounted-for water by means of rehabilitation will lead to improved profitability for SEDAPAL compared to similar work in other districts.

The detailed outputs of the Project are shown in Table 1. While the target districts and types of output were as originally planned, the quantity of actual achievement varied considerably. It appears that these discrepancies can be attributed to the following circumstances in addition to the fact that the outputs set at the time of appraisal were rough estimates.

<Rehabilitation of the Water Supply Network>

- After the conclusion of the loan agreement, the Sectorization Program was implemented based on the findings of a study assisted by the World Bank, and the rehabilitation of large diameter distribution pipes (not included in the original plan) was conducted.[2] Many of the relatively large

[2] The main purposes of the sectorization are, leveling of the distribution pressure, advancement of water distribution management and localisation of repair work or accident damage. The distribution sectors can basically be classified into three levels: large, medium and small. A large sector means a trunk system of which the main purpose is water conveyance. A medium sector means a mid-level water distribution network of which the main purpose is the control of water distribution. A small sector is set up to allow the

diameter water pipes required rehabilitation, pushing up the average unit cost of the rehabilitation work. Because of the limited budget size, the total length of the rehabilitated distribution pipes was shortened compared to the original plan. For the same reason, the number of replacements for gate valves increased compared to the original plan.

- Part of the work to replace household connection was conducted under the metering program by the World Bank portion, and as a result the number of household connections covered under the JICA loan decreased compared to the original plan.

Table 1 Project Outputs (Original and Actual)

	Original	Actual
< Rehabilitation of Water Supply System (System Rehabilitation) >		
• JICA Loan Portion		
- Rehabilitation of water distribution pipes: diameter of up to 10"	394 km	256 km
12 - 28"	0 km	14 km
- Replacement of gate valves	652	814
- Installation of fire hydrants	791	719
- Replacement of household connections	72,276	12,974
• World Bank Portion		
- Rehabilitation of water distribution pipes	226 km	191 km
- Rehabilitation of pumping wells	85	89
< Rehabilitation of Sewerage System (System Rehabilitation)>		
• JICA Loan Portion		
- Rehabilitation of sewage pipes ∅ up to 12"	417 km	154 km
∅ 14 - 28"	0 km	11 km
- Replacement of household connections	83,291	9,890
- Replacement of manholes	8,331	3,105
• World Bank Portion		
- Rehabilitation of sewers	200 km	82 km
< Improvement of Efficiency of Water Resources Utilization (Water Conservation) >		
• Installation of water meters (World Bank Portion)	406,000	427,000
• Extension of water transmission pipes (JICA Loan Portion and World Bank Portion)	73 km	61 km
< System Expansion in Emerging Districts (World Bank Portion) >		
• Installation of new water supply pipes and water distribution pipes	89 km	64 km
• Installation of sewage pipes	33 km	37 km
• New house connections	300,000	200,000
< Consulting Services >		
• JICA Loan Portion: supervision of the work under the JICA loan portion		
• World Bank Portion: detailed design, supervision of the work under the World Bank Portion and related survey		

Source: SEDAPAL's response to external evaluator's questionnaire

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localised stoppage of water supply or repair work. With the introduction of a SCADA (supervisory control and data acquisition) system which consists of many water sectors where water movement is controlled using valves and meters, it is possible to establish facilities and a management style which is capable of performing a water distribution operation function (water pressure adjustment) and management function (data acquisition, data processing and facility operation). It is planned that the water supply system in the Lima-Callao Metropolitan Area will ultimately consist of some 450 small sectors. As of January, 2009, 176 sectors have been constructed and the SCADA system is in operation for 101 sectors.

<Rehabilitation of Sewerage Network>

- The conditions of large diameter sewage pipes were much worse than expected. The subsequent decision to prioritize the rehabilitation of these large diameter sewage pipes under a limited budget led to a rise in the average unit cost of the rehabilitation work, thus reducing the overall length of the rehabilitated sewage pipes. As the rehabilitation of sewage pipes was given priority for the allocation of the limited budget, the number of replacements for household connection pipes was far fewer than planned.

<Service Expansion to Emerging Districts>

- In emerging districts, the actual number of households newly connected to the water supply system did not reach the plan because the National Housing Fund (FONAVI), which was planning to install secondary distribution pipes, was abolished and could not complete the necessary work. [3]

2.2.2 Project Cost

The total project cost combining the JICA loan portion and the World Bank portion was ¥33.58 billion which was equivalent to 104% of the estimated project cost at the time of appraisal (89% on a US dollar basis). In terms of the JICA loan portion, the project cost of ¥11.32 billion and loan amount of ¥8.42 billion were almost as planned. The project cost for improving efficiency in water resource utilization increased from the planned figure because of the introduction of the SCADA system. The consulting service cost also increased because of the additional cost of modifying the design as necessitated by new findings after the commencement of the work and also because of the cost of an additional survey for the sectorization program.

Table 2 Project Cost (Original and Actual)

(Unit: ¥ million)

Item	Original	Actual
Total Project Cost	32,323 (US$ 306 million)	33,575 (US$ 273 million)
Cost Breakdown by Component		
• System rehabilitation	15,898	16,682
• Water conservation	5,490	8,917
• Network expansion	4,011	3,052
• Consulting service	2,282	4,924
• Contingency for price escalation	4,643	-
Cost Breakdown by Portions		
• JICA Loan Portion	11,236	11,321
• World Bank Portion	21,087	22,254
Breakdown of Funding by Source		
• JICA Loan	8,427	8,415
• World Bank Loan	15,450	18,148
• Government of Peru	8,466	7,012

Source: Project Completion Report (SEDAPAL)
Foreign Exchange Rate: US$ 1 = ¥103 (planned); US$1 = ¥121 (actual)

[3] The World Bank provided an additional loan which was not part of the Project to implement the planned laying of the secondary distribution pipes.

2.2.3 Project Period

The project was planned to start from February 1995 and end in November 2001 with a duration of 82 months, but in reality the project was started in March 1996 and ended in September 2004 with a duration of 103 months or 126% of the original plan.

At the time of appraisal, it was planned that the work under the JICA loan portion would commence in the middle of 1997, however the work only commenced in September 1999, more than two years later than planned. Reasons are that procurement procedure took longer than expected and the restrictions imposed by the Peruvian government on the amount of ODA and counterpart funds to be used in view of Peru's tight fiscal situation. In subsequent years, the process of obtaining permits, etc. from local authorities and complicated work involving the excavation of existing streets led to further delay. As a result, the Project was finally completed in September 2004, nearly three years later than the originally planned completion date.

2.3 Effectiveness (Rating: a)

This project has largely achieved its objectives, therefore its effectiveness is high.

2.3.1 Water Supply

Based on the findings described below, the purpose of the Project in the water supply sector, i.e. realization of the effective utilization of water resources (water conservation) to improve the water supply service, was fully achieved.

(1) Increase in the Availability and Production of Water

Under the Project, the availability and production of water were increased by the following measures.

i) Reduction of Leakage

As a result of the rehabilitation of deteriorated water supply facilities in the 12 target districts, the leakage rate was reduced. At the time of appraisal, the planned leakage reduction was 1.30 m^3/sec but the actual result according to a SEDAPAL estimate was 1.19 m^3/sec.

ii) Conservation of Water

The wide dissemination of water meters and the collection of water charge based on the consumption volume led to an incentive for water users to conserve water. According to a SEDAPAL estimate, the average water consumption per capita per day dropped from 236 litres in 1994 to 176 litres in 2001. With the installation of a water meter at approximately 410,000 households under the Project, the combined water saving effect is estimated to be some 2.15 m^3/sec. The fact that the water charge almost doubled in 10 years has presumably contributed to the water conserving behaviour of users.

Water meter of SEDAPAL

iii) Increasing of Production Capacity

As a result of the rehabilitation of wells under the Project, the production capacity of underground water increased. It is inferred that the production capacity increased by 1.42 m^3/sec.

The combined effect of the implementation of the Project was an increase of water available for distribution by approximately 4.8 m^3/sec, which is equivalent to 23% of the total water production

in Lima-Callao Metropolitan Area (approximately 21 m^3/sec). It is, therefore, reasonable to assume that a serious water supply shortage would have occurred in the Metropolitan Area without the implementation of the Project.

(2) Improvement of the Distribution Efficiency

The Metropolitan Area is divided into two areas based on the main source of water supply, i.e. either surface water or groundwater. Prior to the Project, continual pumping of groundwater caused the level of groundwater to fall. Under the Project, new transmission pipes were laid in three districts that relied primarily on groundwater, and as a result achieved the complementary use of surface water to prevent continuous groundwater intake and to alleviate the water shortage. With the implementation of the Project, the water distribution volume to these three districts is estimated to have increased by 1.36 m^3/sec (planned increase: 1.42 m^3/sec). As a result of less groundwater intake, (other than in the dry season), the groundwater level at the pumping wells in these districts rose by 10 - 15 m.

(3) Improvement of the Water Supply Service in General

As shown in Table 3, the water service coverage in the Lima-Callao Metropolitan Area has increased to as high as 91% in the last 10 years during which the number of households receiving water supply has increased by approximately 50%. During this period, even though the water production did not increase, the average water supply hours greatly improved. It is inferred that such efficient use of water resources was made possible because of (i) reduction of leakage due to the rehabilitation of the water supply network, (ii) water saving due to the installation of water meters and raised water charge and (iii) optimization of the water distribution due to extension of the water mains, sectorization of the distribution network and introduction of the SCADA system.

Table 3 Main Indicators for Water Supply Service in the Lima-Callao Metropolitan Area

	Before the Project	After the Project	Planned Value (For Reference)
Water Service Coverage	75% (1995)	91.1% (2008)	88%
Number of Connections	839,000 (1997)	1,231,000 (2008)	1,020,000
Water Production	642 million m^3 (1997) 20.4 m^3/sec (1997)	659 million m^3 (2008) 20.9 m^3/sec (2008)	890 million m^3 28.1 m^3/sec
Average Water Supply Hours	11.5 hours/day (1995)	21.5 hours/day (2008)	No planned value
Physical Losses (Leakage)	31% (1994)	25% (2007)	29%
Unaccounted-for Water Ratio	45.0% (1994)	37.0% (2008)	41%
Water Meter Installation Ratio	3.4% (1994)	70.3% (2008)	46%

Sources: The actual values (after the Project) are provided by SEDAPAL while the planned values are the target values set at the time of appraisal by the World Bank (1995).

In the seven target districts in the JICA loan portion, some one million people (some 12% of the total population of 8.6 million in the Metropolitan Area) were using the water supply service in 2007. Although the number of households using this service increased by 10% in 10 years, the unaccounted-for water ratio dropped by 21%, reflecting the water conservation effect of the Project. The average water supply hours in these seven districts increased from some 16 hours a day in 1999 to 21.4 hours a day in 2008, almost reaching a 24 hours–a-day water supply except in the Callao District (19.5 hours a day) and Rimac District (20.2 hours a day). The number of repair works of the water supply system conducted by the Surquillo Service Center which is responsible for three of the seven districts fell from 802 in 2000 to 352 in 2008, showing the positive effects of the system rehabilitation.