Ex-Post Project Evaluation 2015: Package III-2

(El Salvador, Peru)

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JAPAN INTERNATIONAL COOPERATION AGENCY

GLOBAL GROUP 21 JAPAN, INC.

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Republic of El Salvador

FY 2015 Ex-Post Evaluation of Japanese ODA Loan

"La Union Port Development Project"

External Evaluator: Hiromi Suzuki S., IC Net Limited

0. Summary

The La Union Port Development Project (hereinafter referred to as "the Project") was implemented for the purpose of meeting the increased demand for maritime cargo transportation by constructing La Union Port in the Gulf of Fonseca in the eastern part of El Salvador. The Project also envisaged that the increased port capacity in El Salvador resulting from the Project would stimulate distribution of goods and improve its efficiency, thereby contributing to the economic development of the eastern region of El Salvador. Although the Project is relevant to the country's development plan and development needs as well as Japan's ODA policy, there is a possibility that the necessity for La Union Port has slightly declined due to the lack of implementation of a maritime trade strategy and policies in line with the development plan and the recent improvement of Acajutla Port. The realization of positive project effects has been hampered possibly by insufficient preliminary investigation of the phenomenon of sedimentation in the berth and access channels; restriction of the port operation strategy to a concession-based operation when the relevant legal framework was not in place, and further stagnation of port operation resulting from the exclusion of gantry cranes[1] from the scope of the Project. Based on the above, the relevance of the Project is fair. The change of the project scope following the expansion of the target ships to include post-Panamax ships[2]; the necessity for additional dredging of the berth and access channels as a result of sedimentation exceeding the original forecast; and the steep rise of equipment and material prices, resulted in the actual project cost and project period significantly exceeding the planned cost and period. Therefore, the efficiency of the Project is low. The actual use of La Union Port has been very limited against the background of an insufficient water depth, lack of gantry cranes and decline of the demand for cargo transportation. As a result, the level of achievement of the project purpose is low with hardly any realization of the expected impacts. Therefore, the effectiveness and impact of the Project are low. The sustainability of the project effects is only fair because there are some problems concerning the technical capability to dredge the berth and the access channels, and the financial situation in addition to a lack of clarity regarding the future operating system and business plan for La Union Port. Based on the above, the Project is evaluated as being unsatisfactory.

[1] A gantry crane is a gate-type large crane with a structure which allows its movement on rails. In this ex-post evaluation, a gantry crane is defined as a container crane installed on a pier of a port to load and unload containers to/from container ships.

[2] A Panamax ship is a ship of which the size is the largest to pass through the Panama Canal. Any ship larger than this size is called a post-Panamax ship. In June 2016, a ceremony to celebrate the completion of the construction of the third set of locks in the Panama Canal was conducted and currently post-Panamax ships can also transit the canal.

1. Project Description

Project Location

La Union Port (Courtesy of CEPA)

1.1 Background[3]

In the 1990's, the economy of El Salvador steadily grew as a result of the policy introduced after the end of the civil war in 1992 which aimed at facilitating international trade, liberalization of finance, inward investment and productivity improvement. In the second half of the 1990's, international trade was the main driving force for the economic recovery of the country and the trade accounted for some 50% of the country's GDP. Maritime transportation played an important role as a means of transportation and one-third of international cargo was handled by Acajutla Port which was the only port in El Salvador that could be used for international trade. Cargo handling, especially the handling of containers which demands swift operation was restricted at Acajutla Port due to unfavorable natural conditions, including considerable swells because of the port's position directly facing the Pacific Ocean. Because of this, some export cargo, including container cargo, was transported to neighboring Guatemala by land for export via Puerto Barrios Port.

The demand for maritime cargo transportation in El Salvador was expected to grow to around 4.5 million tons by 2015 with container cargo accounting for 800,000 to 900,000 tons. As of 1996, however, the cargo handling capacity of Acajutla Port was 1.95 million tons. Even with improvement of the existing facilities, it was considered that the maximum cargo handling capacity would only increase to 2.5 million tons/year. By 1999, the cargo handling volume of Acajutla Port reached 2.3 million tons/year, approaching its expected maximum handling capacity. This situation made strengthening of the port facilities in El Salvador to meet the increasing demand for maritime cargo transportation[4] an urgent task.

While Cutuco Port in La Union Province along the Gulf of Fonseca in the eastern region of El Salvador had been used for the export of coffee and cotton, this port was closed

[3] Based on materials provided by JICA and the 2004 ODA Country Data Book for El Salvador published by Japan's Ministry of Foreign Affairs.

[4] In the second half of the 1990's, the Government of El Salvador examined the possibility of constructing a full-scale container terminal at Acajutla Port but abandoned this plan due to technical reasons as well as the declared national policy of prioritizing the development of the eastern region.

down in 1996 due to its much deteriorated facilities. At that time, the Government of El Salvador emphasized the development of the eastern region which was traditionally a poor region ravaged by the civil war which raged in this region in the 1980's and made a request to JICA for the provision of technical cooperation for the development of an international port which would make the best use of the excellent natural conditions of much weaker wind and waves in the Gulf of Fonseca compared to Acajutla Port. In response, JICA conducted the *Study for Port Reactivation in the Union Province of the Republic of El Salvador (1997-1998)*. This study produced the *Master Plan for Port Reactivation in the Gulf of Fonseca* (target year of 2015) which proposed the construction of the new La Union Port at the former Cutuco Port site. This was followed by a feasibility study for a short-term plan (target year of 2005).

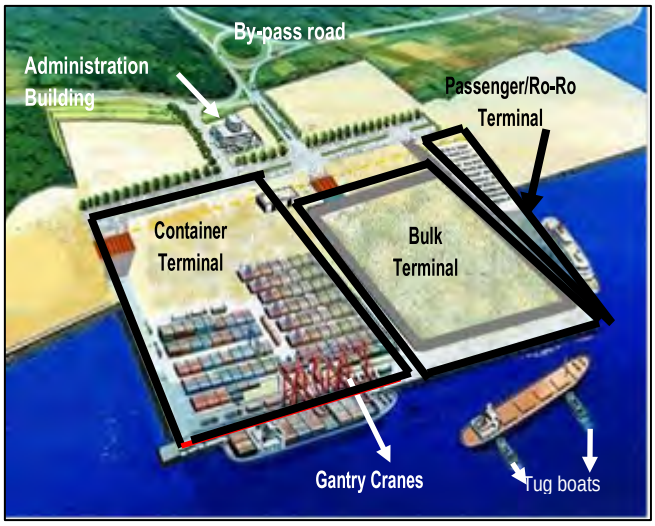
This Master Plan assumed that La Union Port would become the principal container port in El Salvador handling most of the container cargo arriving and leaving the country and would also handle other types of cargo in the eastern region. In addition, La Union Port was expected to play the role of facilitating the development of the eastern region, the development of an export processing zone with an area of some 100 ha was assumed in the neighboring area of the port to bring about new demand for cargo transportation. On the other hand, it was assumed that Acajutla Port would handle cargo other than container cargo in the west and central regions.

Under these circumstances, the Government of El Salvador gave the highest priority status to the development of La Union Port and made a request for an ODA loan to conduct the short-term plan[5] of La Union Port. In response, a review of the feasibility study results was conducted and the appraisal of the plan was done in December 2000, and the Technical Evaluation and Appraisal for the *Detailed Design for the Port Reactivation Plan of La Union Province in El Salvador (2001-2002)* as an ODA loan-related D/D was implemented. The Project was subsequently implemented from October 2001, when the agreement for the ODA loan was signed, to July 2009.

1.2 Project Outline

The Project aimed at meeting the increased demand for maritime cargo transportation through an increase of El Salvador's port capacity by means of constructing La Union Port along the Gulf of Fonseca in the eastern part of the country, thereby stimulating distribution of goods and improving its efficiency and contributing to the economic development of the eastern region of the country.

[5] According to the *Final Report for the Project for Maintenance Dredging of the Port of La Union* and the interview survey with CEPA, the Master Plan for La Union Port consists of four phases. This Project constitutes Phase I (short-term plan) while Phase II, Phase III and Phase IV entail the expansion of the port to the southeast, northwest and further southeast respectively.



Source: Provided by CEPA.

Figure1 La Union Port: Terminal Layout, Port Access Channels and Port Access Channel Support Facilities

Loan Approved Amount/ Disbursed Amount	11,233 million yen/11,207 million yen
Exchange of Notes Date/ Loan Agreement Signing Date	May 2001 / October 2001
Terms and Conditions	Interest Rate Civil Works: 2.2% Consulting Service: 0.75% Repayment Period (Grace Period) Civil Works: 25 years (7 years) Consulting Service: 40 years (10 years)
	Conditions for Procurement: Civil Works: General untied Consulting Service: Bilateral tied
Borrower / Executing Agency	Guarantor: Government of El Salvador / Autonomous Executive Ports Commission (CEPA)
Final Disbursement Date	August 2010
Main Contractor (Over 1 billion yen)	Jan De Nul N.V. (Belgium) / Toa Corporation (Japan) (Joint Venture)
Main Consultant (Over 100 million yen)	Nihon Koei Co., Ltd. (Japan)
Feasibility Studies, etc.	F/S: “The Study for Port Reactivation in the Union Province of the Republic of El Salvador” (JICA Development Study, 1997-1998), SAPI: “Special Assistance for Project Implementation for the La Union Port Development Project in El Salvador” (JICA Special Assistance for Project Implementation, 2008-2009)

Related Projects	[Technical Cooperation] "The Study for Port Reactivation in La Union Province of the Republic of El Salvador" (1997-1998), "Technical Evaluation and Appraisal for Detailed Design on Port Reactivation Plan of La Union Province in El Salvador" (Loan-Related D/D 2001-2002), "The Project for Maintenance Dredging of the Port of La Union" (2010-2014), "The Project for the Strengthening of Teaching Quality of MEGATEC, La Union" (2008-2012), "Technical Assistance Study regarding the Operation Methods of the Container Terminal" (October 2009-June 2010), Advisor for Port Management and Promotion (2012-2014), "The Project for the Strengthening of Capacities for Rural Tourism Development in the Eastern Region of El Salvador" (2010-2013), Development Planning Advisor for the Technical Secretariat of the Presidency (2012-2016) [Projects of Other Organizations] World Bank: "Assistance for the Construction of MEGATEC, La Union" (2005-2009), World Bank: "Teacher Training and Curriculum Development for MEGATEC, La Union" (2005-2009)

2. Outline of the Evaluation Study

2.1 External Evaluator

Hiromi S. Suzuki (IC Net Limited)

2.2 Duration of Evaluation Study

The ex-post evaluation study for the project was conducted over the following period.

Duration of the Study: October 2015 to March 2017

Duration of the Field Survey: January 31, 2016 - February 13, 2016, and June 11 - 20, 2016

2.3 Constraints During the Evaluation Study

Since its opening in 2010, La Union Port has not been fully utilized because of problems concerning dredging and concession (see "3.3 Effectiveness" for more details) and this situation has further developed into a political debate within El Salvador. At the time of this ex-post evaluation, a tendency towards rather over-heated coverage of the situation by newspapers, etc. [6] was observed. Therefore, any policy or strategy for the maritime transportation sector, including La Union Port, is a very sensitive political issue and it was difficult to obtain information on the official position of the government or very reliable information during the field survey. Equally, through the interview survey with maritime transportation companies conducted as part of the beneficiary surveys it was difficult to obtain

[6] The Project was originally requested and commenced by the government of the Nationalist Republican Alliance (ARENA, until 2009). Since 2009, the left wing government of the Farabundo Marti National Liberation Front (FMLN) took over, and since then has been operating the port.

opinions on the issue and frequently the evaluator came across opinions seemingly influenced by the inaccurate information from the newspapers, etc. Because it was not possible to obtain the official position of the government from the Technical Secretariat of the Presidency who leads the aspects of policy and strategy, extensive efforts were made to obtain information from multiple sources, including such relevant departments as the Department of Finance and the Department of Tourism and those involved in the Project under the previous administration. This ex-post evaluation is based on information that was available by the end of the second field work (June). Information obtained beyond the time was basically not taken into consideration for the evaluation and was described in the footnotes just as reference information.

3. Results of the Evaluation (Overall Rating: D[7])

3.1 Relevance (Rating: ②[8])

3.1.1 Relevance to the Development Plan of El Salvador

The *National Development Plan* (formulated in October 2000) of El Salvador at the time of the project planning designated four areas in the country as priority areas for development and specified public works to function as the driving force for development in each area. As the eastern region was one of these areas prioritized for development by the government, the Project, including the surrounding areas of the Gulf of Fonseca, was given the status of a development project of the highest priority to act as the main driving force for regional development. As a project contributing to the regional integration of Central America, the Project was also expected to contribute to the vitalization of distribution of goods throughout Central America.

The *Five Year National Development Plan 2014-2019* which is the ongoing national development plan at the time of the ex-post evaluation upholds three objectives: "sustainable economic growth", "comprehensive education and social fairness" and "safe civil life". The development of transportation infrastructure is aimed at achieving a better efficiency of the distribution of goods through consolidation of the transportation sector, and socioeconomic integration of Central America under the objective of "sustainable economic growth", and ports are considered to form part of the said infrastructure. In 2012, the *Integral and Sustainable Development Strategy for the Coastal Zone 2012-2024* was formulated as a comprehensive development plan for Pacific coast areas of El Salvador, including the section from Acajutla Port to La Union Port. This regional development plan upholds four objectives: "improvement of productivity through investment", "improvement of the living standard of local residents", "infrastructure improvement and strengthening of distribution of goods" and "strengthening of

[7] A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory.
[8] ①: Low; ②: Fair; ③: High

principal cities as centers for growth". Both Acajutla Port and La Union Port are expected to play an important role in all of these objectives. This plan has clearly adopted a policy of seeking mutually complementary roles of these two ports in that Acajutla Port mainly handles bulk cargo and other miscellaneous cargo while La Union Port primarily handles container and transhipment cargo.[9]

In addition, according to the results of interviews to CEPA and Department of Tourism, the government has maintained its commitment to the development of the eastern region and has prepared the *Master Plan for the Comprehensive and Sustainable Development of the Eastern Region of El Salvador 2015-2025* with the cooperation of JICA.[10] The priority sectors of this Master Plan include the transportation sector and it aims for the vitalization of the economy through the utilization of the Project.

However, the above policy and plan do not offer a concrete plan for La Union Port and no clear direction has been established for the operation of this port. Therefore, the relevance of the Project to the development policies of El Salvador at the time of its planning and time of ex-post evaluation is high but there is no clear policy for the operation of La Union Port at the time of the ex-post evaluation.

3.1.2 Relevance to Development Needs of El Salvador

As already described in "1.1 Background", at the time of appraisal (2000) one-third of the international cargo of El Salvador was handled by Acajutla Port, the only international port in El Salvador, and the port was approaching its maximum handling capacity. It was predicted that even if the facilities and handling capacity of the port were improved, the country's demand for cargo transportation would exceed the handling capacity of the port in 2005. Therefore, the construction of La Union Port was proposed to allow this new port to handle most container cargo.[11]

By the time of the ex-post evaluation, the role of international trade in the economy of El Salvador has further expanded.[12] The cargo handling volume of ports temporarily dropped after the global financial crisis that occurred from 2008 to 2009 but has since recovered to reach 4.63 million tons in 2015 which is some 80% of that predicted at the time of appraisal (5.8 million tons in 2015).[13]

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[9] Bulk cargo (or just cargo) means cargo loaded onto a ship without being packed, such as grains, salt, coal and mining ore. Transhipment means the transfer of cargo at an intermediate port instead of cargo transported by the same ship from the port of embarkation to the port of disembarkation.

[10] This Master Plan was announced to the nation by the President in October 2016. With respect to La Union Port it considers the starting of operations of the ferry (for information on the ferry see "3.3.1 Quantitative Effects" and footnote 32) and the operation of La Union Port as strategic undertakings, however, no details are described.

[11] *The Study for Port Reactivation in La Union Province of the Republic of El Salvador* (JICA Development study, 1997-1998)

[12] According to statistics of the Central Reserve Bank of El Salvador, the share of the amount of international trade in the GDP increased from 50% at the time of appraisal to 61% in 2014.

[13] Technical Evaluation and Appraisal for Detailed Design on Port Reactivation Plan of La Union Province in El

However, the cargo handling volume of La Union Port in 2015 remained as small as 20,000 tons in 2015 because of such constraints as insufficient water depth due to the lack of dredging of the berth and access channels, lack of gantry cranes, etc. (see "3.3 Effectiveness" for more details). Therefore, the cargo handled by ports in El Salvador continues to be handled by Acajutla Port, including container cargo which accounts for almost one-third of the total cargo volume. According to CEPA, the cargo handling capacity of Acajutla Port has increased to 8 million tons which far exceeds the predicted figure (maximum of 2.5 million tons) at the time of appraisal as a result of recent investment in facilities and equipment.[14] However, Acajutla Port has the limitation of only allowing calls by container ships equipped with on-board cranes because the ground at Acajutla Port is not strong enough to support a heavy gantry crane, and because of other constraints posed by the water depth and port structure. As a result, the container cargo handling capacity of Acajutla Port cannot be expected to increase beyond 8 million tons. There is, therefore, a strong need for El Salvador to provide a port which allows larger container ships, such as post-Panamax ships and container ships not equipped with an on-board crane to call. It is therefore, reasonable to assume that there is a need at the time of the ex-post evaluation to utilize La Union Port which was constructed as the only fully-fledged container port. However, it must be noted that the much greater increase of the cargo handling capacity of Acajutla Port beyond the assumption made at the time of appraisal means that Acajutla Port is now handling some of the container cargo which is supposed to be handled by La Union Port.

As such, the necessity for La Union Port, which was clear at the time of appraisal, has not been lost at the time of the ex-post evaluation but may have been slightly weakened by the fact that the improvement of Acajutla Port has been much more than predicted at the time of appraisal.

3.1.3 Relevance to Japan's ODA Policy

The priority areas for Japan's economic cooperation for Latin America, in the Medium-Term Policy on ODA (prepared in August 1999) at the time of appraisal included "development of basic infrastructure for the rectification of regional disparity" and "development of economic and social infrastructure for the development of the environment to contribute to the encouragement of the private sector and facilitation of foreign direct investment. In addition, based on the ODA Medium-Term Policy and the results of the economic policy dialogue, the ODA Policy for El Salvador was prepared in November 2011 which lists (1) vitalization of production sectors, (2) social development (education, health care and medical care), (3)

Salvador (ODA-related D/D; 2001-2002)

[14] According to CEPA, the improvements at Acajutla Port include expansion of the container yard; change from the single stacking of containers to triple stacking, automatization of container management and introduction of transportation facilities for bulk cargo (belt conveyor, etc.)

environment and (4) democratization and stabilization of the economy as four priority areas. The assistance for the development of economic infrastructure and technology transfer for the transportation sector, etc. were considered to be a way to contribute to the vitalization of the production sector which has a big potential capacity.

Based on the above, the Project is highly relevant to Japan's ODA policies.

3.1.4 Relevance to Appropriateness of Project Planning and Approach

At the time of the ex-post evaluation, the cargo handling volume of La Union Port is quite limited and there is little realization of the expected project effects due to two direct causes which are the limited operational capacity of the port, and the unclear port management system including business strategy (see "3.3 Effectiveness" for more details). The following three issues relating to the appropriateness of project planning and project approach during implementation can be pointed out as the background.

(1) Insufficient Investigation of the Phenomenon of Sedimentation at Access Channels and Berth

In general, the berth and access channels require periodic dredging (maintenance dredging) as they experience the phenomenon of sedimentation by sand and silt. In the case of a port with long access channels, the cost of such dredging can account for a major part of the port maintenance cost. Therefore, proper assessment of the scale of this phenomenon (volume of sediment soil) and the dredging cost are important factors for the port's profitability analysis.

In the Project, the scale of sedimentation of the berth and access channels has been far greater than that predicted at the project planning stage. It is, therefore, necessary to re-dredge the access channels and also to continually conduct maintenance dredging. However, because of the huge cost of such work, no dredging has been conducted since the opening of La Union Port in 2010.[15] This lack of dredging is one of the direct factors preventing the active use of the port, greatly affecting the effectiveness of the Project (see "3.3.1 Quantitative Effects (Operation and Effect Indicators)").

The chronology of the sedimentation surveys of La Union Port under the Project is as follows.

a. Prior to the Feasibility Study in 1998, no survey had been conducted in the Gulf of Fonseca on the phenomenon of sedimentation. As part of the Feasibility Study, the volume of

[15] According to the Concessions Law enacted in 2011, maintenance dredging was the responsibility of CEPA. The Law was revised in 2013 so that CEPA and private port operators could discuss and conduct such dredging using a mutually agreed manner. Although re-dredging is the responsibility of CEPA, it has not been conducted because of constraints in terms of equipment (dredging boats) and budget (see "3.5.4 Current Status of Operation and Maintenance" for details).

sedimentation was calculated in a trial manner using the results of past sounding surveys (surveying of the seabed topography using ultrasonic waves, etc.) and those of a newly conducted sounding survey. However, the necessity for more detailed investigation in the coming years was pointed out in view of the insufficient availability of data.

b. As part of the Detailed Design Study (implemented as an ODA loan-related D/D outside the scope of the Project from 2001 to 2003), the annual volume of sedimentation was estimated by simulation using a numerical model. The resulting estimate was 1.24 million m^3/year of sedimentation volume and the conclusion was that the dredging frequency would need to be increased compared to the assumed frequency at the time of the Feasibility Study. No field experiment to produce a much more accurate forecast of the rate of sedimentation took place because of the huge cost that would be incurred for such an experiment.[16]

c. After the commencement of the construction work under the Project in 2005, a bathymetry study which was conducted in parallel with the dredging work discovered in 2007 that there was considerable sedimentation in the inner channels, outer channels and berth. The actual volume of sedimentation was estimated to be nearly four times the previously estimated volume, causing concern in regard to the prospect of a smooth port operation after opening.

d. Because it was believed necessary to conduct a detailed investigation of various issues, including identification of the causes of the massive amount of sedimentation, in order to predict the future rate of sedimentation and to plan adequate measures, the Special Assistance for Project Implementation for the La Union Port Development Project in El Salvador (SAPI) was implemented from 2008 to 2009. This study disclosed that near the seabed, there was slow movement of suspended mud heading towards deeper areas of the seabed, causing severe burying of the access channels.[17] Following this discovery, from June 2006 and onwards, the rate of sedimentation was newly estimated based on sounding data obtained both prior to and after dredging.

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[16] In a field experiment, pseudo-access channels are introduced in the subject area to investigate the mechanism and rate of sedimentation. While the preliminary study for the Detailed Design Study stated that "in-situ sedimentation data from at least a field experiment is essential to obtain a numerical value (i.e. volume of sediment soil) which can withstand rigorous evaluation", it also stated that "in order to do that it takes a considerable cost, thus in most of the cases in reality it is impossible to obtain sedimentation data". It also mentioned that "trial calculation of the volume of sedimentation this time is necessary to obtain a reference value for subsequent determination of the contents of a future access channel dredging plan". It is a fact that the Japanese consultant proposed that CEPA conduct a detailed investigation of the phenomenon of sedimentation at the time of signing the consulting service agreement for the Project but as a result of discussions during the contract negotiation, such an investigation did not materialize, partly because it was not included in the scope of work agreed upon by JICA and El Salvador during appraisal and partly because of the huge cost. (These comments are based on materials provided by CEPA. The actual details, including whether or not the proposed investigation included a field experiment, have not been clarified.)

[17] This kind of burying (sedimentation) mechanism was not assumed in the simulation mentioned earlier.

e. Because the accuracy of the SAPI estimation mentioned above was insufficient to calculate the volume of maintenance dredging, JICA conducted an additional sounding survey and data analysis from 2011 to 2012 as part of the *Project for Maintenance Dredging of the Port of La Union (2010-2014)*. As a result, it became clear that annual dredging of more than 8 million m^3 of sediment would be required to maintain the access channel water depth of 14 m as planned. In addition, as part of this project, financial analysis was conducted using the dredging cost for various cases of water depth (8 m to 14 m) and the estimated demand for cargo transportation based on each water depth. This analysis suggested that when the port usage fee at La Union Port at the time remained unchanged, the operation of La Union Port would always be in deficit regardless of the water channel depth.[18]

(2) Exclusion of Gantry Cranes from the Scope of the Project

After the commencement of the Project, the water depth of the berth for the container terminal was changed from 14 m to 15 m in 2005 following a request by CEPA to enable La Union Port to receive post-Panamax ships. The resulting increase of the construction cost led to the exclusion of the procurement of gantry cranes from the scope of the Project based on the amendment of the loan agreement between the two countries through legal procedure and the procurement of gantry cranes was left to the private port operator of which the introduction was planned in the Project. The agreement between CEPA and JICA regarding this change included the clause that CEPA would procure gantry cranes if it was found difficult by private port operator to procure them. At the time of the ex-post evaluation, CEPA still assumed that gantry cranes would be procured by a private port operator as mentioned in the next section. Because the appointment of such a private port operator has so far not taken place, gantry cranes have not been procured.[19]

The existence of gantry cranes is essential for La Union Port which is conceived as the only full-scale container port in El Salvador. The exclusion of gantry cranes from the scope of the Project has led to a situation where a private port operator has not been forthcoming. The lack of gantry crane limits the size of container ships which are able to make port, posing a grave risk of preventing the realization of positive project effects. While this change of the plan took place before the discovery of the phenomenon of excessive sedimentation beyond the original estimate, the increase in the targeted water depth at the berth has further increased the dredging cost.

[18] To improve the profitability of the port, this analysis proposed an increase of the port usage fee and extra efforts to realize the growth of La Union Port as a hub port for transhipping, among others.

[19] See "3.2.1 Project Outputs" for more details. Apart from gantry cranes, the procurement of tug boats was also excluded from the scope of the Project. However, a tug boat was provided by CEPA by the time of the ex-post evaluation.

(3) Limitation of the Operating Method to a Concession

As far as the operating method of La Union Port is concerned, leasing of the terminal to a private port operator (hereinafter referred to as “a concession”) was assumed at the time of signing the loan agreement and JICA subsequently provided technical cooperation based on this assumption. However, there is still no prospect of fulfilling this assumption. The procurement of gantry cranes and dredging were also to be conducted by a private port operator, after changing the scope of the Project. The failure to find a suitable private port operator to act as a concessioner means that the achievement of the expected project effects has been hampered.

At the time of the planning of the Project, the idea of a concession enabling efficient operation of the port was commonly accepted throughout the world. In El Salvador, however, there was no precedence of a concession and the relevant legal framework was non-existent. After the completion of the construction work in December 2008, based on the situation that no consensus could be built in regards to the concession law, JICA conducted a technical assistance study regarding the operation methods of the container terminal from October 2009 to June 2010. As a result, it recommended a partial concession after a five-year period of self-operation, and based on this, CEPA bought the necessary equipment using its own means and started self-operation for the time being. However, the policy afterwards took a turn, and it was decided to pass the concession law through the congress instead. At the end, it took nearly 10 years for debates involving CEPA, the Technical Secretariat of the Presidency and the congress to bear fruit with the Concession Law for Container Oriented Multi-Purpose Terminal Phase I for La Union Port in 2011. This Law was revised in 2013. After a period of necessary preparation by CEPA, a tender was finally organized from 2014 to 2015 but no bidder came forward. Because of this, CEPA has been directly operating the port up to the present on a provisional basis.

As can be seen, it can be said that there has been insufficient consideration of the possibility that the development of a suitable legal framework might take much longer than originally predicted, and that the successful signing of a concession contract may take time because such contract is strongly susceptible to market conditions and the perceived profitability.

Based on the above, the Project was highly relevant to the development policies and development needs of El Salvador and also the ODA Policy of Japan for El Salvador. In this sense, the level of its relevance is high. However, it can be pointed out that there has been no concrete plan detailing the role, operation and other aspects of La Union Port and there is a possibility that the necessity for La Union Port has slightly declined because of the improvement of Acajutla Port in recent years. Moreover, the realization of positive project effects has been hampered by the facts that in spite the fact that there was a need for a preliminary investigation of the phenomenon of sedimentation of the berth and access channels,

civil works started without conducting such investigation taking into consideration CEPA's decision; the exclusion of gantry cranes, which are crucial for a container port, from the scope of the Project; and the restriction of the port management method to a concession at a stage when the relevant legal framework was not in place. In short, the appropriateness of the project plan, approach and other aspects of the Project are questionable. Taking all of the factors to determine the relevance of the Project into consideration, the overall relevance of the Project is fair.

3.2 Efficiency (Rating: ①)

3.2.1 Project Outputs

The planned facilities under the Project and the actual results are shown in Table 1. Comparison of these actual results with the original plan is given in "Comparison of the Original and Actual Scope of the Project" at the end of this report.

Table 1 Actual Output at the Time of Ex-Post Evaluation

Item	Contents
I. Civil Engineering Work	
• Container Terminal	Pier: 1 berth, water depth 15m, total length approx. 360m (for Panamax ship) Container yard area: approx. 184,000m^2/ Handling capacity 750,000TEU
• Bulk Terminal	Pier: 1 berth, water depth 14m, total length approx. 220m(for Panamax ship) Yard area: approx.162,000m^2
• Passenger Ship ／ Ro-Ro Ship Terminal	Pier: 1 berth, water depth 9.5m, total length approx. 240m
• Seawall	1,730m
• Buildings	Total building area: 6,300m^2 (Maintenance Shop and Container Freight Station were cancelled.)
• By-pass Road	14.3km
• Paving Work	83,340m^2
• Dredging of Port Access Channels and Berth	Aggregate length：22.3km（Inner channels 5km, Outer channels 17.3km） Water depth: Sedimentation to make the water depth of 7.1-14m for inner access channels and 10m-14.5m for outer access channels
• Land Reclamation Work	4.1million m^3
• Port Access Channels Supporting Facilities	16 GPS-mounted drifting buoys , one lighthouse and automatic ship identification system
II. Equipment (Gantry Cranes; Tug Boats)	Outside the scope of the Project. The gantry cranes have not been installed. Tug boats are procured by CEPA as needed.

III. Consulting Service	Review of the feasibility study, support for tender and supervision of the civil engineering work. A study on the landfill soil was added. Assistance for the procurement of equipment was cancelled following the decision to make equipment outside the scope of the Project.

Source: Based on documents provided by CEPA.

Changes of the outputs greatly affecting the project period and project cost are explained below.

- As described in "3.1.4 Appropriateness of the Project Planning and Approach", the maximum size of a container ship which can use La Union Port was assumed to be the Panamax size at the time of appraisal. This was later changed to the post-Panamax size following a proposal based on a new demand forecast for maritime transportation by CEPA. This change necessitated an adjustment of the water depth from 14 m to 15 m as well as extension of the container berth and an increase of the container yard area. To compensate for the increased construction cost caused by these changes, gantry cranes and tug boats were removed from the scope of the Project as it was expected that these would be provided by a private port operator. These changes that were based on the new demand forecast were made in consideration of the market conditions at the time as well as the situation of post-Panamax ships becoming the mainstream for container shipping. For several reasons, however, La Union Port has not been fully utilized since its opening. The principal reasons are: hasty deepening of the water depth without an adequate forecast of the dredging cost when it was pointed out that there was a strong need for further detailed investigation of the phenomenon of sedimentation, and passing-on of part of the facility cost to a private port operator (i.e. removal of gantry cranes from the scope of the Project) when preparations to develop a legal framework for a concession system were slow to proceed.

- The original plan was to use the dredged sediment to create the berth and access channels for reclamation. Following the discovery that the quality of the dredged sediment was unsuitable for reclamation, a study on the dumping of the dredged sediment was added and it was decided to dump the dredged sediment elsewhere in the Bay of La Union. In addition, in the case of the seawall, the originally planned length of 605 m was almost trebled because of the creation of a dumping site for the dredged sediment (in the western part of the bay). As this change was necessitated by the local natural conditions, it was appropriate.

- While a by-pass road was within the scope of the Project, the construction of such a road was not covered by the ODA loan and it was constructed by the Department of Public Works in

El Salvador.[20]Improvement of the section connecting the by-pass road to the coastal trunk road was added to the work. As this additional section connects the said trunk road and the City of La Union, it is important from the viewpoint of local development. Therefore, this change was appropriate.

3.2.2 Project Inputs

3.2.2.1 Project Cost

The total project cost at the time of appraisal was 14,977 million yen of which 11,233 million yen was to be covered by an ODA loan. The actual total project cost of 23,281 million yen (155% of the planned cost) was significantly higher than planned. In contrast, the actual ODA loan disbursed was 11,207 million yen which was almost as planned.

Table 2 Project Cost[1]

(Unit: million yen)

	At the Time of Appraisal[2]				Actual Result			
	Foreign Currency	Local Currency	Total		Foreign Currency	Local Currency	Total	
			Total	ODA Loan			Total (% to the Plan)	ODA Loan
Civil Engineering Work	6,747	2,577	9,324	7,030	10,308	9,008	19,316 (207%)	10,308
Equipment and Materials	2,333	0	2,333	2,333	0	0	0	0
Consulting Service	436	242	678	678	899	389	1,288 (190%)	899
Reserve	941	251	1,192	1,192	0	0	0	0
By-pass Road[3]	0	863	863	0	0	2,058	2,058 (238%)	0
Administration Cost	0	54	54	0	0	587	587 (1,087%)	0
Tax	0	533	533	0	0	32	32 (6%)	0
Total	10,457	4,520	14,977	11,233	11,207	12,074	23,281 (155%)	11,207 (100%)

Source: Appraisal is based on documents provided by JICA. Actuals are based on documents provided by CEPA.

Notes

1. Foreign exchange rates [at the time of appraisal]: foreign currency portion (Yen 108.36 = US$1); local currency portion (¢8.75 = US$1); [at the time of ex-post evaluation]: foreign currency portion (Yen 108.8 = US$1) (based on the average annual rate of the IMF for 2002 to 2010)
2. Price escalation factors: foreign currency portion 0.8%, local currency portion 3.0%; reserves: ground work 10%, underground work 15%, equipment and materials 5%; timing of quantity survey: December, 2000
3. While the by-pass road was within the scope of the Project, it was not covered by an ODA loan. It was, therefore, constructed by the Department of Public Works of El Salvador.

[20] This by-pass road connects La Union Port with San Miguel, a major city in the eastern region of El Salvador, and El Amatillo on the border with Honduras (both of these cities are on the Pan American Highway) without passing through urban areas of the City of La Union. Moreover, this by-pass road has also made it possible to connect La Union Port with the southern coastal trunk road. The construction of this by-pass road preceded the main construction work under the Project so that the by-pass road could function as a service road for the main construction work.

The total project cost over-ran the original budget by 8,304 million yen, most of which was attributable to the increased cost of the civil engineering work and not related to any increase or decrease of the project outputs.[21] The main reasons for the increased civil engineering cost are explained below.

- The change of the maximum ship size from the Panamax size to the post-Panamax size increased the volume of the work, pushing up the civil engineering work cost by US$ 23 million (approximately 2,507 million yen) and the consulting service fee by US$ 1 million (approximately 108 million yen). These extra expenses were met by the re-allocation of the equipment budget (gantry crane and tug boat) for the ODA loan and CEPA's own funds.

- After the commencement of the Project, it was discovered that the rate of sedimentation of the access channels was far greater than predicted at the time of the detailed design, necessitating additional dredging to maintain the design water depth.

- The prices of materials which were steady at the time of appraisal began to increase since 2004 and the project cost was severely affected by global price increases of oil and construction materials in 2007 and 2008.

3.2.2.2 Project Period

While the assumed project period at the time of appraisal was from October, 2001 to March, 2006 (four years and six months or 54 months), the actual period was from October, 2001 to July, 2009 (seven years and 10 months or 94 months, 174% of the originally planned period), exceeding the original plan by three years and four months (Figure 2).[22] La Union Port was completed in December 2008 and was handed over to CEPA in January, 2009, however, port operation did not commence immediately because of the delayed development of the necessary legal framework for the introduction of a private port operator. The port was finally opened on 21st July, 2010 under the direct management of CEPA.

The main reasons for the significant delay of project completion are explained below.

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[21] The civil engineering cost exceeded the planned budget by 9,992 million yen. Considering that 1,297 million yen was re-allocated to the civil engineering work due to a decision to remove equipment (gantry crane and tug boat) from the scope of the Project, the net excess was as huge as 8,695 million yen. This exceeds by far the increase in the amount of the project cost (22,615 million yen) that resulted from the berth depth increase (increase in output). The exclusion of equipment from the scope of the Project meant a decrease of the outputs.

[22] The idea of "project completion" based on the attachment of the loan agreement is defined as "the completion of the entire construction work and consulting services". Consulting services included the elaboration of the Project Completion Report among other tasks, since these continued until July 2009 after the opening of the port, the actual completion of the Project was considered to be July 2009. Although gantry cranes and tug boats were not procured, these were not considered in the actual performance of the Project in the project period due to their exclusion from the scope of the Project.

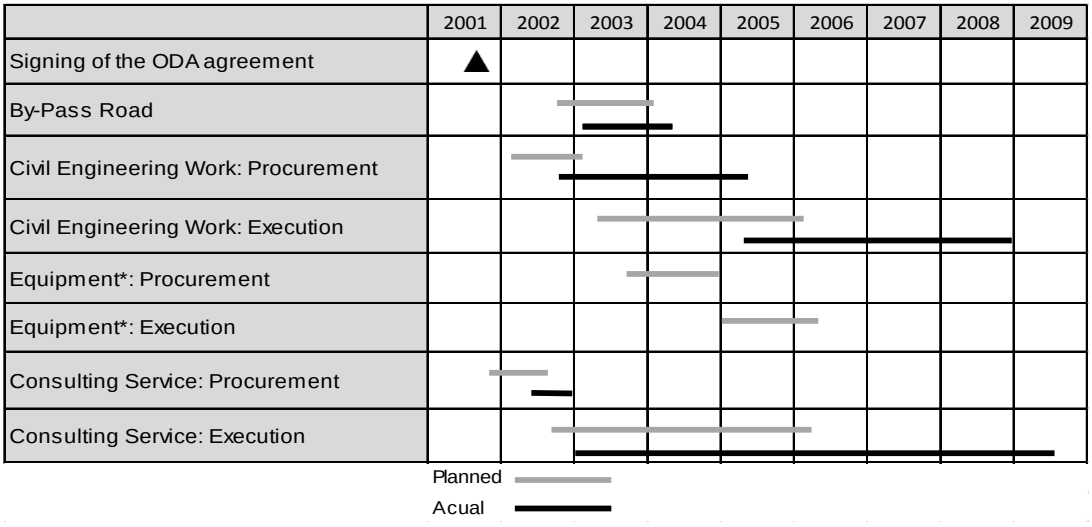
- The completion of the detailed design (conducted separately from the Project as an ODA-related D/D) was delayed from the planned March, 2002 to October, 2002, affecting the start of the procurement process for the civil engineering work by eight months.

- The procurement process from review of the tender documents to selection of the successful bidder for the civil engineering work took a long time because CEPA lacked experience of handling the tender process. In addition, the lengthy contract negotiations caused by a significant increase of the bidding price above the assumed price due to inflation, etc. resulted in an actual procurement period of 32 months instead of the planned 12 months.

- The civil engineering work was planned to last for 36 months. This work actually took 45 months to complete because of additional work necessitated by a modification in the detailed design following the change of the ship size to the post-Panamax size; additional investigation concerning sediment for reclamation; and implementation of additional dredging.

- Lengthening of the consulting service period: The delayed start of the civil engineering work and subsequent lengthening of the project period meant a longer contract period. As the consulting service contract included the preparation of a project completion report and assistance for a warranty completion report, the consulting service contract ended seven months after the completion of the construction work.

Figure 2 Planned and Actual Project Periods



Source: JICA for the planned periods and CEPA for the actual periods.

* Equipment means gantry cranes and tug boats. As these were removed from the scope of the Project, their procurement did not take place.

3.2.3 Results of Calculation of Internal Rates of Return

The EIRR at the time of appraisal was 15%.[23] At the time of the ex-post evaluation, efforts were made to calculate the FIRR and EIRR but no actual results were obtained because of the difficulty of accurately estimating the costs and benefits.[24]

Both the project cost and project period significantly exceeded the plan. Therefore, the efficiency of the Project is low.

3.3 Effectiveness[25] (Rating: ①)

3.3.1 Quantitative Effects (Operation and Effect Indicators)

The assumed effect of the implementation of the Project was the ability of El Salvador to cope with increasing shipping cargo traffic and the annual cargo handling volume at La Union Port and these were set as the indicators for the quantitative effect of the Project.

Table 3 Operation and Effect Indicators for La Union Port

Indicator (Unit)	Target	Actual Results					
	2015[1]	2010 (Year of Opening)	2011	2012	2013	2014	2015 (Target Achievement Rate)
【Principal Indicators】							
1. Total Cargoes Handled							
a. Container Cargoes (Thousand TEU)	275	0.6	4.0	18.4	0	0	0 (0%)
b. Bulk & General Cargoes[3] (Thousand tons/year)	841	9.9	23.4	37.5	30.5	32.3	21.9 (3%)
【Auxiliary Indicators (for Reference)】							
2. Annual Number of Ships Docked (Number of Ships by Category /Year)							
a. Container Ship	208	4	14	48	0	0	0 (0%)
b. Bulk & General Cargo Ship	53	2	3	4	6	6	4 (8%)
c. Passenger Ship/ Ro-Ro Ship	34	0	0	0	0	1	0 (0%)
d. Other (Mostly Fishing Boats[2])	－	1	0	5	9	4	19
3. Berth Occupation Ratio[3] (%)	－	1.3%	1.9%	2.5%	10.1%	1.4%	10.3%

Source: CEPA.

Notes

1. As the target values for these indicators were revised based on the demand forecast at the detailed design (ODA Loan-Related D/D) stage, the revised target values are used for the ex-post evaluation. In addition, although target values were also set for 2005 and 2010, the level of achievement of the target values in 2015 is used for ex-post evaluation purposes after consultation with CEPA because of the operation commencement year of La Union Port (2010).
2. There is a canned tuna factory run by Calvo, a Spanish canned tuna producer, at Corsain Port located next to La Union Port. La Union Port and Calvo have an agreement that La Union Port will be responsible for the entire maintenance service for the tuna fishing boats including refuelling.

[23] According to JICA materials, for the calculation of the EIRR at the time of appraisal, the costs consisted of the construction cost and maintenance cost while the benefits consisted of the difference between the with-project and without-project cargo transportation cost and cargo handling cost at another port, and the income from the transhipment handling of foreign cargo.

[24] Discussions were held with CEPA regarding the possibility of calculating the FIRR only. However, partly because of the lack of a clear picture of the future operation of La Union Port, no agreement was reached to calculate the FIRR based on, for example, the current income and current operation and maintenance cost.

[25] The effectiveness is rated in consideration of not only the effects but also the impacts.

3. Berth occupation ratio: A target figure of 43% was set only for the container berth. Because the available berth occupation ratio includes that of a berth belonging to the bulk terminal, no target figure is entered on the table. In 2015, the occupation time by fishing boats was said to be quite long.

At the time of appraisal, the "total cargo handled" among the various indicators listed in Table 3 was set as the principal indicator while the "number of ships docked" and "berth occupation ratio" were set as auxiliary indicators.[26] Subsequently, based on the review results of the feasibility study conducted as part of the ODA loan-related D/D, the total cargo was divided into "container cargo" (thousand TEU/year) and "bulk and general cargo" (thousand tons/year) and a target value was set for each.[27] Each of the other indicators was also given a target value.

In July, 2010, La Union Port was opened under a provisional management regime directly run by CEPA. As shown in Table 4, the cargo handling volume so far has been much lower than the target. Even though this port was constructed as the sole full-scale container port in El Salvador, the handling of containers ended in 2012. Similarly, the handling volume of bulk and general cargo declined from some 40,000 tons in 2012 to 20,000 tons in 2015, achieving only 3% of the target volume. At present, most of the maritime cargo traffic still goes through Acajutla Port (see "3.1.2 Relevance to Development Needs").

To facilitate the use of La Union Port, CEPA granted such preferential treatment as a discounted port usage fee for a joint venture of American President Lines (APL) and Hamburg Sud, successfully attracting a regular weekly service of container ships (maximum draft of 9.5 m) at the end of 2011. This joint venture originally used Acajutla Port but took this opportunity in view of the potential handling of the maritime cargo of Honduras at La Union Port. However, it withdrew its operation involving La Union Port at the end of 2012 after one year of operation because of the comparative disadvantage of La Union Port when various components of the transaction cost were taken into consideration.[28] This disadvantage was caused by the slow progress of market penetration in Honduras, and the concentration of the cargo transportation demand in El Salvador around Acajutla Port. No container ships have called at La Union Port since 2013 and only bulk cargo ships (mostly carrying fertilizer) and fishing boats (for maintenance) currently call at La Union Port. Because of this situation, the total annual cargo handled, annual number of ships docked and berth occupation ratio have been far below the planned levels.

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[26] The provisional target value was shown only for the "total cargo handled".

[27] TEU (Twenty-Foot Equivalent Unit) is a unit which roughly indicates the volume of cargo and is used to indicate the loading capacity of a container ship or cargo handling capacity of a container terminal. Of containers of standard sizes, one 20 foot container is considered to constitute 1 TEU.

[28] Here, the transaction cost includes the cargo transportation cost from La Union Port to the western part of El Salvador where there is a concentration of major markets and the additional cargo transportation cost to and from San Bartolo near San Salvador for export inspection by the customs office located in San Bartolo due to the absence of a customs office at La Union Port. By the time of ex-post evaluation, remedial measures to reduce such transaction cost have been introduced by CEPA, including the introduction of customs, immigration and quarantine facilities and the deployment of the requirement manpower, for La Union Port.

Based on the results of interviews with CEPA and findings of a study on relevant enterprises (see "3.4.1 Intended Impacts"), the reasons for the slow progress of use of La Union Port can be summarized as follows.

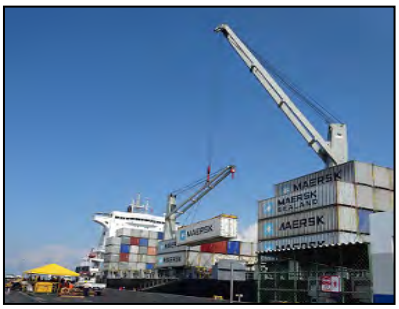
Constraints in Terms of Port Capacity

The berth and access channels at La Union Port have not undergone re-dredging or maintenance dredging (see "3.5.4 Current Status of Operation and Maintenance" for details) and the water depth of the inner access channels has become approximately 7 m in parts, restricting the navigable ship size. Ships capable of making port at La Union Port at the time of ex-post evaluation are restricted to those with a maximum draft of approximately 8 m to 8.5 m even if they are able to use the water depth at high tide (9 m), exploiting the tidal range of approximately 2 m (the draft of a Panamax ship is 12 m). Meanwhile, the absence of a gantry crane at La Union Port restricts the use of this port only by container ships equipped with an on-board crane. Because of these facts, the cargo handling capacity of La Union Port is restricted.

Declined Demand for Cargo Handling[29]

The target values for the indicators described earlier were set based on the demand forecast conducted as part of the review under the feasibility study implemented from 2001 to 2002. However, the economic growth of El Salvador stagnated following the global financial crisis that occurred from 2008 to 2009 and the overall demand for cargo handling in El Salvador fell below the forecast.[30]

Despite the original assumption of the development of a complementary relationship between La Union Port and Acajutla Port in terms of official policy and planning, the cargo handling capacity of Acajutla Port has gradually increased since 2009 against the background of slow progress of the use of La Union Port (the total cargo handling volume increased to 8 million tons and the container handling capacity increased to 135,000 TEU in 2009 and 180,000 TEU in 2015). As Acajutla Port is now capable of handling a much larger cargo volume that was forecast at the time of the appraisal, it has absorbed much of the cargo transportation demand which was supposed to be handled by La Union Port.[31]



Acajutla Port

[29] See "3.1.2 Relevance to the Development Needs".

[30] According to reference materials provided by the Central Reserve Bank of El Salvador and CEPA, the GDP growth rate of El Salvador in 2008 was -3.5%. The cargo handling volume of Acajutla Port steadily increased until 2008 but declined by 24% in 2009 compared to the 2008 level. The overall cargo handling volume of ports in El Salvador in 2015 was approximately 80% of the forecast made at the time of appraisal. Deterioration of public security in El Salvador, especially in the eastern region which in turn caused stagnation of domestic and foreign direct investment in the said region can also be considered as exogenous factors that explain the declining of cargo demand.

[31] According to CEPA, Acajutla Port handled 1.59 million tons of container cargo in 2015. This volume is believed

Uncertain Port Operating System and Business Strategy

The original plan for the operation of La Union Port was leasing of the terminal to a private port operator. The actual tender was held from 2014 to 2015, four years after the opening of the port, due to the lengthy time required to develop a suitable legal framework. Unfortunately, however, no bidder came forward. La Union Port is provisionally operated directly by CEPA, but the future operating system is under consideration and it has not been defined.

Meanwhile, despite the official policy of making Acajutla Port and La Union Port primarily handle bulk cargo and container cargo respectively, the container handling volume of Acajutla Port has been increasing through a series of investment in port facilities. In reply to the evaluator's question about the future port management strategy and roles of these ports during an interview, CEPA replied that as the Government of El Salvador (Technical Secretariat of the Presidency) is responsible for any decisions on policy and strategy, CEPA cannot give an official answer. In this interview, no clear explanation was given regarding either the marketing efforts for La Union Port or management efforts, including revision of the port usage fee to a more competitive level.

La Union Port:
Container terminal, cranes and administration building

Interviews with maritime shipping companies and shippers found that the situation described above constitutes uncertainty along with the problem of sedimentation of the berth and access channels in regard to use of La Union Port. Because these uncertainties are regarded as risks by potential port users, they are partly responsible for the slow progress of the utilization of this port.

One positive move to help achieve the intended effects of the Project is the coordination that is being done between El Salvador and Costa Rica for the introduction of a ferry service between La Union Port (El Salvador) and Caldera Port (Costa Rica).[32] This ferry would provide a regular service between these two ports three times a week with a travelling time of 16 hours one-way. The CEPA believes that the start of this ferry service as a first step towards the better utilization and operation of La Union Port will attract more users to vitalize port operation.

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to be equivalent to approximately 80% of the container cargo which was originally supposed to be handled by La Union Port in the year concerned. The CEPA intends to continue to invest in equipment, etc. for Acajutla (introduction of a container scanner and widening of the access road to the port, etc.) in the coming years as part of the plan to increase this port's cargo handling capacity by a further 30%.

[32] This ferry service will be operated by a joint venture of Spanish, French, Tunisian and Mexican enterprises. The total amount of investment is approximately US$ 44 million. The information given in the main text is based on an interview with a representative of this joint venture and materials provided by the joint venture. A ferry boat is 150 m in length and 14,700 DWT and can carry 100 container trucks and 400 passengers. According to JICA, as of August 2016, ground levelling of the port premises, parking lot and access roads had already been completed anticipating the operation of the ferry.

Phase 1 (six month period from the start) will be confined to the transportation of 60 – 100 container trucks per trip and Phase 2 will be the commencement of a passenger transportation service. Travel between El Salvador and Costa Rica takes approximately three days by land and also involves customs clearance and other procedures when crossing borders in Nicaragua and Honduras. Travel by sea would reduce the number of such procedures as well as the transportation cost. There is also an indirect effect of improving the safety of truck drivers. This ferry service is mentioned in the *Master Plan for the Comprehensive and Sustainable Development of the Eastern Region of El Salvador 2015-2025* referred to earlier.[33]

3.3.2 Qualitative Effects

The qualitative effects of the Project envisaged at the time of appraisal were "vitalization and improved efficiency of distribution of goods in El Salvador", "short-term creation of employment as a result of implementation of the Project", "creation of employment through port operation", and "economic development of the city of La Union as a port city and vitalization of the local economy through an export processing zone, etc." All of these are analysed as impacts.

3.4 Impacts

3.4.1 Intended Impacts

The assumed impacts of the Project were the vitalization and improved efficiency of distribution of goods and promotion of the local economy in the eastern region of El Salvador. To be more precise, this promotion of the local economy meant "the creation of short-term employment through the implementation of the Project", "employment through port operation" and "economic development of the city of La Union as a port city and vitalization of the local economy through an export processing zone, etc." as mentioned earlier. Because of the limited use of La Union Port, however, as mentioned below, these impacts have hardly materialized except for creation of the short-term employment.

- The vitalization and improved efficiency of distribution of goods were expected to ease the congestion at Acajutla Port in particular. Both the cargo handling capacity and actual cargo handling volume of Acajutla Port have greatly increased beyond the assumptions made at the time of appraisal as a result of investment in equipment as well as infrastructure and automation of container management. The average waiting time for container ships using this port fell from 13.7 hours in 2004 to 5.1 hours in 2015, achieving the improved efficiency

[33] Besides the ferry operation, other items that are being considered in the Master Plan are the construction of a logistical park, promotion of tourism businesses, and construction of a sustainable energy generation center, among others.

of distribution of goods. However, this improvement has been achieved irrespective of the Project and cannot be considered to be an impact of the Project.

- Because of the much greater scale of the civil engineering work than originally planned, it is safe to infer that the scale of short-term employment created during construction was larger than originally assumed. In regard to employment through port management, four graduates and three interns from the fairly new MEGATEC (*Modelo Educativo Gradual de Aprendizaje Técnico y Tecnológico*; a two year technical college) La Union have been employed at the port along with some local residents employed as security personnel. All other people working at the port are full-time employees of CEPA and their recruitment has no local preference. According to the ferry operator, once the ferry mentioned in 3.3.1 – Quantitative Effects is at the operational stage, this operator may well be able to newly employ some 75 MEGATEC graduates by the start of Phase 2 of the ferry operation.

- The Master Plan at the moment of appraisal (year 2000) calls for the construction of an export processing zone covering some 100 ha of land located next to La Union Port but no concrete moves have been made to materialize this plan. According to the municipal government of La Union, a series of investment totalling some US$ 6 million was made in the three year period from 2008 to 2010 with the expectation of knock-on effects from La Union Port. This investment included a hotel and branches of a bank and mobile service provider. By the time of the ex-post evaluation, all of these have ended or suspended their business operation and the expected increase of local employment and tax revenue has not materialized.

A questionnaire survey was conducted as part of the ex-post evaluation to clarify the awareness of the impacts of the Project among local residents.[34] This survey found that 38% of local residents are aware that La Union Port was constructed as an international port. Less than 30% believe that La Union Port has successfully achieved the expected boost to the local economy in terms of investment, employment and income (see Table 5). Around 2013 and 2014, large cruise ships and training vessels of the US Navy called at La Union Port several times, bringing many visitors to the restaurants and shops of the city of La Union. The reply that La

[34] The questionnaire survey was conducted in February, 2016 with 100 local residents of the City of La Union and neighboring area. The sampling method used was judgement sampling where approximately the same number of people was sampled from each of five occupation groups (commerce, company employee, full-time housewife, student and other) in eeach of the five nearest districts to the project site (La Union, Concepcion, El Centro, Pueblo Viejo and San Carlos) so that the gender ratio would be roughly equal. For this judgement sampling, the representative sampling method was used. The attached condition for sampling was that the respondent must have lived or had a business in one of these districts before and after the Project. 54 respondents were male and 46 were female. By age group, 33% were in their 20's, 17% in their 30's, 16% in their 40's, 18% in their 50's and 16% in their 60's or older. Strictly speaking, this survey should have covered a much wider area because the development of the eastern region was part of the project purpose. However, in view of the limited port operation, only the nearest districts to the port were selected. There is no major bias in the subject districts of this survey but there is a possibility of localized bias in a wider area.

Union Port has contributed to increased investment, employment and income appears to be based on the experience of these visits. 79% of local residents replied that "La Union Port is currently (i.e. at the moment of the ex-post evaluation) not operating although it operated in the past" while 19% replied that "La Union Port is currently operating to some degree but it has nothing to do with the local economy". These results indicate that most people questioned have no information on the actual state of port operation. A question about the level of income before and after the Project found the possibility that there may have been a general decline of income among residents.

The most hoped for impact at the time of commencement of the Project, according to 70% of the respondents, was "increased employment in the eastern region". At the time of ex-post evaluation, 57% of the respondents continued to expect this impact and 41% replied that in order to achieve it a "leadership of the government" would be required, clearly indicating the desire among local residents for a strong government leadership to vitalize La Union Port as well as the eastern region.[35]

Table 4 Resident Questionnaire Survey Results: Degree of Achievement of Project Purposes

Project Purpose	Nearly or Sufficiently Achieved	Fairly or Totally Unachieved
1. La Union Port has been developed as an international port.	38%	62%
2. The Project has contributed to the handling of increasing maritime cargo and also to the vitalization and improved efficiency of distribution of goods in El Salvador.	30%	70%
3. The Project has contributed to increased investment and businesses in the eastern region.	28%	72%
4. The Project has contributed to increased employment in the eastern region.	22%	78%
5. The Project has contributed to the increased income of local residents of the eastern region.	23%	77%

Source: Resident Questionnaire Survey Results.

An interview survey was conducted with 13 enterprises, such as maritime shipping companies and shippers, which may possibly use La Union Port, asking them to freely express their expectations and opinions with respect to the said port.[36] The most representative opinions obtained were the following:

[35] In contrast, 7% of the respondents replied that "La Union Port should be closed and the area should be used for other purposes".

[36] As part of the ex-post evaluation, an interview survey was conducted from 8th February to 31st March, 2016 with 13 companies which could possibly use La Union Port. The target companies consisted of six shipping companies, two service companies, two agro-industrial companies and three manufacturers. As far as shipping companies are concerned, a list of candidate companies was provided by CEPA while likely shippers were introduced by the Chamber of Commerce and Industry of El Salvador, Association of Exporters of El Salvador, the American Chamber of Commerce of El Salvador, etc. The questions asked are what they expect of La Union Port, what they consider to be a bottleneck for their use of this port, what remedial measures they think are necessary and what

- At the early stage of the Project, there was an expectation that La Union Port would become a strategic port linking all countries in Central America. Our company established a branch in the City of La Union in expectation of the economic development of the eastern region.

- The government should introduce a much clearer policy for ports in El Salvador. Whether or not two ports are really necessary should be clarified by means of conducting an appropriate market survey. If they are found to be necessary, the respective roles of Acajutla Port and La Union Port should be clearly determined.

- La Union Port has become a tool for political argument. It should be separated from politics returning to the original point where the Project was genuinely upheld as an important infrastructure development project necessary for the development of El Salvador.

- La Union Port has, in fact, the best infrastructure, including the location of the container yard, etc., to handle container cargo. Additional investment should be made in a gantry crane, re-dredging, etc. It is necessary to actively attract a private port operator, shipping companies and shippers through a subsidy for the dredging cost, adequate revision of port usage fees and other measures.

- There are ships which can call at La Union Port during high tide with the current water depth, suggesting a possible need for the use of this port. Under the guidance of the government, CEPA should make active marketing efforts to attract new users.

3.4.2 Other Impacts

(1) Impacts on the Natural Environment

Every change of the detailed design for the Project made in 2000 and 2002 were approved by the Department of Environment and Natural Resources and all work requested by the Department at the time was properly conducted. This included a bottom materials survey as well as a biological survey involving dredged sediment and additional environmental conservation measures, such as a biological survey at the terminal construction site, surveys to analyze the constituents of the sediment to be used for land reclamation, surveys for the proposed location of the dredged sediment dumping site and impact survey to the marine ecology, deforestation and reforestation[37], monitoring of other effects from the construction works such as exhaust gas, dust, muddy water, noise and vibration, and no special problems were observed in regard to the natural environment.

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they consider the advantages and disadvantages of La Union Port as an international port to be.

[37] In the Detailed Design, deforestation area due to the Project was decreased from 26 ha to 23 ha, however, with the new regulation of 2002 it was established that 625 trees would have to be planted per each deforested hectare, thus a total afforestation of 14,375 trees was conducted.

(2) Land Acquisition and Resettlement

Part of the planned construction site for La Union Port was owned by the neighboring Corsain Port Authority and this piece of land was purchased by CEPA from the Corsain Port Authority. 66 households (approximately 250 people) illegally occupying this land were relocated to a newly developed residential site located some 7 km from the city of La Union. Houses and such basic infrastructure as water supply and electricity supply were provided by CEPA. Because of the absence of a law concerning the relocation of illegal residents in El Salvador, the conditions, etc. for this relocation were agreed through consultations between CEPA, Corsain Port Authority and local resident. This relocation was completed in 2001. As of the time of ex-post evaluation, a local school has been constructed by the Department of Education and a church has also been constructed with the own funding of residents.

A group interview with relocated residents found that the housing conditions have certainly improved since relocation. Most of the relocated people used to be fishermen and their families, and have engaged in unfamiliar farming since relocation. Their income is said to be rather unsteady as many people work as seasonal laborers due to a lack of funds to rent farming land, difficulties caused by drought and other reasons. As they were told at the time of consultations that “there would be more employment opportunities during the construction and after the opening of La Union Port and that their income would increase”, many of them expressed a hope for the early re-vitalization of port operation.

(3) Other Impacts

There have been some other impacts as described below.

- Impact on local fisheries: During the project implementation period, meetings were constantly held with local fishermen to explain the progress situation of the Project, including the advance notice of restricted navigation and explanation of the compensation scheme for damaged fishing nets. Several measures, including the installation of buoys to clearly mark the construction and dredging areas and water quality monitoring at the time of dredging, were implemented. As a result of these measures, the negative impact on local fisheries was limited.

- By-pass road: In addition to the construction of a new road which by-passes urban La Union to connect La Union Port with the nearby trunk road (Pan American Highway), the road section connecting the port to the coastal trunk road was improved. Even though the traffic volume of these roads was small at the time of ex-post evaluation, there is a possibility that these roads will contribute to improved local traffic with the former acting as a suburban circular road for the city of La Union and the latter as a connecting road between the city of La Union and the coastal trunk road.

- Collaboration with MEGATEC La Union: MEGATEC is a two year college that educates advanced engineers and to foster human resources, making the best use of local industries. MEGATEC La Union was opened in 2008 and JICA implemented the Project for the Strengthening of Teaching Quality of MEGATEC La Union from 2008 to 2010 as a technical cooperation project accompanying an ODA loan project. This college has such specialist courses as "Port Management" and "Physical Distribution and Customs Inspection". The former in particular was introduced with La Union Port in mind. The Port Management Course produces some 30 to 40 graduates a year. According to the college, it is difficult to secure employment for these graduates because of the lack of full-scale operation at La Union Port.[38] The college intends to conduct a follow-up survey on graduates with a view to significantly modifying the curriculum or even withdrawing these courses depending on the survey findings.

To summarize the effectiveness and impacts of the Project, the use of La Union Port has been extremely limited due to an insufficient water depth, lack of gantry cranes and decline of the maritime transportation demand. As a result, the project purpose of meeting the increased demand for maritime cargo transportation in El Salvador has been minimal. This means that the Project has had little impact on the vitalization and improved efficiency of distribution of goods in El Salvador and promotion of the local economy in the eastern region.

Compared to the plan, the Project has achieved its objectives at a limited level and, therefore, its effectiveness and impacts are low.

3.5 Sustainability (Rating:②)

As mentioned earlier, the originally planned operating system for La Union Port was that the terminal would be leased to a private port operator and would operate under the supervision of CEPA. A tender was eventually held after a lengthy period to develop the required legal framework but no bidder came forward. Since its opening in 2010, La Union Port has been operating under the direct but provisional management of CEPA and a future operating system for the port is currently being examined.[39] Because of the future operating system is uncertain, the following issues are analysed here based on the current operating system.

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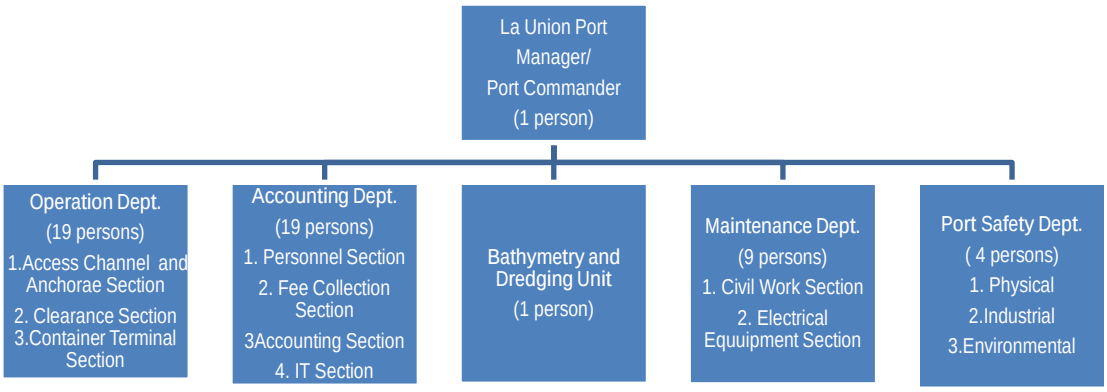
[38] Although some graduates have found employment at Acajutla Port, there is a significant possibility that other graduates have been unable to utilize their specialist knowledge and skills at their current places of employment.

[39] Interviews with some companies (conducted by CEPA) which had been expected to participate in the tender found that the reasons for no bidders were lack of prospects for the cargo transportation demand (due to the lack of local industries in the eastern region and little prospect of international cargo transportation); lack of a consistent vision for La Union Port on the part of CEPA; and likely huge financial burden on a private port operator in terms of the cost of gantry cranes and dredging. In addition, according to interviews conducted during the ex-post evaluation to CEPA, it was confirmed that as of June 2016, CEPA was considering four alternatives for port operation: (1) revision of the Concession Law again to reduce the financial burden caused by maintenance dredging, etc. on a private port operator and launch of a new tender, (2) wait for the completion of separate efforts to develop a legal framework for public-private cooperation and development of a flexible public-

3.5.1 Institutional Aspects of Operation and Maintenance

At the time of ex-post evaluation, the operating and maintenance of La Union Port are directly conducted by a subsidiary of CEPA. The organization and manpower strength of the current operating system are shown in Figure 3. There are a total of 89 people, including full-time staff members of CEPA, outsourced doctor, nurse, personnel department assistants, accounting assistants and security guards.



Source: CEPA.

Figure 3 Operating and Maintenance System of La Union Port

An interview survey conducted at La Union Port confirmed that the decision-making process for operation and maintenance was clearly established. Actual observation at the port confirmed that security was strictly enforced. In view of the current level of use of this port, the available operating and security systems are judged to be adequate.[40]

3.5.2 Technical Aspects of Operation and Maintenance

The technical level of CEPA personnel at the time of ex-post evaluation is judged to be sufficient in almost all of the relevant fields, partly because of a series of technology transfers provided by various donors, including JICA and the World Bank, since the onset of the Project. As far as dredging of the access channels and berth is concerned, however, the current system cannot be described as fully satisfactory because the envisaged dredging work requires a

private partnership (with private sector investment in facilities and equipment and public sector investment in basic infrastructure under a regime of broadly-defined cooperation) within the legal framework, (3) outsourcing of only some services, such as loading and unloading, port security, etc., as is currently the case at Acajutla Port and (4) continued direct management of the port by CEPA.

[40] La Union Port was certified as “a safe port for ships” by the El Salvador Maritime Port Agency based on the International Ship and Port Facility Security (ISPS) Code in May 2014.

dredging boat equipped with a high level of equipment and suitable technical capability of its operators.

Table 5 shows the academic background, specialist field and length of employment of those employed at La Union Port. Considering the operating status of the port at the time of ex-post evaluation, the staff level as well as their technical competency is satisfactory[41] even though the Bathymetry and Dredging Unit should be further strengthened.

Table 5 Technical Background of Operation and Maintenance Staff at La Union Port

	Academic Career / Specialist Field	Average Years of Employment
Operating Section	4 graduates (2 engineers) 17 technicians (9 specializing in port management)	5 years and 8 months
Maintenance Section	1 graduate (engineer) 7 technicians (6 specialist engineers and 1 high school leaver)	13 years
Bathymetry and Dredging Section	1 engineer (having completed a bathymetry and dredging training course)	5 years and 8 months

Source: CEPA.

In regard to facilities and equipment other than the berth and access channels (including the generator, control system, waste water treatment facilities, water purification facilities, navigation aid facilities and fire-fighting/disaster prevention equipment), staff members responsible for these at the Operating Section and Maintenance Section have undergone the relevant training on operation and management provided by the manufacturer or supplier. The present operation and maintenance of La Union Port is adequate as it is conducted in line with the relevant manuals introduced under the Project as well as manuals provided by equipment manufacturers and suppliers. The original manuals are kept by either the Operating Section or Maintenance Section and there are enough copies for use in the field.

Routine maintenance of buoy (provided by CEPA)

An annual maintenance plan is prepared for La Union Port and the budget is set after approval of the plan by the Maritime Port Authority. In principle, preventive maintenance is conducted in accordance with the plan. At La Union Port, inspection is conducted based on a clear maintenance plan to allow use of the port at any time, except for the berth and access

[41] According to a JICA advisor dispatched to CEPA from 2012 to 2014 (as a port operation advisor), the port operation and maintenance capacity of CEPA has greatly improved through a series of technical cooperation, etc. Especially notable is CEPA's infrastructure management capacity as evidenced by the maintenance of the Acajutla Port facilities which are in good condition.

channels. Equipment, etc. is regularly operated to check its working status.[42] Both the Operation Section and Maintenance Section keep their own maintenance records.

Every year, CEPA establishes the staff training needs prepares a training program within the budget and conducts training. In the case of La Union Port, each employee undergoes an average of 32 hours of training.[43] This training mainly takes place at the Central American Commission for Maritime Transport (COCATRAM), El Salvador Institute for Vocational Training or at MEGATEC. At Acajutla Port, field training is conducted. According to CEPA, the types of training required for those working at La Union Port include operation and maintenance relating to dredging and navigation aid facilities, exchange of electronic data, port safety management and operation of port management software.

At the time of ex-post evaluation, the only technical weak point at La Union Port in terms of operation and management is dredging of the access channels and berth (see Footnote 41). Hardly no-one who received technology transfer concerning dredging under the Project for Maintenance Dredging of the Port of La Union implemented by JICA has left their job at CEPA as of the time of ex-post evaluation. One of these is an engineer working in the Bathymetry and Dredging Unit.[44] In regard to maintenance of the access channels and berth dredging work, the Access Channel and Berth Dredging Plan (Manual) prepared by CEPA in 2014 under the above-mentioned project has not been implemented because of the lack of related equipment as well as financial constraints. To make matters worse, CEPA is unable to put forward a clear long-term plan for dredging.

While some ships can still call at La Union Port with the present water depth, there appears to be no clue at present to solve the problem of sedimentation. Under such circumstances the opinion of the port management expert (who was dispatched to assist La Union Port by JICA from 2012 to 2014) that "there is a need to solve the problem of sedimentation at La Union Port, which poses a high level of technical difficulty, by utilizing the world's highest level of technology in the relevant field"[45] seems to be reasonable thus far.

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[42] For example, the maintenance plan for 2016 has 46 preventive maintenance items and four breakdown maintenance items. The plan gives detailed descriptions of the maintenance required, including the responsible section, outline of the required work and detailed procedure of the work, timing of execution (timing of tender in the case of outsourcing), frequency of inspection, monitoring and budget.

[43] In 2015, training was provided for those working at La Union Port on five operation-related subjects (total of 34 participants) and 20 maintenance-related issues (total of 45 participants). In 2016, training is planned on 18 operation-related issues and 12 maintenance-related issues.

[44] Under this project, two staff members of CEPA received training in Japan for a period of one month from November to December 2011 on such subjects as the operation and management of dredging work, bathymetry method and tidal level prediction. The engineering team for the project delivered lectures, exercises, discussions and OJT a total of 12 times. At the same time, the economy team conducted technology transfer regarding the current situation of container transportation in Central America, level of port usage fees and industrial development in the neighboring area of the port, port planning and inward investment through lectures and discussions 16 times. (Based on the *Final Report for the Project for Maintenance Dredging of the Port of La Union*, 2014).

[45] Completion Report for the Work of the Port Management Expert, 2014.

Accordingly, appropriate dredging is essential if the main role of La Union Port is that of a full-scale international container port as envisaged by the original plan.

3.5.3 Financial Aspects of Operation and Maintenance

The CEPA has four subsidiaries (one airport, two port and one railway management companies) in addition to its headquarters. Apart from the one which is responsible for La Union Port, all other subsidiaries are making a profit. The CEPA as a whole has been operating in the black since 2013 (Table 6).

Table 6 Profit and Loss Statement of CEPA

(Unit: US$ 1,000)

Item	2013	2014	2015
Turnover	96,189	92,160	94,704
General Administration Cost	73,485	82,291	86,761
Net Profit for the Term before Tax	22,704	10,248	7,943
Tax	2,494	2,039	NA
Net Profit for the Term	20,210	8,201	NA

Source: CEPA.

The actual financial performance of La Union Port from 2013 to 2015 (Table 7) shows that while the turnover never reached half a million US dollars, the general administration cost, including the maintenance cost of maintaining the port's capability of receiving ships at any time was almost US$ 1.8 million to 2.5 million, recording a permanent operating loss. In addition, non-operating expenses as depreciation and interest payment for Japan's ODA loan and other exceeded US$ 9 million, resulting in annual losses of more than US$10 million/year. It must be noted that these figures do not include the berth and access channel dredging cost.[46]

Table 7 Profit and Loss Statement for La Union Port

(Unit: US$ 1,000)

Item	2013	2014	2015
Turnover	395	408	253
General Administration Cost	2,453	2,117	1,789
Operating Profit/Loss	(2,058)	(1,709)	(1,535)
Non-Operating Expenses	9,655	9,040	9,185
Net Profit for the Term before Tax	(11,699)	(10,376)	(10,699)

Source: CEPA.

[46] The Concession Law stipulates that CEPA is responsible for the cost of re-dredging and the payment for maintenance dredging is divided between CEPA and port operator by negotiation. The 2014 Final Report for the Project for Maintenance Dredging of La Union Port estimates that the actual dredging cost (i.e. maintenance dredging cost plus one-tenth of the re-dredging cost as of 2020) will depend on the water depth, ranging from some US$ 12 million/year for a depth of 10 m to some US$ 45 million/year for a water depth of 14 m (originally planned water depth). Based on the technical and financial analysis results for dredging and port management, the report recommends positive efforts to minimize the financial risk are required by examining the implementation of "phased dredging" in the coming years (for the first 10 years, the water depth of some 10 m will be maintained using a contracted dredging boat and the water depth will then be deepened to some 13 m with second re-dredging).

The above findings clearly indicate that the operation and maintenance cost for La Union Port which has been constantly operating in the red has been supported by the other subsidiaries operated by CEPA the healthier profit-making operation of Acajutla Port, El Salvador International Airport, etc. There is, therefore, concern regarding the financial sustainability of the Project.

3.5.4 Current Status of Operation and Maintenance

The maintenance conditions of the infrastructure facilities, etc. at La Union Port are generally good as described in Table 9 except for the state of dredging of the berth and access channels. Because of the problem of sedimentation at the access channels, the types of ships which can call at the port are rather limited. The port itself is ready to receive these ships at any time. The field survey conducted as part of the ex-post evaluation discovered relatively minor problems in addition to the problem of dredging but these problems can be dealt with by CEPA (Table 8).

Table 8 Operation and Maintenance Problems Experienced by La Union Port at the Time of Ex-Post Evaluation

Infrastructure and Facilities	Operation and Maintenance Situation at the Time of Ex-Post Evaluation
Terminal: No problems in general	• Minor cracks in the concrete/asphalt surfaces are observed. These cracks do not pose a structural problem and CEPA plans to conduct resurfacing. • The attachment of seaweed is prominently observed at parts of the piers in direct contact with seawater. This seaweed requires periodic removal. • The emergency shower and eye-washing facilities are slightly rusty due to their direct exposure to salty wind. Scouring of the rust to remove it and the application of a corrosion-resistance coating is necessary.
Building: No problems in general	• The elevator control system for the building has experienced frequent breakdowns but this problem has been solved by repair work conducted by the manufacturer.
Dredging of berth and access channels: Urgent response required	• No maintenance dredging has been conducted since the completion of the Project. At the time of ex-post evaluation, the water depths of the inner and outer access channels are 7.1 m to 14 m and 10 m to 14.5 m respectively and are almost the same as the commencement of the Project. It is planned to conduct re-dredging to make the water depth 9 m over an eight month period in 2017, and after conduct the planned procurement of a dredging boat.
Navigation aid facilities: Continual response required	• Of the 16 buoys deployed, No. 12 Buoy forces ships to unnecessarily change course by almost 55°. The urgent removal of this buoy is essential while examining whether or not this buoy is required and, if required, a suitable position. Although consultations are in progress with a contractor, removal and possible re-positioning of this buoy will require the approval of the Maritime Port Authority. Work is, therefore, in progress to follow the necessary procedure.

Source: CEPA and site visits

As far as dredging of the berth and access channels is concerned, CEPA has signed an agreement with a Cuban company (waiting for approval from the Ministry of Foreign Affairs as of August 2016) and plans to conduct a sedimentation survey while at the same time conducting the maintenance dredging. For the said dredging, it plans to borrow a cutter suction dredging boat from the Navy, enhance its dredging capacity with its own funding over a period of six months and conduct re-dredging to a water depth of 9 m in an eight month period during 2017 (the current water depth is 7 m).[47] The CEPA is also planning in the long-term to procure its own dredging boat at a cost of some US$ 2 million.[48]

Based on the above, it is clear that there are technical and financial problems regarding dredging of the berth and the access channels in addition to a lack of clarity concerning the future operating system as well as business plan. Some problems are observed as described above in relation to the operation and maintenance aspects of the Project. Therefore, the sustainability of the project effects is fair.

4 Conclusions, Lessons Learned and Recommendations

4.1 Conclusions

The Project was implemented for the purpose of meeting the increased demand for maritime cargo transportation by constructing La Union Port in the Gulf of Fonseca in the eastern part of El Salvador. The Project also envisaged that the increased port capacity in El Salvador resulting from the Project would stimulate distribution of goods and improve its efficiency, thereby contributing to the economic development of the eastern region of El Salvador. Although the Project is relevant to the country's development plan and development needs as well as Japan's ODA policy, there is a possibility that the necessity for La Union Port has slightly declined due to the lack of implementation of a maritime trade strategy and policies in line with the development plan and the recent improvement of Acajutla Port. The realization of positive project effects has been hampered possibly by insufficient preliminary investigation of the phenomenon of sedimentation in the berth and access channels; restriction of the port operation strategy to a concession-based operation when the relevant legal framework was not in place, and further stagnation of port operation resulting from the exclusion of gantry cranes from the scope of the Project. Based on the above, the relevance of the Project is fair. The change of the project scope following the expansion of the target ships to include post-Panamax ships; the necessity for additional dredging of the berth and access channels as a result of

[47] The company that will do the enhancement of the dredging capacity and the maintenance dredging to be conducted afterwards is planned to be decided by public tender. In order to maintain the water depth of 9 m after the re-dredging, it is necessary to re-dredge every three months. With respect to the dumping site of the re-dredged sand (two sites) the approval from the Ministry of Environment and Natural Resources has already been obtained.

[48] According to JICA, as of August 2016, CEPA had entered into an agreement regarding the dredging with a Cuban company, and was waiting for the approval by the Ministry of Foreign Affairs. Once approved, the plan is to conduct a study on sedimentation while re-dredging at the same time, In addition, the procurement of a dredging boat is under consideration as a mid-term plan.

sedimentation exceeding the original forecast; and the steep rise of equipment and material prices, resulted in the actual project cost and project period significantly exceeding the planned cost and period. Therefore, the efficiency of the Project is low. The actual use of La Union Port has been very limited against the background of an insufficient water depth, lack of gantry cranes and decline of the demand for cargo transportation. As a result, the level of achievement of the project purpose is low with hardly any realization of the expected impacts. Therefore, the effectiveness and impact of the Project are low. The sustainability of the project effects is only fair because there are some problems concerning the technical capability to dredge the berth and the access channels, and the financial situation in addition to a lack of clarity regarding the future operating system and business plan for La Union Port. Based on the above, the Project is evaluated as being unsatisfactory.

4.2 Recommendations

4.2.1 Recommendations for the Government of El Salvador

Recommendations to the Government of El Salvador (Technical Secretariat of the Presidency)

The Government of El Salvador must fulfil its responsibility to determine a new maritime strategy for both La Union Port and Acajutla Port and clearly demonstrate the political will to execute such strategy so that these two ports can realize their respective roles of vitalizing and improving the efficiency of distribution of goods in El Salvador. To be more precise, clear determination of the role and business policy for each of these two ports is essential to maintain their mutually complementary relationship in an appropriate manner based on the enhanced capacity of Acajutla Port, the establishment of a clear concept for a dredging plan for La Union Port through the technical cooperation of JICA, etc. and the latest trend of the international maritime transportation market and trend of and need for local development of the eastern region.

Potential port operators, shipping companies, etc. have been reluctant to manage or use La Union Port because of uncertainty regarding the expected role, operating system, water depth of the berth and access channels and general business policy, including suitable usage fees, at this port. There is a real need for the Government of El Salvador to clearly indicate its vision for the business operation of this port to facilitate its use.

Recommendations to the Executing Agency

CEPA needs to work on the use and revitalization of La Union Port that were observed during the ex-post evaluation, that is, it needs to consider the operation method of the port, the operation of the ferry, the enhancement of the dredging ship and dredging up to 9 m of water depth, conduct sedimentation surveys, construction of the logistics park, promotion of the tourist industry and construction of a sustainable energy generation center needs to be realized.

At the same time, CEPA should continue to examine a desirable port operating system and every possible means of enabling the active use of La Union Port other than those mentioned above.

4.2.2 Recommendations to JICA

It is essential for JICA to continually work on the Government of El Salvador concerning the utilization of the outputs of the Project as well as technical cooperation provided in connection with the Project through the submission of the recommendations described in 4.2.1 to the Government of El Salvador.

4.3 Lessons Learned

Adequate Evaluation of the Volume of Sedimentation in a Port Project

In the case of a port construction project where any sort of investigation on the phenomenon of sedimentation at the planned anchorage site and access channels has never been conducted before the project or there is a possibility that the success of the project significantly depends on the size of the maintenance dredging cost due to the long length of the access channels to be dredged, it is necessary to conduct detailed investigation of the rate of sedimentation, including a field test, as when required, at the planning stage to evaluate the volume of sedimentation with sufficiently reliable accuracy. For the present Project, although the necessity for a detailed test was already recognized when the findings of the Feasibility Study were reviewed, such a test was not conducted because of the cost involved. However, the actual rate of sedimentation at the dredged channels is far greater than the forecast, causing serious adverse impacts on port utilization and the financial health of port operation. The detailed analysis conducted later revealed the mechanism and speed of sedimentation were specifically unique at this port which was not expected at the time of project planning. If detailed investigation, including a field test, had been conducted at the earliest possible stage when the possibility of a greater scale of sedimentation than that assumed was suggested, there is a strong likelihood that the worsening of the problem could have been prevented and correct judgement on changes of the project design during the implementation period could have been made.

Risk Assessment and Follow-Up When Deciding the Legal Removal of an Important Component from the Project Scope

When an important component of a project, which is essential for project success, is removed from the project scope (defined in the loan agreement and legally bound) for some reason, the risk associated with the removal of the component in question should be fully assessed to judge whether or not the intended removal is acceptable. Moreover, measures

designed to minimize the conceived risk must be implemented and a full-scale follow-up survey/analysis must be conducted. In the case where such judgement must be made at the project implementation stage, similar attention must be paid based on the risk which has been re-evaluated, taking changes of the various conditions assumed at the planning stage into consideration. In the case of the Project, as a result of the change of the target ship size from Panamax ship size to post-Panamax ship size, gantry cranes were removed legally from the scope of the Project on the grounds of project cost, and was planned to be subsequently procured by the private port operator which would secure the concession. At this time, as gantry cranes were considered to be a crucial component for the successful development of La Union Port, there was an agreement between JICA and CEPA to minimize the risk by CEPA procuring the gantry cranes in the case that the said private port operator could not afford to do so. These gantry cranes to be procured by a private operator have not yet been procured, however, because a concession contract has not been made. The fact that CEPA has been unable to procure this crane has restricted the use of La Union Port. In short, the risk concerning the viability of a concession should have been properly assessed, including the background that the development of the legal framework for a concession had been much slower than originally assumed. Even if the gantry cranes were to be removed from the scope of the loan, the possibility of retaining the gantry cranes within the scope of the Project, by designating them as a project component to be funded by the El Salvador side should have been examined. In this way, monitoring and follow up of the gantry crane procurement situation would have been legally possible and the actual procurement of the crane would have been more likely.

Risk assessment and prior measures to be taken in case there is a shift to a new operating system (introduction of a concession system)

When an operating system is to be newly developed under a project, the preconditions for the successful development of the said system must be carefully recognized. If a risk that cannot be ignored is recognized, a more feasible alternative should be prepared. Especially when the introduction of the private sector through a concession, etc. is envisaged, it is essential to assess the risks associated with various conditions, including the development of the relevant legal framework, market prospects and profitability, which enable the participation of the private sector. It is also necessary to examine a possible operating system in advance in preparation for the non-participation of the private sector and to monitor these conditions so that the course of action can be steered towards the introduction of a more realistic and appropriate operating system, such as direct port management, if a change of action is found to be needed. In the case of the Project, there was an agreement between JICA and CEPA right from the planning stage that port operation would be conducted by means of a concession contract, and thus JICA and CEPA have been working on the legislation and technical cooperation centered

on the assumption of the concession method. A suitable legal framework was finally put in place more than 10 years later than originally scheduled and the tender for the concession was held. As the market situation surrounding La Union Port and the profitability of port operation had considerably changed during this time, no bidder came forward. The decision to make a concession holder, i.e. private operator of the port, responsible for the procurement of gantry cranes restricted the port's functions because of failure to materialize a concession contract. Since its opening, La Union Port has been operated directly by CEPA on a provisional basis and the actual level of port usage has been low. More active use of the port may have been possible if alternative port operating systems, including direct management, had been examined along with a concession contract to start with, and also if a change of the system to a more realistic operating system, such as direct management, had been considered at the time when the development of a legal framework was taking much longer than expected along with changes in both market conditions and prospective profitability of port operation.

Comparison of the Original and Actual Scope of the Project

Item	Original	Actual
1. Project Outputs I. Civil engineering work I-1 Container terminal		
a. Pier	1 berth; water depth to 14 m Length: approx. 300 m	1 berth; water depth: 15 m Length: approx. 360 m
b. Container yard	Area: approx. 120,000 m^2 Handling capacity: 750,000 TEU	Area: approx. 184,000 m^2 Handling capacity: as planned
I-2 Bulk terminal		
a. Pier	1 berth; water depth to 14 m Length: approx. 260 m	1 berth: water depth: 14 m Length: approx. 220 m
b. Bulk yard	Area: approx. 100,000 m^2	Area: approx. 162,000 m^2
I-3 Passenger/Ro-Ro pier	1 berth; water depth to 9.5 m Length: approx. 240 m	1 berth: water depth: 9.5 m Length: as planned
I-4 Seawall	605 m	1,730 m
I-5 Buildings	Port administration building, maintenance shop, container gate, cargo gate, power supply station, office for employees and engineers, water supply and drainage facilities, etc. Total building area: 4,400 m^2	Maintenance shop and container cargo station were cancelled. Total building area: 6,300 m^2
I-6 By-pass road	Approx. 7 km	14.3 km
I-7 Paving	58,800 m^2	83,340 m^2
I-8 Dredging of access channels and berth	Inner access channels (7.5 km): dredged to a water depth of 13 m Outer access channels (15.9 km) and berth: dredged to a water depth of 14 m Total volume of dredged sediment: approx. 9.7 million m^3	Sedimentation has made the water depth of inner access channels and outer access channels to be 7.1 m to 14 m and 10m to 14.5m respectively Total access channel length: 22.3km (5km of inner access channels and 17.3km of outer access channels)
I-9 Land reclamation	1.83 million m^3	4.1 million m^3
I-10 Navigation aid facilities	Buoys and lighthouse: 1 set	As planned
II. Equipment		
II-1 Gantry crane	Two (40.6 tons)	Outside the scope of the Project
II-2 Tug boat	Two (rated horse power: 3,600 PS)	Outside the scope of the Project
III. Consulting service	Procurement support; construction supervision (including guidance and supervision regarding implementation of environmental measures) support for operation and maintenance aspects of the Project	Support for equipment procurement that was excluded from the scope of the Project was cancelled. The contract period was extended because of the need to revise the design and other reasons.
2.Project Period	October 2001 to March 2006 (54 months)	October 2001 to July 2009 (94 months)
3.Project Cost		
Amount Paid in Foreign Currency	10,457 million yen	12,074 million yen
Amount Paid in Local Currency	4,520 million yen (US$ 42 million)	10,026 million yen (US$ 92 million)
Total	14,977 million yen	23,270 million yen
Japanese ODA Loan Portion	11,233 million yen	11,207 million yen
Exchange Rate	US$ 1=108.36 yen (As of October 2000)	US$ 1=108.80 yen (Average between January 2002 and January 2010)

Republic of Peru

FY 2015 Ex-Post Evaluation of Japanese ODA Loan Project
"Provincial Cities Water Supply and Sewerage Improvement and Expansion Project
(Iquitos, Cusco and Sicuani)"

External Evaluator: Hajime Sonoda, Global Group 21 Japan, Inc.

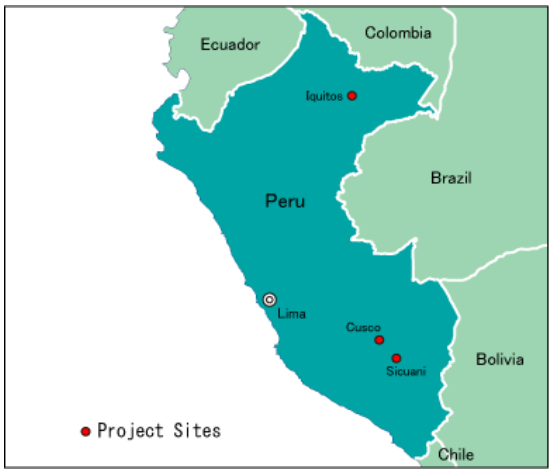
0. Summary

The Provincial Cities Water Supply and Sewerage Improvement and Expansion Project (Iquitos, Cusco and Sicuani) (hereinafter referred to as "the Project") was implemented in order to improve the water supply and sewerage coverage rate in the Peruvian regional cities of Iquitos (Loreto Region), Cusco and Sicuani (Cusco Region) by means of improving and constructing water supply and sewerage facilities as well as enhancing capacity for water production and sewerage treatment, thereby contributing to improvement of environmental and sanitary conditions in the target area. From the time of the ex-ante evaluation through to the ex-post evaluation, the water supply and sewerage sector remained an important issue for the Government of Peru. At the time of the ex-ante evaluation, needs for water supply and sewerage development in the three target cities were high, and the Project facilities are playing an important role at the time of the ex-post evaluation. Moreover, the Project was consistent with Japan's aid policies at the time of the ex-ante evaluation. Therefore, the relevance of the Project is high. Due to two changes of government and deterioration of the operating conditions by Sanitation Service Company (hereinafter referred to as "SSC") in the target cities following signing of the loan agreement, construction works of the sewerage component in Cusco and the water supply and sewerage components in Sicuani were delayed by more than 10 years, and the Project period was three times longer than planned. Due to price inflation over this period and expansion of the water treatment plants and sewage treatment plants and so forth, the Project cost was roughly 80% greater than planned. Accordingly, the Project efficiency was low. In Iquitos and Cusco, the project has realized water production and sewage treatment capacity greater than planned while expansion of the water supply and sewerage networks has been constructed mostly as planned. Accordingly, the Project has contributed to improvement of environmental and sanitary conditions as planned in both these cities. In Cusco, there has been major improvement in the water supply and sewerage coverage rates and water supply time as well as in prevention of pollution in the Huatanay River. On the other hand, in Iquitos, where issues remain concerning non-revenue water and water shortage continues, no major improvement has been witnessed in water supply services. In Sicuani, the water supply and sewerage facilities are not yet completed and had not started operating by the time of the ex-post evaluation. While the project effect is expected to be high in the water supply sector, judgment cannot be made concerning the sewerage sector where concerns exist over operation of the

sewage treatment plant. Summing up, effectiveness and impact of the Project have been high. In Cusco, there are no problems concerning operation and maintenance, and sustainability is high. In Iquitos, sustainability is low, as there are some minor issues in technical aspect and concerns in financial aspects. In Sicuani, since concerns remain over the sewage treatment plant in terms of institution, technology and finance, sustainability is low-fair. Overall, sustainability of the effects realized by the Project is fair.

In conclusion, the Project is evaluated to be partially satisfactory.

1. Project Description



Project locations

Distribution reservoir constructed at the Iquitos Sanitation Service Company

1.1 Background

In Peru, when the economy collapsed in the late 1980s, hardly any investment was carried out in the water supply and sanitation sector, and facilities became deteriorated. As more and more of the population moved into urban areas, the water supply coverage rate declined, the water supply capacity was unable to keep up with demand, and restrictions were placed on water supply time in many regional cities. The sewerage coverage rate was even lower than the water supply coverage rate, with almost half of all regional cities having no sewage treatment plants and untreated sewage being discharged into rivers.

The administration of President Fujimori (1990-2000) regarded water supply and sewerage improvement and expansion as an important policy issue. In 1992, it conducted reform of the sanitation sector. At this time, it established National Program of Potable Water and Sewerage (*Programa Nacional de Agua Potable y Alcantarillado*: hereinafter referred to as "PRONAP") under the Ministry of Presidency, and National Sanitation Services Supervisory (*Superintendencia Nacional de Servicios de Saneamiento*: hereinafter referred to as "SUNASS") under the Ministry of Economy and Finance. As a result of this reform, in regional cities, the regional governments started provision of water supply and sewerage services through SSCs,

etc. under technical support from PRONAP and supervision by SUNASS.

PRONAP compiled the National Water and Sewage Program in 1992 and started work on water supply and sewerage improvement and expansion with assistance from JICA and other donors. JICA gave assistance to Lima metropolitan area through three separate ODA Loan projects. Concerning regional cities, based on the city-based feasibility study that was implemented under support from the Inter-American Development Bank, it implemented the Provincial Cities Water Supply and Sewerage System Improvement and Expansion Project targeting the two cities of Piura and Chimbote in 1999.[1]

This Project, based on the feasibility study that was implemented under support from the Inter-American Development Bank against the background described above, was intended to implement water supply and sewerage improvement and expansion in three cities, i.e. Iquitos in Loreto Region, Cusco in Cusco Region, and Sicuani in Cusco Region. In response to the request for assistance by the Government of Peru, the fact-finding mission was dispatched in 1999, the ex-ante evaluation (review) was conducted, and loan agreement was signed in 2000.

１.２ Project Outline

To improve the water supply and sewerage coverage rate in the Peruvian regional cities of Iquitos, Cusco and Sicuani by means of improving and constructing water supply and sewerage facilities as well as enhancing capacity for water production and sewerage treatment, thereby contributing to improvement of environmental and sanitary conditions in the target area.

Loan Approved Amount / Disbursed Amount	7,636 million yen / 6,010 million yen	
Exchange of Notes Date/ Loan Agreement Signing Date	September 2000	
Terms and Conditions	Interest Rate	Water supply improvement and expansion: 1.7%, Sewerage improvement and expansion / consulting service: 0.75%
	Repayment period (Grace Period)	Water supply improvement and expansion: 25 years (7 years), Sewerage improvement and expansion / consulting service: 40 years (10 years)
	Conditions for Procurement	Water supply improvement and expansion: general untied, Sewerage improvement and expansion / consulting service: bilateral tied
Borrower / Executing Agencies	Republic of Peru / Ministry of Housing, Construction, and Sanitation (*Ministerio de Vivienda, Construcción y Saneamiento*: MVCS), National Urban Sanitation Program (*Programa Nacional de Saneamiento Urbano*: PNSU)	

[1] JICA provided loans for “Lima-Callao Metropolitan Area Water Supply and Sewerage Improvement Project” (1996), “Southern Lima Metropolitan Sewerage Improvement Project” (1996), and “Pomacocha-RioBlanco Water Resource Transfer Project (MARCA II)” (1997). The Inter-American Development Bank implemented feasibility studies in 36 out of 67 regional cities in Peru and offered funding for improvement of infrastructure in some of these.

Final Disbursement Date	January 2013
Main Contractor (Over 1 billion yen)	Water supply in Iquitos: Construtora Norberto Odebrecht (Brazil), China International Water & Electric Corporation (People's Republic of China) Waste water treatment plant in Cusco: COSAPI S.A. (Peru) Water supply and sewerage in Sicuani: COMSA (Peru)
Main Consultant (Over 100 million yen)	Iquitos and Sicuani: NJS Co., Ltd. (Japan), Cusco: Nippon Koei LAC (Japan)/Nippon Koei (Japan) (JV)
Related Projects	Provincial Cities Water Supply and Sewerage System Improvement and Expansion Project (ODA Loan, 1999)

2. Outline of the Evaluation Study

2.1 External Evaluator

Hajime Sonoda (Global Group 21 Japan, Inc.)

2.2 Duration of Evaluation Study

The ex-post evaluation study for the Project was conducted over the following period.

Duration of the Study: July 2015-March 2017

Duration of the Field Survey: January 14-February 9, May 13-27, 2016

2.3 Constraints during the Evaluation Study

The water supply and sewerage facilities of the Project in Cusco were removed from the scope of the ODA Loan in 2004 following the start of the Project, and came to be constructed under funds by the Peruvian side. They remain within the scope of the Project activity. However, because they were constructed as a part of the series of water supply and sewerage construction works implemented by Cusco SSC (EPS SEDACUSCO S.A.)[2], it was not possible to fully clarify the detailed results of its implementation, i.e. scope, cost and implementation period of the Project. Part of the facilities were built by own funding in Iquitos and Sicuani as well, and it was not possible to obtain information on their cost, implementation period and number of new connections.

3. Results of the Evaluation (Overall Rating: C[3])

3.1 Relevance (Rating: ③[4])

3.1.1 Relevance to Development Plan of Peru

As was described in section 1.1 Background of the Project, at the time of the ex-ante evaluation (2000), the water supply and sewerage was an important policy area. At this time the administration of President Fujimori established PRONAP under the Ministry of Presidency,

[2] *Empresa Prestador de Servicios SEDACUSCO Sociedad Anónima*

[3] A: Highly satisfactory; B: Satisfactory; C: Partially satisfactory; D: Unsatisfactory

[4] ③: High, ②: Fair, ①: Low

carried out sanitation sector reform under the decentralization policy, developed a water sector development plan and was making efforts for water supply and sewerage improvement and expansion in local cities.

After that, the second presidency of Alan Garcia (2006-2011) greatly increased the amount of public sector investment in the water supply and sewerage sector under the slogan of "Water for All"[5]. In the mid-term strategy (planning period 2016-2021) that was prepared by Ministry of Housing, Construction and Sanitation (hereinafter referred to as "MVCS") in 2015, the strategic goal is "increased access to high-quality and sustainable water supply and sanitation services in urban and rural areas." Concerning water supply and sewerage improvement and expansion in local cities, the mid-term strategy indicates plans for strengthening of the operational capacity of the SSCs, participation by the private sector, measures to secure greater sustainability and so on.

In this way, the Project had high relevance to development plans both at the time of the ex-ante evaluation and the time of the ex-post evaluation.

３.１.２ Relevance to the Development Needs of Peru

As was described in section 1.1 Background of the Project, at the time of the ex-ante evaluation (2000), there was a great necessity for water supply and sewerage improvement and expansion in numerous local cities. In the three cities targeted by the Project, there were needs for water supply and sewerage improvement and expansion as described hereafter.

Iquitos (population in 1998: 390,000) is a core city in the Amazon region. Here, due to the influx of population that led to an increase in water demand, it became urgently necessary to improve the water supply coverage rate and supply time.

Cusco (population in 1998: 290,000) is Peru's top city for tourism. It had been developing groundwater resources under financial assistance from France, etc. However, in order for it to develop as a tourism city, it was necessary to improve the deteriorated water supply network, expand water supply to surrounding areas and increase supply time. In addition, the sewerage coverage rate was low and the sewage treatment rate was also low due to the insufficient capacity of existing treatment plant. As a result, water quality in the Huatanay River in the city had reached critical levels and there was concern over the impacts of this on agriculture via irrigation use of the river water.

Sicuani (population in 1998: 40,000) is a commercial city and transport hub. Its water supply coverage rate and water supply time were at a sufficient level. However, it was necessary to expand the water supply and sewerage network to new residential areas. Sewage was being discharged in the untreated state, so it was urgently necessary to construct a treatment plant.

[5] According to data of the MVCS, public sector investment in the water supply and sewerage sector was no greater than 0.1% of GNP until 2005, however, since 2009 it has been 0.6-0.8%.

As is described in the section on effectiveness, at the time of ex-post evaluation, water and sanitation facilities improved or constructed by the Project are playing an important role in providing water supply and sanitation services in each city. Accordingly, importance of the Project is also sustained at the time of the ex-post evaluation.

3.1.3 Relevance to Japan's ODA Policy

At the time of the ex-ante evaluation, priority sectors according to the Country Assistance Plan of the Japanese Government for Peru (2000) were poverty countermeasures, support for the social sector, development of the economic base, and environmental conservation. In the area of poverty countermeasures, the plan stated "concerning basic human needs (BHN), assistance will be advanced based on water supply and sewerage improvement and expansion in future" and proposed water pollution countermeasures in the field of environmental conservation. Accordingly, the Project had a high degree of relevance to Japan's ODA policies in Peru.

3.1.4 Appropriateness of the Project Planning and Approach

While the detailed design was performed in Sicuani more than 10 years after the completion of the feasibility study, the treatment method for the sewage treatment plant has been changed because the planned site area for the sewage treatment plant could not be obtained. Serious concerns have been raised regarding the operation and maintenance under the Sicuani SSC (EPS EMPSSAPAL S.A.)[6] that lacks both in technical competency and financial capacity, since the new treatment method requires more advanced techniques and a larger amount of the operation and maintenance expenditure compared to the treatment plant in the original plan. While this change had been carried out in accordance with the procedures applicable for public investment projects in Peru, neither the possible alternative sites nor the financial sustainability had been examined in order to avoid further delay on the project execution. An adequate consideration should have been given when a change of plan would possibly have serious impacts on the sustainability. However, this weakness is not considered to have significantly diminished the relevance of the Project as a whole. Therefore, it does not degrade the assessment of relevance.

Summing up, implementation of the Project was fully consistent with and relevant to the development policies and development needs of Peru and the aid policies of Japan.

[6] *Empresa Municipal Prestadora de Servicios de Saneamiento de las Provincias Alto Andinas Sociedad Anónima*

3.2 Efficiency (Rating: ①)

3.2.1 Outputs

In the Project, water supply improvement was implemented in Iquitos; water supply and sewerage improvement was implemented in Cusco; and water supply and sewerage improvement was implemented in Sicuani. The planned and actual outputs of the Project were as indicated in Table 1. As the facilities in this project are constructed to improve and expand existing water supply and sewage facilities in each city, they are scattered inside the city, and do not necessarily function together.

Table 1 Comparison of Planned and Actual Outputs

Plan	Actual
＜Iquitos water supply＞ Water production facilities: ・ Intake: reconditioning of intake 2 locations ・ Water treatment plant: new construction (production capacity 520 liter/sec) Water distribution facilities: ・ Clear water reservoirs: new construction 2 locations, repair 1 location ・ Water transmission pipeline: expansion and repair 18 kilometers ・ Pumping stations: new construction 1 location, repair 3 locations ・ Water distribution reservoirs: new construction 10 locations, repair 1 location ・ Distribution mains and distribution network: 187 kilometers ・ Connections: new construction 11,388, meter installation 11,388, repair 3,594	(completed in 2012) Water production facilities: ・ Intake: mostly as planned ・ Water treatment plant: new construction (production capacity: 750 liter/sec) Water distribution facilities: ・ Clear water reservoirs: new construction 3 locations, repair 1 location [1)] ・ Water transmission pipeline: expansion and repair 15 kilometers [2)] ・ Pumping stations: new construction 1 location, rehabilitation 3 locations ・ Water distribution reservoirs: new construction 10 locations, repair1 location ・ Distribution mains and distribution network: 135 kilometers ・ Connections: new construction 11,084, repairs 1,348, meter installations 11,388 ・ Introduction of SCADA system
＜Cusco water supply＞ Water distribution facilities: ・ Water distribution reservoirs: new construction 4 locations ・ Pumping stations: new construction and reconstruction 3 locations ・ Water transmission pipeline: new construction 26 kilometers ・ Water distribution network: new construction 16 districts, 29 kilometers ・ Connections: new construction 3,564 (including meters)	(completed in 2015) Water distribution facilities: ・ Water distribution reservoirs: new construction 1 location ・ Pumping stations: new construction and reconstruction 2 locations ・ Water transmission pipeline: partially implemented (implemented 9 kilometers out of 26 kilometers, not implemented 8 kilometers; concerning the remaining 9 kilometers, the planned locations and implementation situation are unclear). ・ Water distribution network: 16 districts (extension is unclear) ・ Connections: new 3,564 or more
＜Cusco sewerage＞ Sewage collection facilities: ・ Sewerage main: 15 kilometers ・ Secondary collector: 16 kilometers ・ Collector network: 16 districts, 23	(completed in 2014) Sewage collection facilities: ・ Sewerage main: 13 kilometers ・ Secondary collector: 14 kilometers ・ Collector network: 15 districts, extension

kilometers ・ Connections: new construction 7,190 Sewage treatment facilities: ・ Treatment plant: 300 liter/sec, oxidation pond system ・ Untreated sewerage conveyance pipeline to the new treatment plant: 7 kilometers	unclear ・ Connections: unclear Sewage treatment facilities: ・ Treatment plant: 460 liter/sec, trickling filter system ・ Untreated sewerage conveyance pipeline to the new treatment plant: none
＜Sicuani water supply＞ Water production facilities: ・ Water intake and conduction facilities: rehabilitation (2 locations, springs) Water distribution facilities: ・ Water distribution reservoirs: new construction 2 locations, rehabilitation 2 locations ・ Pumping stations: new construction 2 locations ・ Chlorine injection system (2 locations) ・ Water transmission pipeline and distribution mains: 6 kilometers ・ Water distribution network: expansion 6 districts, 19 kilometers	(completed in 2016) Water production facilities: ・ Water intake and conduction facilities: rehabilitation (3 locations, springs) Water distribution facilities: ・ Water distribution reservoirs: new construction 2 locations, rehabilitation 2 locations ・ Pumping stations: new construction 2 locations ・ Chlorine injection system (1 location) ・ Water transmission pipeline and distribution mains: combined with the water distribution network 17 kilometers (plan when the contract was signed; actual situation unclear) ・ Water distribution network: expansion 6 [3)] districts
＜Sicuani sewerage＞ Sewage collection facilities: ・ Sewerage main and collector network: 21 kilometers ・ Pumping stations: 1 location ・ Connections: 7 districts, new 2,125 Sewage treatment facilities: ・ Treatment plant: 77 liter/sec, oxidation pond system	(completed in 2016) Sewage collection facilities: ・ Sewerage main and collector network: 20 kilometers (final result unknown) ・ Pumping stations: 2 locations ・ Connections: 8 districts [3)], (number of new connections is unknown) Sewage treatment facilities: ・ Treatment plant: 80 liter/sec, anaerobic lagoon and trickling filter combined system

Source: Materials provided by JICA, MVCS, and SSC in each city

Notes: 1) Construction of one distribution reservoir and rehabilitation of one distribution reservoir implemented by the Peruvian fund are included.
2) Length of pipelines for one distribution reservoir implemented by the Peruvian fund is not included.
3) 5 districts of water supply network expansion and 5 districts of collector network expansion implemented by the Peruvian fund are included.

After the signing of the loan agreement in 2000, implementation of the Project using ODA Loan was suspended until 2002 due to changes of government that took place twice and the related reorganization of ministries. After 2002, the Project was implemented in Iquitos, Cuzco, and Sicuani, in this order (for details, see "3.2.2.2 Project Period"). The circumstances of implementation in each city, change of project scope and quality of outputs are explained bellow.

（1） Iquitos

In Iquitos, it was planned in the water supply sector to increase water production through rehabilitating water intake facilities and constructing a water treatment plant (adjacent to the existing water treatment plant), and to improve water distribution facilities including the

construction of water distribution reservoirs. Among the planned project scope, one distribution reservoir was constructed and one clear water reservoir was rehabilitated by their own funding during the period when utilization of ODA Loan was suspended. Thereafter, because of funding restrictions that arose due to price inflation, etc. following the loan agreement, the priority components of the planned works excluding the above were implemented between 2006-2008. After that, part of the Project work was assigned to Cusco SSC for implementation under its own funds (details are given later), and as a result, part of the ODA Loan was freed up, allowing the suspended Project works of Iquitos to be additionally implemented between 2010-2012. The main revisions in the Project scope were as follows:

- According to updating of the population forecast, the water treatment plant production capacity was increased.
- In the additional works, the SCADA system was introduced to water supply[7].

Out of the above changes, the SCADA system has so far never been operated because of frequent breakdown of measuring instruments etc. of the system due to lightning strike and difficulties in repair works. It can be said that facilities had not been designed to cope with the harsh local weather conditions and the operation and maintenance capacity had not been thoroughly examined. The other changes are considered to be appropriate.

Water intake (left) and treatment plant (right) in Iquitos

According to Iquitos SSC (EPS SEDAROLETO S.A.)[8], among the installations provided by the Project, many valves have been damaged before the expiration of their service

[7] SCADA (Supervisory Control And Data Acquisition) system is a type of industrial control system that entails system monitoring and process control by computer. In Iquitos, a system was introduced for a comprehensive monitoring on water level and flow rate data at water intakes, purification plants and distribution reservoirs.

[8] *Empresa Prestador de Servicios SEDALORETO Sociedad Anónima*

life. Iquitos SSC also points out that the panels of the flocculation tank in the water treatment plant were installed according to the specifications in the detailed design, however, due to the poor material quality, many panels were damaged and taken out, and this has led to lower treatment efficiency.

（２） Cusco[9]

In Cusco, in the water supply sector, the plan was to construct facilities for transmitting and distributing water in the city from the water production facilities (groundwater) that were constructed in 2000, and to expand the water distribution networks in the city. In the sewerage sector, the plan was to construct sewerage mains, collector networks and sewage treatment plant based on the oxidation pond system.

In the water supply sector, having acquired a new water source, because it was necessary to speed up construction of water transmission and distribution facilities, Cusco SSC started work on construction of part of the facilities under its own funds during the period of suspension of utilization of ODA Loan. However, because the financial conditions of Cusco SSC temporarily deteriorated in 2002-2003, the SSC was careful about constructing facilities with the ODA Loan transferred through the central government. Furthermore, it obtained financial support partially from the MVCS for construction of Huatanay interceptor, which is a key sewer main. Against this background, in 2004 agreement was reached between the MVCS, Cusco SSC and JICA that the loan fund would be used only for construction of the sewage treatment plant.

Concerning the sewage treatment plant, it was difficult to purchase the originally planned land because there were so many landowners on the site. Therefore, it was decided to construct a plant based on the trickling filter system, which requires less space than the oxidation pond system, on the site of the existing treatment plant. As a result, it was no longer necessary to construct a conveyance pipeline to carry collected sewage to the new treatment plant. The treatment capacity of the treatment plant was increased to enable the plant to respond to demand up to 2024 based on the revised population forecast. Also, at the request of Cusco SSC, digestion tanks, which enable part of the excess sludge to be changed to combustible gas and thereby reduce the quantity of excess sludge, were added.

In the water supply component, water distribution network expansion was implemented in 16 locations as planned, however, work on the water distribution facilities was only partially implemented. This was because the necessity to construct water distribution reservoirs and pumping stations was partially eliminated due to revision of the routes of water

[9] As was indicated in section 2.3 Constraints during the Evaluation Study, since the water supply and sewerage facilities in Cusco were constructed as part of the series of water supply and sewerage construction works implemented by Cusco SSC, it was not possible to fully clarify the detailed results of the Project (scope, cost and implementation period).

transmission and distribution. Construction of the sewage collection facilities has generally been implemented according to plan by Cusco SSC in numerous projects until now. It should be also noted that, concerning the water distribution facilities and sewage collection facilities, Cusco SSC has implemented numerous works outside the scope of the Project.

Waste Water Treatment Plant (left) and SCADA system for the Waste Water Treatment Plant (right) in Cusco

（３） Sicuani

In Sicuani, in the water supply sector, the plan was to improve water distribution pressure in high-altitude districts through construction of water distribution reservoirs, and to expand the water distribution network to newly constructed residential districts. In the sewerage sector, the plan was to construct a sewage treatment plant and a new sewerage main, and to expand the collector network to new residential districts.

In Sicuani, an opposition campaign arose among residents who were afraid that the implementation of water supply and sewerage improvement and expansion using ODA Loan would lead to privatization of the utility and large increases in water tariffs, and this developed into a political issue. Moreover, because Sicuani SSC faced a difficult financial situation and could not obtain support from the local government, it was unable to make a decision on immediately utilizing ODA Loan following the end of its suspension. In 2007, the Sicuani SSC decided to utilize the loan for the consulting service and commenced detailed design. However, due to further escalation in public opposition to the ODA Loan, in 2009 agreement was reached between the MVCS, Sicuani SSC and JICA to use the national budget rather than the loan for construction. The construction work by the national budget was started in December 2012 under a single contract that also included both water supply and sewerage components, and it was scheduled to be completed in June 2016[10].

[10] According to the information obtained after the second field trip, the construction works have been completed in July 2016 and trial operation was commenced.

The Project scope was finalized by conducting detailed design under the consulting service based on the plan at the time of appraisal. There were following major changes in this stage, as well as during the implementation phase.

- Due to the delay in the implementation utilizing ODA Loan, the scope of the Project was downsized as Sicuani SSC and Sicuani municipal government conducted expansion through its own funding in five out of the six districts where water distribution network expansion was planned and in five out of seven districts where collector network expansion was planned. Expansion of the remaining districts was implemented by the national budget. Also, one more district of collector network expansion was added to the project scope. These changes were necessary and appropriate in accordance with expansion of the urban area.
- It was scheduled to implement rehabilitation of water intake at two locations. However, in reality, rehabilitation (including expansion of water conduction capacity) was conducted at two locations and protection works (construction of embankment and fence) were implemented at one location. While it was found at the time of the detailed design that the arsenic concentration exceeded the standard which was revised to be stricter in 2010, after the commencement of the implementation, the protection works were implemented as planned. However, the water source in question was no longer used and, as a result, the protection works were not necessary.
- Concerning the treatment plant, because only around one eighth (4.2ha) of the planned site area (32ha) could be secured[11], anaerobic lagoon and trickling filter combined system, which can conduct treatment on a smaller area than the oxidation pond that was planned originally, was adopted[12]. Due to adoption of this treatment method, operation and maintenance of the sewage treatment plant required more sophisticated technology compared to the original plan and became more expensive. However, no consideration of alternative sites or financial analysis was made in this process, and serious challenges were left in financial sustainability[13]. Therefore, there is room for doubt on the appropriateness of this change.
- In the implementation stage, the filter medium was changed from stone to plastic at the request of Sicuani SSC. This change was intended to further improve the treatment efficiency, while it led to higher cost and a longer implementation period, and doubt

[11] According to Sicuani SSC, the initially intended site was common land in a village, for which an agreement was reached in 1996 to sell it as the site for the sewage treatment plant However, during more than 10 years of project delays, part of the land fell into private ownership and negotiations became difficult.

[12] See section 3.1.4 Appropriateness of the Project Planning and Approach.

[13] According to the Sicuani SSC and MVCS, it was thought to look for another site again, but the change of the site requires 3-4 years for the investigation and approval process according to Peru's public investment system. For this reason, construction at the originally planned site was decided in order to avoid further delays in implementation.

remains over its necessity.[14]

- Following the start of construction, the consultant at its own discretion changed the position of the pretreatment facilities in the sewage treatment plant. This triggered an opposition movement among local residents that resulted in them occupying the treatment plant. Following negotiations with the residents, the pretreatment facilities were restored to their original position, and odor prevention equipment, etc. was additionally installed in accordance with the request of local residents.[15]
- For the detailed design, designing works of the equipment to receive transmitted electricity for the pumping stations and the sewage treatment plant were included in the original plan were not produced. They were carried out during the construction stage. In implementation, the actual pipeline works costed almost more than double of the original plan. Furthermore, as the amount of earth works for sewage treatment plant construction was more than estimated, a large additional cost was incurred in the implementation stage. According to the interview during the field visit, the Sicuani SSC believes that the estimation by detailed design on the quantity of water transmission, distribution and sewerage mains and collector network as well as the earth work was not accurate.

Water distribution reservoir (left) and waste water treatment plant (right) under construction in Sicuani

[14] This change was approved due to reasons including easier implementations of the construction work and the operation and maintenance, the higher treatment efficiency, and the ease of future expansion, while it is not believed to be a change requiring an urgent action. Meanwhile, it had caused the increased cost and the longer time to complete the construction, as the plastic filter material needed to be imported.

[15] According to the officer in charge of MVCS and Sicuani SSC, the odor prevention equipment is not required based on the environmental norms.

The implementation stage showed some inefficiency, for example, it was necessary to reconstruct the water distribution reservoirs due to poor work quality, and the reservoir pumps had to be re-procured because they did not satisfy the necessary performance. However, because the works were still not finished at the time of site visit of the ex-post evaluation, it was not possible to make a final judgment on the quality of the works.

Sicuani SSC thinks that the poor quality of the detailed design led to higher working costs and a longer working period, and the changes to the plan made by the consultant without approval of the SSC triggered an opposition movement by local residents and also caused higher working costs and a longer working period. Therefore, Sicuani SSC is not satisfied with the performance of the consultant.[16]

As described above, it can be pointed out that there were certain aspects where the quality in managing and executing the construction was low in this project, especially in Iquitos and Sicuani.[17]

3.2.2 Project Inputs

3.2.2.1 Project Cost

Table 2 shows the planned and actual Project cost. The ODA Loan was not used for the consulting service and construction of the water supply and sewage collection facilities in Cusco, nor for construction of water supply and sewerage facilities in Sicuani. Therefore, only 79% (6,010 million yen) of the planned ODA Loan amount (7,636 million yen) was used. However, excluding the cost for water supply and sewage collection facilities in Cusco for which the actual amount is unknown (planned amount: 2,521 million yen), the actual project cost of 15,216 million yen was 178% of the planned amount of 8,554 million yen, largely exceeding the planned amount. Accordingly, although use of the ODA Loan declined, much of the extra project cost had to be covered by the Peruvian side (budget of the MVCS: total 9,206 million yen for those components under comparison). The large increase in the project cost was caused by revisions in the project scope resulting from expansion in the scale of sewage treatment plants and changes to the treatment method in Cusco and Sicuani, and high price inflation that arose during the delay in implementation by 5-11 years in each city[18].

[16] Due to the opposition movement by local residents, the Project cost in Sicuani increased by 30% or more. The working period was extended by some 15 months due to suspension of civil works, change of the position of pretreatment facility and addition of odor treatment facility, etc.

[17] This has impacts on the sustainability (regarding the operation and maintenance aspects) in Iquitos, and on both the financial sustainability and the efficiency in Sicuani.

[18] The consumer price index in Peru increased by 50% or more between 1999, when the Project costs were estimated, and 2015.

Table 2 Planned and Actual Project Cost

(Unit: million yen)

	Planned			Actual		
	Total	ODA Loan	Peruvian side	Total	ODA Loan	Peruvian side
Iquitos water supply*	2,026	2,026	0	5,396 [2)]	3,934	1,462
Cusco water supply	530	530	0	Unknown [1)]	0	Unknown
Cusco sewerage	1,991	1,991	0	Unknown [1)]	1,175	Unknown
(Sewage treatment facilities*)	(894)	(894)	(0)	(2,603)	(1,175)	(1,428)
Sicuani water supply / sewerage*	1,138	1,138	0	2,987 [2)]	0	2,987
Price inflation, physical contingency*	1,427	649	778	0	0	0
Consulting service* (detail design, procurement support, supervision)	1,302	1,302	0	1,722	901	821
Land acquisition and tax*	1,767	0	1,767	2,508	0	2,508
Total (*Total)	10,181 (8,554)	7,636 (6,009)	2,545 (2,545)	Unknown (15,216)	6,010 (6,010)	Unknown (9,206)

Source: materials provided by JICA and the MVCS

Note: 1) Out of the water supply and sewerage works in Cusco, sewage collection facilities (collector network) have been constructed as a part of numerous projects by Cusco SSC since 2000. As a result, it was not possible to calculate the actual cost of works.

2) Cost of the facilities constructed in Iquitos and Sicuani using its own funds during the suspension period of ODA Loan utilization is not included. Project cost in Sicuani is the planned amount as of October 2015. The estimation standard for the planned amount is September 1999.

Exchange rate (Planned) US$1 = 113.5 yen, 1 Nuevo Sol = 34.0 yen
(Actual) US$1 = 101.0 yen (actually applied rate)
1 Nuevo Sol = 32.7-38.4 yen (average rate during the contract term)

3.2.2.2 Project Period

The loan agreement for the Project was signed in September 2000. The Project was scheduled to be completed in May 2005, however, in reality, as is shown in the Figure 1, it has been implemented in the order of Iquitos, Cusco and Sicuani. In Sicuani, it is not yet completed as of May, 2016[19]. The planned project period was 57 months (September 2000-May 2005). However, in reality it was more than 189 months (September 2000-May 2016), rising at least to 332% of the planned period, largely exceeding the planed period. In line with this delay, the final disbursement date of ODA Loan was extended two times[20]. The main reasons for the large increase of the project period were as follows:

- After the loan agreement was signed in 2000, implementation was suspended until 2002 because there were two changes of government and consequential reorganization of ministries and government offices. Also, in 2001 the manpower of the executing agency PRONAP (at the time) was greatly reduced, resulting in a major decline in operation and supervision capacity.

[19] Refer footnote 10.

[20] The final disbursement date was January 2008 (seven years after the loan agreement became effective). However, it was extended to October 2010, and extended again until December 2012.

- Due to the abovementioned economic and political turmoil and the effects of decentralization that was advanced from 2002 onwards, the economic condition of the SSCs deteriorated, and difficulties were encountered in securing counterpart funding by local governments[21].
- In Iquitos, decision was made to implement the Project in 2003 when it appeared that the counterpart funding by local government could be secured. Thereafter, the procurement and start of construction works were delayed because a major increase in costs became apparent through the detailed design and it was necessary to review the scope of the Project. After that, additional works were implemented under the ODA Loan that became available. There was no major delay in the works itself.
- In Cusco, implementation of the Project was decided upon agreeing to change the funding arrangement by excluding the water supply and sewage collection facilities from the targets of the loan fund in 2004. After that, four years were spent on additional studies (financed outside the scope of the ODA loan) to revise the plans for the sewage treatment plant and re-examination by the Government of Peru[22]. The consulting service was procured in 2009, and the construction works were procured in 2010. Concerning the procurement of construction works, substantial time was spent on preparing the tender documents and negotiating the contract, and the works were started in March 2012. There was no major delay in the works itself.
- In Sicuani, because the local government was not willing to bear its own financial resources, no decision was made on project implementation until 2007 when the local government was changed. The consulting service procurement procedure was commenced in 2008. However, an opposition movement arose among residents who were unhappy about the Project utilizing an ODA Loan. It was not possible to sign the contract until a decision to use the national budget in construction was made in 2009. In addition, the detailed design period increased due to the long time required to acquire the sewage treatment plant site. The works were started in 2012 with the aim of finishing them in 12 months. However, the work schedule was extended some 29 months due to the following factors related to construction of the sewage treatment plant. Moreover, in Sicuani, because the water supply and sewerage works were conducted under a single contract, completion of the water supply facilities was also delayed[23].

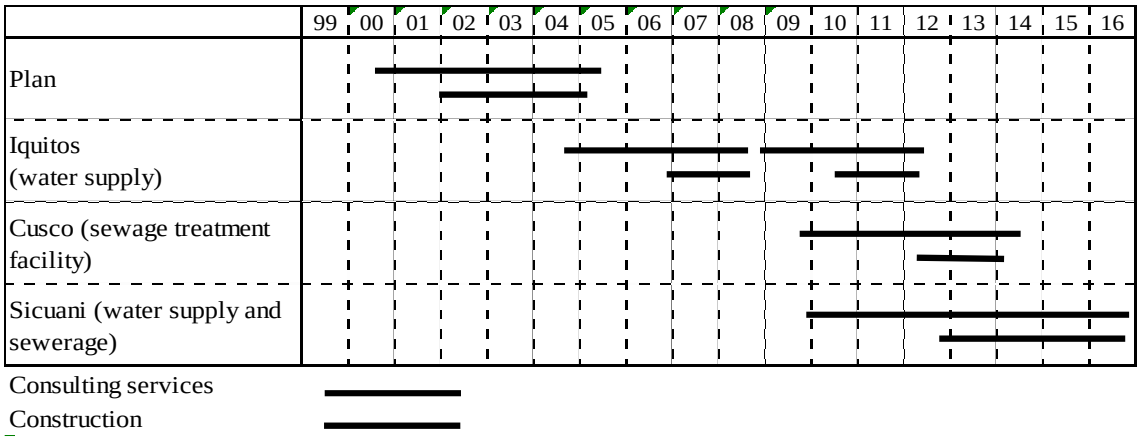
[21] Deterioration in the financial standing of the local government that was the shareholder also had an impact on the SSC.

[22] In Cusco, because the scope of the ODA Loan was limited to the sewage treatment plant, the Project was required to once more pass through the domestic review process that was revised in 2004. In Iquitos and Sicuani, this process was not demanded.

[23] In works contracts in Sicuani, it is possible to impose penalty on contractors that cause delays in the works

- Delay in acquiring land for the access road to the treatment plant (5.5 months)
- Change to the filtrate medium in the treatment plant (6.2 months)
- Addition of the equipment to receive transmitted electricity that was missing in the detailed design (2.0 months)
- Suspension of works due to opposition by residents to the changed location of pretreatment facilities (6.8 months)
- Further change of the location of pretreatment facilities and addition of deodorization equipment (8.1 months)

Figure 1 Planned and Actual Project Period in Each City (1999-2016)



Source: Materials provided by JICA and the MVCS
Note: Period of the construction through own funding in Iquitos and Sicuani during the suspension period of ODA loan utilization is not indicated. The planned construction period was approximately three years in Iquitos and approximately two years in Cusco and Sicuani.

3.2.3 Results of Calculations of Internal Rates of Return (reference only)

Targeting the water supply plant of Iquitos, the financial internal rate of return was recalculated assuming the Project life to be 30 years, the costs to comprise construction cost and operation and maintenance cost, and the benefit to be revenue from water tariffs. As a result, the financial internal rate of return (FIRR) was calculated to be 2.0%, far lower than the initially planned value of 16.8%. The economic internal rate of return (EIRR) calculated based on the cost excluding taxes from the cost was 5.3% (there was no planned value).

The main reason why the FIRR of the water supply in Iquitos was less than planned was due to the fact that the project cost was more than doubled. Incidentally, not enough data was obtained to conduct recalculation for Cusco and Sicuani and no recalculation was

schedule. However, the reference works period was only set regarding completion of the sewage treatment plant, and it was only stipulated that the water supply and sewage collection facilities should be finished by the time of completion of the sewage treatment plant. If the construction period based on partial completion and partial delivery is set, the contractor would have hurried to finish the works. However, because no such target was defined, the water supply works took longer than necessary.

conducted.

As is described above, both the project cost and project period significantly exceeded the plan. Therefore, efficiency of the project is low.

3.3 Effectiveness[24] (Rating: ③)

3.3.1 Quantitative Effects (Operational and Effect Indicators)

The objectives of the Project were to improve the water supply and sewerage coverage rate and to strengthen water supply and sewage treatment. Table 3 shows the targets that were proposed for each city at the time of review, and the actual achievements. Also, Table 4 and 5 show the level of achievement of other indicators before and after the Project regarding performances of water and sanitation services in each city. The post-project performance of these indicators reflects not only the effects of the Project but also effects of numerous other projects that have been implemented by the SSCs in each city.

Table 3 Achievement of Targets Adopted at the Time of Appraisal

	Increase in water production capacity Increase in sewage treatment capacity (operational indicator)		Increase in service population of water supply and sewerage since 1995 (effect indicator)	
	Planned (2010)	Actual (ratio compared to plan)	Planned [(a)] (2010)	Actual (ratio compared to plan)
Iquitos water supply	520 liter/sec	750 liter/sec[(b)] (144%)	225,000	176,000 (2013) (78%)
Cusco water supply [(c)]	-	-	135,000	129,000 (2013) (96%)
Cusco sewerage	300 liter/sec	506 liter/sec[(d)] (169%)	135,000	222,000 (2013) (164%)
Sicuani water supply	18 liter/sec	40 liter/sec[(e)] (222%)	10,000	13,000 (2012) (130%)
Sicuani sewerage	77 liter/sec	80 liter/sec[(f)] (104%)	13,000	17,000 (2012) (131%)

Source: Materials provided by JICA and each city's SSC

Note: The "Increase in water production capacity" and "Increase in sewage treatment capacity" show effects derived from the Project alone, while, the "Increase in service population of water supply and sewerage" reflect not only the effects of the Project but also numerous other projects that have been implemented by the SSC in each city. Concerning the actual "Increase in water production capacity" and "Increase in sewage treatment capacity," the higher values out of the realized design equipment capacity and maximum production or treatment volume achieved so far were used. For details, see (b)-(f) below.

(a) Plan values were set for 2010, however, the calculation method was not specified and the planned values for 2011 onwards were unclear. Therefore, planned figures for 2010 were used.
(b) Design capacity after modification of plan (Construction was completed in 2008. Maximum production recorded in 2014 746 liter/sec.)
(c) Although a target figure of 420 liter/sec was indicated for water supply, it must be a mistake as no such components are included in the Project.
(d) Because treatment performance (2015) exceeds the equipment capacity (460 liter/sec) after modification of plan, the treatment performance was adopted.
(e) Results of test conducted by Sicuani SSC in 2015 (the facilities were completed but have not started operation).
(f) Because facilities were not completed, the designed capacity was adopted.

[24] Effectiveness is rated upon also taking impact into account.

Table 4 Other Indicators concerning Water Supply

	Iquitos	Cusco	Sicuani (before Project completion)
Water production*	1995: 620 liter/sec 2013-15: 1,015 liter/sec	1995: 326 liter/sec 2013-15: 644 liter/sec	1995: Approx. 60 liter/sec 2013-15: 69 liter/sec
Water supply population**	1995: 157,000 2013: 333,000	1995: 145,000 2013: 274,000	1995: 25,000 2012: 38,000
Coverage rate**	1998: 68% 2015: 81%	1998: 73% 2014: 98%	1998: 88% 2015: 86%
Population with new connections**	Approximately 60,000	Approximately 15,000	(not known)
Water supply hours**	1998: 13 hours 2013-15: 13.6 hours	1998: 11 hours 2013-15: 20.5 hours	1998: 21 hours 2012: 23.8 hours
Water pressure**[25]	Approx. 9 meter water column	30 meter water column or more	Approx. 15 meter water column
Non-revenue water rate*	2015: 56%	1995: 38% 2013-15: 35%	1995: 57% 2015: 44%

Source: Materials provided by JICA, Each city's SSC
Note: (*) Operational Indicator, (**) Effect Indicator
The post-project achievement (2013 -) of the above indicators reflect also other projects which have been implemented in each city, excluding the "water production " of Iquitos and Sicuani and the "population with new connections (estimated based on the number of new connections)" in each city.

Table 5 Other Indicators concerning Sewerage

	Cusco	Sicuani (before Project completion)
Sewage treatment volume*	2015: 506 liter/sec	80 liter/sec (planned)
Population served**	1995: 68,000 people 2013: 290,000 people	1995: 20,000 people 2012: 37,000 people
Coverage rate**	1998: 46% 2014: 80%	1998: 88% 2012: 84%
New connections**	Approximately 28,000 people	(not known)
Treatment efficiency*	BOD removal rate: 90% (2015) Before treatment BOD: 445mg/liter After treatment BOD: 47mg/liter	BOD removal rate: 90% (planned) Before treatment BOD: 390mg/liter After treatment BOD: 15mg/liter

Source: Materials provided by JICA, Each city's SSC
Note: (*) Operational Indicator (**) Effect Indicator
The post-project performance of these indicators (2013 onwards) includes the effects of other projects implemented by each city, except for the sewage treatment capacity of Cusco, the new connection population in each city (estimated based on the length of installed end sewers), and the treatment efficiency in Cusco.

As shown in Table 3, the planned targets for the improvement of water supply capacity and sewage treatment capacity were achieved in all cities, while increase in service population of water supply and sewerage (population that receive water and sewerage service) was achieved except for water supply in Iquitos and Cusco. The improvement of water supply capacity and sewage treatment capacity was achieved by the facilities that were constructed in the Project, while, much of the increase in the target population of water supply and sewerage

[25] Meter water column is the unit of pressure that can support a water column of 1 meter. The standard in Peru is 15-50 meter water column.

was not realized as a direct result of the Project, but rather due to the effects of the numerous projects that have been implemented by the SSCs, etc. in each city[26]. Therefore, in the ex-post evaluation, "increase in the service population of water supply and sewerage" (Table 3) was treated as a reference indicator, and the effectiveness of the Project in each city was judged based on selected indicators shown in Table 3, 4, 5 and the manifestation of the specific effects mentioned in 3.3.2 that were anticipated from the Project.

３.３.２ Project Effects in the Target Cities

（１） Iquitos water supply

In Iquitos, the main issues concerned were increase in water production, equalization of water distribution and expansion of the water supply area.

Thanks to the rehabilitation of water intake and conduction facilities and construction of the new water treatment plant, which was a bottleneck for water production, the water supply capacity was increased to 750 liter/sec which was higher than the planned 520 liter/sec. The water production volume before the Project was approximately 620 liter/sec in the old water treatment plant, while the average water production volume of the old and new water treatment plants combined between 2013-2015 was approximately 400 liter/sec higher than this at 1,015 liter/sec. The water production volume of the new water treatment plant is 719 liter/sec (average between 2013-2015) and the facility utilization rate is 96%. According to Iquitos SSC, water quality of the water treatment plant satisfies all standards including residual chlorine and turbidity and there is no problem[27]. Accordingly, the expected effects of the Project in terms of increasing water production were achieved more than planned. On the other hand, in Iquitos, because the meter installation rate is low at 41% (2015) and there are many illegal connections to the water supply, the ratio of non-revenue water is high at 56% (2015). The Project is believed to have contributed to reducing non-revenue water (increasing revenue water) by renewing water distribution pipes in central areas and installing water meters[28].

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[26] In Cusco, development of water sources not included in the Project facilitated major increase in the water supply population. Moreover, the water supply and sewerage service populations in each city increased thanks to ongoing expansion of water transmission and distribution networks and sewerage networks and increase in the number of connections in line with population growth. The Project was only a small part of such development. In particular, almost all additional connections to existing water transmission and distribution networks and sewerage networks were realized outside of the Project. The increases in water supply population and sewerage service population that were presented at the time of appraisal were not indicated as targets for the Project alone, but rather as goals for the overall region to be achieved through the combined effort of numerous projects.

[27] However, at the time of the field survey in the ex-post evaluation, as the raw water had high chromaticity and some of the facilities at the water treatment plant were undergoing repair, there was slight turbidity and color in the water. This was also reflected in the results of the survey of beneficiaries.

[28] Due to the renewal of deteriorated distribution pipes and replacement of house connections in line with the installation of meters, water leaks are reduced and non-revenue water is reduced. The meters that were installed in the Project correspond to 48% of all the water meters installed in the city. Iquitos SSC has been striving to reduce the non-revenue water rate through adjusting its water distribution program in recent years. Ever since a non-revenue water rate of 63% was recorded in 2013, the rate has been going down. In the first three months of 2016, the non-revenue water rate was 55%.

Concerning water distribution, before the start of the Project, because there were no distribution reservoirs, water was distributed to all city districts by direct pumping from the old water treatment plant. As a result, water pressure was insufficient at the ends of distribution network, and uniform water distribution could not be realized. According to Iquitos SSC, in the Project, because numerous distribution reservoirs were constructed, it became possible to secure enough water pressure even in areas far away from the water treatment plant and conduct uniform water distribution over a wide area. Because the facilities constructed in the Project are fully utilized and have contributed to improving water production and distribution, it is thought that the anticipated Project effects regarding improvement of water transmission and distribution have been achieved. However, the average water supply hours per day has remained almost the same (13 hours in 1998 versus 13.6 hours on average between 2013-2015), and the recent water pressure has been low at around 9 meters water column on average. Due to the limited capacity of water intake which is influenced by water level of the river etc., water production has been unable to keep pace with the increase in water supply population, and since effective water volume is limited (high non-revenue water rate), the water shortage is continuing[29].

The water supply service population increased from 157,000 (1995) to 333,000 (2013), and the water supply coverage rate increased from 68% (1998) to 81% (2015). Through the Project, new connections were established to approximately 11,000 households (approximately 60,000 people). This is almost as planned and is equivalent to 34% of the increase in water supply service population of 176,000. Therefore, it is thought that the Project target concerning increase of water supply service population has been almost achieved.

Accordingly, the anticipated Project effects regarding water supply in Iquitos have been achieved more than was planned, and the Project effectiveness is deemed to have been "very high".

（２） Cusco water supply

In Cusco, the main issues in water supply were increase of service population, coverage rate and water supply hours. Improvements have been seen in these areas (Table 4) thanks to the synergistic effect by securing new water sources and construction of water distribution facilities including those in the Project[30].

As shown in the Table 4, the water supply service population increased from 145,000 (1995) to 274,000 (2013), and the water supply coverage rate increased from 73% (1998) to 98% (2014). The Project contributed to this by making new connections to approximately 3,500

[29] Whereas the water supply population almost doubled between 1995 and 2013, the amount of water production only increased by approximately 70%.

[30] The water sources that were constructed in 2000 account for 42% of total water production volume in Cusco (2013-2015).

households (approximately 15,000 people). The number of these new connections was roughly as planned and accounted for 12% of the increase in the water supply population of 129,000. Accordingly, it is deemed that the improvements in water supply population and coverage rate in Cusco were roughly as planned.

The water supply time increased greatly from 11 hours (1998) to 20.5 hours (average between 2013-2015). The recent water pressure has been appropriate at 30 meters water column or more. It is thought that the Project contributed to this effect through constructing water transmission pipeline and water distribution reservoirs. However, because part of the Project location could not be confirmed (both in planning and implementation) and the SSC has constructed numerous facilities outside of the Project, it is difficult to identify the specific contribution of the Project. However, considering that all the facilities needed were constructed and being utilized[31], it is deemed that the Project has adequately contributed to improvement of water distribution. Incidentally, the non-revenue water rate improved only slightly from 38% (1995) to 35% (average between 2013-2015). The Project is considered to have contributed to this by installing 3,564 new meters (approximately 5% of all connections).

Accordingly, the anticipated Project effects regarding water supply in Cusco have more or less been achieved, and the Project effectiveness is deemed to have been “high”.

（３） Cusco sewerage

Concerning sewerage in Cusco, the main issues were increase of the sewerage service population and coverage rate, and reduction of discharge of untreated sewage into the Huatanay River where pollution was a serious problem.

The sewerage service population increased from 68,000 (1995) to 290,000 (2013), and the sewerage coverage rate increased from 46% (1998) to 80% (2015) (Table 3, 4). The Project made contribution to this, as it was more or less implemented as planned concerning construction of sewerage mains (27 kilometers out of the planned 31 kilometers), and expansion of the sewerage network in 15 out of the 16 planned districts. The Project directly resulted in new connections to around 7,000 households (28,000 people), equivalent to 13% of the increase in sewerage service population of 222,000[32]. Therefore, it is thought that the Project target concerning increase of sewerage service population and sewerage coverage rate was more or less achieved as planned.

The constructed sewage treatment plant achieved the capacity target, showing a

[31] See 3.2.1 Outputs (2) Cusco.

[32] There are water supply and sewerage schemes independently operated by community organizations around the service area of Cusco SSC, and the Project’s sewage treatment plant receives some of the sewage from them. Total population served is estimated as much as 150,000. However, there is no clear agreement between the SSC and these community organizations concerning acceptance of sewage and no data that allows the quantity of received sewage to be estimated. Also, no sewerage tariffs are levied. It was also predicted in the planning stage that sewage would be received from these areas, however, it is possible that more sewage than planned is being received due to the rapid increase of population in the surrounding areas of Cusco.

sewage treatment flow of 506 liter/sec (2015, 169% of the planned value) compared to the planned flow of 300 liter/sec. The BOD concentration after treatment was 47 mg/liter (2015), not reaching the planned level in the detailed design of 30mg/liter due to more-than-planned quantity of flow, while, the treatment efficiency is sufficiently high at 90% as planned. Before the Project, BOD load of approximately 59 g/second (2012) was being treated in the old treatment plant. However, at the time of the detailed design, it was planned for the new treatment plant to treat 111 g/second of BOD load. In reality, BOD load of approximately 201 g/second, equivalent to 181% of the planned level, was treated in 2015, and the amount of BOD load flowing into the Huatanay River was reduced by 3.4 times compared to the BOD load registered before the Project[33]. Accordingly, it is deemed that the Project was far more effective than planned concerning reduction in the discharge of pollutant substances into the Huatanay River.

Meanwhile, concerning sewage treatment, there are issues such as the high BOD concentration and excessive volume of inflowing sewage. The BOD concentration of inflowing sewage was 445 mg/liter in 2015, higher than the planned level of 400 mg/liter. Moreover, high concentrations of industrial wastewater, oil, sand, clay, etc. mixed with the sewage caused equipment of the plant to become damaged quickly. The collector network in Cusco is basically separated from the drainage network. However, in reality a lot of rainwater enters the system and the sewage inflow reaches 2,000 liter/sec. at times of rain.[34] Even when rain isn't falling, sewage inflow exceeds 802 liter/sec and it is discharged without undergoing treatment. It is thought that this is because the increase in population exceeded the forecast calculated when the Project was being planned.

Accordingly, regarding sewerage in Cusco, the anticipated Project effects on the reduction of pollutant discharged to the Huatanay River have been achieved more than planned, and the Project effectiveness is deemed to have been "very high".

（4） Sicuani water supply

In Sicuani, where there are numerous water sources that use spring water, the main issues were expansion of the water distribution network to newly constructed residential districts, and securing water pressure for distribution to districts at high altitude. At the time of the second field survey of ex-post evaluation, construction of the water supply facilities was almost completed, but the facilities were still not in operation. The following paragraphs

[33] Due to the influx of rainwater and discharge of highly concentrated, untreated sewage at times of heavy flow, the sewage collection rate and treatment rate couldn't be calculated. Accordingly, it is not clear what percentage of pollutants has been reduced.

[34] Construction of rainwater drainage is the responsibility of local governments, and local governments sometimes arbitrarily connect drainage channels to sewerage networks. In Cusco, at least 200 such connections have been confirmed. Moreover, in order to drain away the water that covers roads at times of rainfall, residents often remove sewerage manhole covers in order to let the rainwater flow in.

describe analysis of the results of water production tests implemented by Sicuani SSC (40 liters/sec), past achievements in terms of expanding the water distribution network, etc., and prospects for the realization of effects after facilities have gone into operation.

Concerning increase in water supply capacity, approximately 40 liter/sec, exceeding the planned level of 18 liter/sec was confirmed through trial production, making it possible to deal with future increases in the demand for water.[35] In the Project, expansion of the water distribution network was implemented in six districts as planned, and service population was increased from 25,000 in 1995 to 38,000 in 2012. Achievements in increase of service population by the Project were as planned. On the other hand, construction of the water supply network was unable to keep pace with expansion of the residential districts, so the water supply coverage rate fell slightly from 88% (1998) to 86% (2015).

The water pressure has been appropriate at around 15 meters water column on average (before completion of the Project). However, in districts that are situated at higher altitude than the existing water distribution reservoirs, the water pressure is inadequate and not enough water is reaching residents. When the water reservoirs in the Project go into operation, appropriate water pressure will be secured even in areas with higher altitude and the situation will be improved. Concerning the water supply time, thanks to the abundant water sources in this city, it was already at 23.8 hours (2012) and there was not much room for improvement.

The non-revenue water rate was improved from 57% (1995) to 44% (2015). It is thought that the Project partly contributed to this by renewing pipelines in city districts that previously experienced severe leaks. In future, if some 3,000 water meters are installed or replaced as planned separately from the expansion of distribution network, it will be possible to improve the non-revenue water rate even more[36].

Accordingly, the anticipated Project effects regarding water supply in Sicuani have been achieved almost as planned, and the Project effectiveness is deemed to have been “high”.

（５） Sicuani sewerage

Concerning sewerage in Sicuani, the main issues were expansion of the collector network in newly constructed residential districts, and the elimination of untreated sewage discharged to rivers. At the time of the second field visit of ex-post evaluation, construction of the sewerage network was almost completed, but the sewage treatment plant was still not finished, and both the network and the plant were still not in operation. The following paragraphs describe analysis of the past achievements in terms of expanding the sewerage network, etc., and prospects for the realization of effects after the sewage treatment plant and

[35] The arsenic concentration is high in some water sources, however, such increase of water production has been achieved using only water sources that have lesser arsenic problems.

[36] The Project goal concerning reduction of non-revenue water is unclear, and it is difficult to determine the extent of the Project contribution.

other facilities have gone into full operation.

The sewerage service population increased from 20,000 (1995) to 37,000 (2012). In the Project, it was planned to expand the collector network in seven districts, while expansion of collector network was implemented in eight districts. As a result, increase of the service population of sewerage network by the Project was larger compared to the plans.

The sewage treatment flow is expected to reach at 80 liter/sec, which is more than the planned level of 77 liter/sec. Moreover, because it is planned to treat all the collected sewerage, the Project is expected to greatly reduce discharge of untreated sewage to rivers. However, as the plant is not yet in operation, actual results are not known. Also, as is described in the section on sustainability, there are a few concerns over the operation and maintenance of the Sicuani sewage treatment plant. Therefore, at the time of ex-post evaluation, it is not possible to forecast operational results of the plant and judge the anticipated Project effects regarding sewerage component in Sicuani.

3.3.3 Summary

The effectiveness of the Project in each city can be summarized as shown in Table 6 based on the above analysis. Considering the weight of each component based on the planned costs, the overall project is deemed to have been high.

Table 6 Evaluation of Effectiveness

	Degree of achievement of target	Project cost ratio
Iquitos water supply	Very high	36%
Cusco water supply	High	9%
Cusco sewerage	Very high	35%
Sicuani water supply	High (expected)	4%
Sicuani sewerage	(not judged)	16%
Overall	High	100%

Note: As the actual cost of some components is unknown, planned values were used for the Project cost ratio.

3.4 Impacts

3.4.1 Intended Impacts

In the Project, it was anticipated that the construction of water supply and sewerage facilities would make a contribution towards improvement of environmental and sanitary conditions in the target districts. The following sections explain the results of the survey of beneficiaries in Iquitos and Cusco. As for Sicuani, no such analysis of impact was conducted as the project effects are yet to be materialized. Improvement of water quality of the Huatanay River which was the main target for environmental improvement in Cusco is analyzed.

Table 7　Main Results of the Beneficiary Survey

	Iquitos	Cusco
Source of water (multiple responses)		
SSC	99%	99%
Refined water (bottled)	59%	37%
Recycling of laundry water	6%	44%
Rainwater	6%	44%
Sources of potable water (multiple responses)		
SSC	66%	100%
Refined water (bottled)	60%	37%
Water supply hours	4.1 hours	19.5 hours
Households that answered they have problems with water supply		
Poor water quality	81%	37%
Short and irregular water supply times	79%	12%
High tariffs	39%	44%
Low water pressure	34%	19%
Frequent water supply interruptions (1 day or more)	25%	20%
Poor maintenance	13%	18%
Poor customer service	17%	13%
Degree of satisfaction with water supply services		
Very satisfied	4%	5%
Satisfied	29%	38%
Slightly satisfied	21%	27%
Slightly dissatisfied	35%	23%
Very dissatisfied	21%	7%
Change in the water supply service (general) following Project implementation		
Greatly improved	0%	11%
Slightly improved	20%	24%
No change	21%	50%
Slightly worse	43%	12%
Much worse	16%	2%

	Iquitos	Cusco
Degree of improvement in water supply service following Project implementation*		
Water quality	3%	0%
Water supply time	-8%	8%
Water cuts	8%	10%
Water pressure	-1%	-7%
Tariffs	-6%	-55%
Maintenance	2%	-36%
Customer service	3%	-29%
Households that answered they have problems with sewerage		
Sewage overflows	-	17%
Bad odor	-	13%
Degree of satisfaction with sewerage services		
Very satisfied	-	10%
Satisfied	-	58%
Slightly satisfied	-	17%
Slightly dissatisfied	-	11%
Very dissatisfied	-	3%
Degree of improvement in household sanitation*	64%	66%
Degree of improvement in local area sanitation*	12%	36%
Changes in lifestyle		
Change for the better	72%	46%
Change for the worse	61%	29%
Change in frequency of diarrhea		
Increased	18%	4%
Decreased	29%	11%

Source: Beneficiary Survey
Note: For the "Degree of improvement", the ratio of responses saying that conditions had worsened was deducted from the ratio saying that conditions had improved.

（1） Results of the survey of beneficiaries (Iquitos, Cusco)

In the ex-post evaluation, as the survey of beneficiaries, questionnaire survey was conducted with respect to a total of 252 households in Iquitos and Cusco. The main results are shown in Table 7.[37] In addition, group interviews with residents were conducted two times in

[37] In Sicuani, no survey was implemented because the Project has not been completed and there were no target residents. The survey of beneficiaries, targeting 126 households in two districts of Iquitos and 126 households in three districts of Cusco, was implemented based on personal interviews using questionnaires. In order to select the households for interviews, first, representative districts in each city that are directly and indirectly benefited from this Project were selected. Then, sample households in each district were picked up in a random manner by visiting every fifth housing unit along the research routes in the blocks that were randomly determined on the map. 63 households in one district within Iquitos were those not having water supply service by the SSC prior to the Project, and the rest were households that had the service even before the Project.

each of Iquitos and Cusco.

Iquitos

In Iquitos, the survey was conducted during the dry season, when water production volume is low, raw water has high chromaticity, and it also coincided with the timing of repairs of the water treatment plant. As a result, many expressed high level of dissatisfaction with water quality and water supply hours, and more than half of the respondents expressed dissatisfaction with general water supply services. According to the survey of beneficiaries concerning the water supply service in Iquitos, residents are unhappy about numerous points including short and uneven water supply hours and poor water quality (turbidity, color), and only 33% of residents answer that they are very satisfied or satisfied with the water supply service. Although the low water quality may be a temporal phenomenon at the time of the survey due to the high chromaticity of the raw water and the repair work at the water treatment plant, its influence was big as 60% of households were separately purchasing potable water.

On the other hand, upon asking about changes following Project implementation to the 63 households that were using the SSC services from before implementation of the Project, only 20% responded that services improved, while more than half said that services deteriorated. Concerning water supply hours and tariffs, most respondents said that the situation had become worse. In some areas around the water treatment plants, even though water supply was available for 24 hours a day before the Project, the water supply hours per day decreased as a result of the Project due to the introduction of uniform water distribution in line with the construction of water distribution reservoirs in the Project. It is thought that this fact was reflected in the above responses.

Out of the targets of the survey of beneficiaries in Iquitos, 65 households (52% of total households) newly acquired water supply service thanks to the Project. These households previously used mainly well water (83%), refined water (49%) and rainwater (37%), while many of them responded that they could save on labor, time and cost in obtaining water and they could obtain high quality water thanks to the Project.

Generally speaking, many respondents indicated that their household sanitary situation had been improved (improved 70%, deteriorated 6%). The reason mentioned is easier access to water than before. Many respondents indicated that the frequency of diarrhea decreased (18% increased, 29% declined). Looking only at those households that had newly acquired water supply services, 43% of them responded that frequency of diarrhea had declined, with the two-thirds saying that the reason for this was the improvement in water. On the other hand, there were no reports of major improvement in the local sanitary conditions (improved 49%, deteriorated 37%). The possible reasons are that some districts become inundated at times of flooding, and that the sewerage system has not been sufficiently constructed. On the other hand,

70% of respondents said that the Project had imparted positive changes on lifestyle (mainly hygiene), but at the same time 60% said that there had been a negative change (mainly issues of sewerage).

Summing up, in Iquitos, although the Project is believed to have contributed to improvement of environmental hygiene conditions, there is deemed to be further room for improvement due to restrictions on effective water volume and sewerage improvement and expansion.

Cusco

The general degree of satisfaction with water supply services in Cusco is relatively high. 43% of households were satisfied with the water supply service. Around 30% of respondents voiced dissatisfaction, with half of those pointing to the high level of tariffs. In addition, dissatisfaction was also voiced on short water supply hours in districts at high altitudes. Some people indicated dissatisfaction with the water quality. According to Cusco SSC, it is thought that this has been caused by the construction works on water distribution pipes that are implemented throughout the city, as no problems have been confirmed regarding water quality at the water treatment plant. Many households responded that water supply services improved following implementation of the Project. Many households reported improvement to water supply time and reduction of water supply interruptions, while many people said that the situation had deteriorated in terms of tariffs, maintenance and customer service. Concerning sewerage, between 70-80% of households are satisfied with conditions. However, there have also been some reports of overflowing sewage and bad odor (details are explained in 3. 4. 2. (1)). It should be also noted that hardly any of the residents in the survey knew that sewage was being treated in the Project treatment plant.

70% of the respondents indicated that their household sanitary situation had been improved, and almost none responded that the situation had worsened. As the main reason for this, the respondents pointed to greater accessibility to water. Many respondents said that the frequency of diarrhea had declined. There were also numerous reports of improvement in the local sanitary conditions (improved 53%, deteriorated 17%). 46% of the respondents said that the Project had imparted beneficial changes on lifestyle (mainly hygiene), but at the same time 29% said that there had been a negative change (mainly issues of tariffs).

Summing up, in Cusco, it is deemed that the Project contributed to improvement of environmental hygiene conditions as planned.

（２） Improvement of water quality in the Huatanay River

Cusco’s Huatanay River, which was suffering from critical water pollution, was still receiving a lot of untreated sewage at the time of the ex-post evaluation. In particular, Safi River,

which is a covered conduit that runs through the historical district of Cusco and converges with the Huatanay River in the city, has a BOD concentration of approximately 300 mg/liter which is the equivalent of sewage. This is a major source of pollution in the Huatanay River. According to water quality data of past years, there was no clear indication that the Project resulted in less pollution in terms of BOD concentration and coliform group. The BOD concentration in the Huatanay River is 10 times higher than the environmental standard of 15 mg/liter, and the coliform group level is 1,000 times the environmental standard. Therefore, pollution in the river continues to be critical.

The Project sewage treatment plant is removing more pollutants than planned and is thus making contribution towards improving water pollution in the Huatanay River. However, the river water quality does not improve because of growth in the population and the increased sewage flow in Cusco and its surrounding area, slow progress in construction of the collector network[38], and continuing inflow of a lot of untreated sewage to the Huatanay River. Also, because rainwater is mixed in with sewage, the sewage flow exceeds the plant's treatment capacity and this is another reason for the discharge of sewage that is conveyed to the treatment plant but remains untreated[39].

３.４.２ Other Positive and Negative Impacts

（１） Environmental and Social Impacts

In each city, environmental impact assessment was conducted in accordance with legislation in Peru. In each case, no major environmental impacts were predicted, and the necessary measures were taken to mitigate and prevent any minor impacts of the works. The following paragraphs describe noteworthy environmental and social impacts in each city.

Iquitos

Following completion of the Project, no noteworthy environmental impacts have been reported. The construction sites of the water distribution reservoirs were all constructed on public land, and agreements were reached with the local government and university that owned the land. There was no need to relocate residents or pay compensation, and no social problems arose.

[38] In the Project, Huatanay collector (sewerage main) was constructed parallel to the Huatanay River based on Peruvian funding. Maximum pipe diameter when the Project was planned was estimated to be 1,200 millimeters, however, due to financial limitations, the maximum constructed diameter was just 600 millimeters. As a result, the sewage collection capacity is insufficient. Therefore, it is now planned to construct another new parallel sewerage main.

[39] In response to these issues, in August 2015, the Ministry of Housing, Construction and Sanitation reached agreement with Cusco SSC, Cusco Region and five related municipalities on formation of an investment program aimed at improving water quality in the Huatanay River. Based on multiple investment schemes, this program aims to construct rainwater drainage facilities, expand the collector network, expand the sewage treatment plants and so on, and concrete plans were being formulated at the time of the ex-post evaluation. In this program, the idea of additional treatment facilities on the site of the Project sewage treatment plant is being considered.

Cusco

In Cusco, it was planned to construct the sewage treatment plant in the downstream of the Huatanay River. However, it was too difficult to acquire the necessary land because there were so many landowners. Accordingly, the new treatment plant was constructed on the site of the existing sewage treatment plant, and there was no need to acquire new land.

In the sewage treatment plant, as a result of introducing the digestion tank, the quantity of sludge for final disposal was reduced and energy efficiency was improved by utilizing the digestion gas (methane gas generated through the digestion process). However, because sludge is not well digested (methane fermentation) as planned and held in the thickening tanks and storage tanks for a long time, it putrefies and generates gas with strong odor of hydrogen sulfide, etc. The residents living around the treatment plant have complained to the local government about the odor, and the local government has consequently pressed charges against Cusco SSC. While making an externally commissioned investigation on the cause of the odor and adjusting plant operation[40], the SSC is examining emergency countermeasures to prevent bad odor. The flammable gas that is generated in the digestion tanks is only used for heating sludge to facilitate the digestion process, while the remainder is incinerated.

In Peru, sludge from sewage treatment plant is regarded as a hazardous waste, and it cannot be received at a general final disposal site unless consent is given by the local government that manages the site. In Cusco, since no such consent has been given, there is a shortage of sites for disposing of dewatered sludge. For this reason, up until September 2015, it was necessary to discharge some of the sludge into the river at night, and this was imparting a negative impact on the environment. Cusco SSC is promoting the composting of digested sludge and tie-ups with waste disposal companies in the private sector, and it appears that all sludge will be appropriately disposed.

Sicuani

Approximately 4.2 hectares of land was acquired to construct the sewage treatment plant. Compensation of 1,580,000 Sol (approximately 55 million yen) was paid. There was no resettlement of residents. 4-5 years after the initiation of the sewage treatment plant operation, it will be necessary to remove settled sludge from the bottom of the anaerobic lagoons, dry it and finally dispose it. At the time of the ex-post evaluation, the location and method for final disposal of sludge were still not decided.

[40] Because operation of the sewage treatment plant in Cusco had been outsourced, Cusco SSC was unable to directly address this issue during this period. Since the SSC took over direct operation of the plant in January 2016, it has started efforts such as regulating retention time in the sludge thickening tanks.

（２） Other impacts

None in particular

As a summary, while the sewage treatment plant in Cusco has some issues concerning odor prevention, the Project contributed to improvement of the sanitary environment in Iquitos and Cusco and alleviation of water quality worsening in the Huatanay River in Cusco, and it mostly achieved its intended impacts in these two cities. Attainment of impacts in Sicuani is not judged. Based on the above, the Project has largely achieved its objectives. Therefore, effectiveness and impact of the Project are high.

Trial composting of sludge by Cusco SSC (left)

Repair team of water supply network of Iquitos SSC (right)

３.５ Sustainability (Rating: ②)

３.５.１ Institutional Aspects of Operation and Maintenance

Iquitos SSC has 365 employees in total including 18 engineers. The operating department conducts the operation and maintenance of water treatment plants and water distribution facilities. This department has 112 employees and there is no shortage of human resources.

Cusco SSC has 226 employees in total including 25 engineers. Its operating department conducts operation and maintenance of water treatment plants and sewage treatment plants. This department has 127 employees including more than 20 engineers, and there is no shortage of human resources. The sewerage treatment plant has 17 staff members including six technicians. A private sector operator used to conduct operation and maintenance. However, the outsourced operation and maintenance work did not fully reflect the requests of SSC and the operator did not provide reliable operation data. Therefore, the SSC employed several external engineers (sanitary expert, SCADA expert, etc.) and commenced directly-managed operation and maintenance from January 15, 2016. Concerning water distribution facilities and sewage

collection facilities, the maintenance department conducts repairs in response to calls from customers. Additional staff are employed during the rainy season when numerous issues arise in the collector network. The maintenance department conducts preventive maintenance of electrical and mechanical equipment. According to this department, there are some constraints in terms of manpower and means of transportation in this regard.

Sicuani SSC has a total of 37 employees but there is no civil / sanitation engineer[41]. Seven of these conduct repairs of water supply and collector network as well as installation of new connections. However, because it is faced with insufficient manpower, equipment and funds, it plans to employ six additional preventive and predictive maintenance personnel in 2016. Concerning operation and maintenance of the sewage treatment plant, Sicuani SSC needs to employ 15 more personnel including one engineer. It is necessary to secure human resources by the end of the construction works and start of trial operation. However, as is described later, there are problems concerning the source of funds and mode of employment and it is not yet clear who will be employed and how.

Summing up, concerning sustainability in institutional aspects, the sewage treatment plant operation and maintenance setup in Sicuani is unclear and has some issues.

3.5.2 Technical Aspects of Operation and Maintenance

Although Iquitos SSC has an internal training system, according to the National Sanitation Services Supervisory (SUNASS), there are few technicians and engineers who are endowed with expertise, and it is necessary to strengthen the technical capacity for water production and operation and maintenance. While it should be noted that the water treatment plant has a preventive and predictive maintenance plan and implements work according to this within the approved budget.

According to SUNASS, Cusco SSC has high technical and operational capacities that are second to the SSC of Lima Metropolitan Area in Peru. Judging from how the necessary data was provided for the ex-post evaluation, there is a sufficient base of data for conducting operation and maintenance. Because the Cusco SSC conducts its own troubleshooting regarding sludge treatment in digestion tanks, it is deemed to possess high technical capacity. Moreover, recruitment of external engineers helps it to secure ample technical capability for operating the sewage treatment plant.

Sicuani SSC has no engineers in the civil engineering and sanitation fields. Although there are employees who have worked for a long time in the facilities and understand them well, their technical levels are not high. Engineers with appropriate capacity are needed in order to appropriately operate and maintain the sewage treatment plant. However, since it is difficult for Sicuani SSC to employ highly competent human resources with its low salary levels, it is

[41] Since Sicuani has no water treatment plant, no human resource is assigned for this purpose.

necessary to examine the source of funding and mode of employment[42].

Summing up, concerning technical sustainability, there are minor issues in Iquitos, and there is concern in Sicuani about whether or not there would be sufficient technical capacity to appropriately operate and maintain the sewage treatment plant.

3.5.3 Financial Aspects of Operation and Maintenance

Table 8 shows the financial conditions of the SSCs in the three target cities in the Project.

Table 8 Financial Status of SSCs in the Three Target Cities

(Unit: 1,000 Nuevos Soles)

	Iquitos SSC			Cusco SSC			Sicuani SSC		
	2012	2013	2014	2012	2013	2014	2012	2013	2014
Operating revenue	25,177	24,998	27,540	34,573	40,311	50,128	1,846	2,221	2,282
Water supply and sewerage tariff revenue	22,774	23,999	25,593	34,573	40,311	50,128	1,343	1,455	2,282
Other revenue	2,403	999	1,947	0	0	0	503	766	0
Operating costs	30,749	33,170	38,585	31,211	37,260	42,959	2,206	2,301	2,306
Cost of operations (a)	18,642	21,582	25,805	22,464	26,693	30,281	878	916	559
Retail expenses	6,660	6,346	7,373	3,262	4,181	5,871	175	160	481
Administration cost, etc.	5,447	5,242	5,407	5,485	6,386	6,807	1,153	1,225	1,266
Operating profit	-5,572	-8,172	-11,045	3,362	3,051	7,169	-360	-80	-24
Non-operating revenue	937	17,720	25,103	14,546	5,443	7,016	6	6	203
Non-operating cost	19	2,723	9,073	13,417	1,897	4,991	0	0	0
Tax	0	0	0	0	1,022	2,293	0	0	0
Ordinary profit	-4,654	6,825	4,985	4,491	5,575	6,901	-354	-74	179
Working Ratio (b)	92%	102%	112%	90%	64%	68%	92%	81%	79%
Operating profit ratio	-22%	-33%	-40%	10%	8%	14%	-20%	-4%	-1%
Current ratio (c)	215%	36%	39%	439%	620%	357%	1,041%	40,317%	62,578%
Debt ratio (d)	275%	245%	260%	45%	34%	23%	1%	343%	578%

Source: SSC of each city

Notes:

(a) This includes operation and maintenance cost and depreciation cost.
(b) Operation and maintenance cost/operating revenue
(c) Fluid assets/fluid liabilities
(d) Liabilities/capital

Iquitos SSC faces difficult financial conditions mainly for the following reasons: low water tariffs, high rate of non-revenue water including stolen water, higher water production costs due to hikes in power tariffs, etc., high personnel costs[43]. It recorded an operating deficit

[42] In order to employ engineers who are endowed with sufficient capacity to operate and maintain Sicuani's sewage treatment plant, it is necessary to pay salary that is equivalent to at least two times the salary of the president of Sicuani SSC. However, since it is not necessary to employ such an engineer on a full-time basis for the sewage treatment plant alone, it may also be possible to employ on a part-time basis an engineer who is resident in another city such as Cusco, which is 3 hours away from Sicuani.

[43] The last hike in water tariffs was in 2010, when they were raised by 11%, however, they have been kept at the same level since then. The company attempted to reduce its personnel with a view to improving its business in

each year between 2013-2015. Its operating profit ratio (including depreciation cost) in 2014 was minus 40%, and its current ratio and debt ratio were both poor at 39% and 260% respectively. Since 2010, it has fallen behind in repayments for the ODA Loan that was transferred to it, and the MVCS has been covering the repayments to JICA. In these circumstances, Iquitos SSC deemed that it could not autonomously rebuild its finances and applied for Transitional Support Scheme under the Basic Water Act. It aims to rebuild its business while receiving technical support from the Technical Organization of Administration of Sanitation Services (OTASS: *Organismo Técnico de la Administracion de los Servicios de Saneamiento*) and financial support from the MVCS.

The financial standing of Cusco SSC is generally good. Its operations were making profit and its operating margin was around 10% each year of 2012-2014. Its current ratio and debt ratio in 2014 were also good at 357% and 23% respectively. It also keeps up to date with its ODA Loan repayments. In 2015, though it continued to show a positive operating profit, because the exchange rate changed unfavorably for repaying the Project loan, which is based on a foreign currency, it incurred a large non-operating loss and appeared likely to record a negative current profit for the year. According to the SSC, both operating profit and ordinary profit were in surplus in the first quarter of 2016.

Sicuani SSC faces harsh financial conditions. It has continuously incurred an operating deficit every year since 2005. In 2014, thanks to a reduction in depreciation costs, it entered profits. Its current ratio is high but its debt ratio has reached 578%[44]. Because it is unable to repay the assigned ODA Loan, the MVCS has been covering the payments. The treatment plant operation and maintenance is estimated to cost roughly 700,000 Sol per year[45], which is equivalent to some one third of annual sales income of the SSC. More cost would be needed if operation and maintenance cost of the newly constructed pumping station for water supply and other facilities are included. In order to cover this, it would be necessary to raise tariffs by some 50% or more, however, this would be difficult to do at once. Considering that an opposition movement arose during the Project among residents who feared tariff hikes, it is doubtful whether such an increase can be made to tariffs[46]. For this reason, the SSC has made a request to the MVCS to help cover operation and maintenance costs for around five years so that it can gradually increase tariffs. MVCS is currently examining the request. However, the current institutional framework does not expect the Ministry to directly support the operation and maintenance costs of a SCC, and nothing specific has been decided so far.

2008, however, it did not succeed because of opposition from the labor union.

44 The high current ratio of the Sicuani SSC is caused by the fact that the fund of state and city governments that are irrelevant to the operation of the SSC was nominally allocated as the current assets of the SSC, and the fact that the amount of such monetary value was large.

45 See section 3.2.1 Outputs (3) Sicuani for information on the change of plans regarding the sewage treatment plant.

46 According to SUNASS, which is in the position of approving water supply and sewerage tariffs, since the operation and maintenance cost of the Project in Sicuani is too large to be covered by tariff hikes, it would be necessary for the central government or region subsidize them in some way or other.

Summing up, in terms of financial sustainability, Iquitos faces major issues and Sicuani has some concerns.

3.5.4 Current Status of Operation and Maintenance

Repairs of the filtration tanks and replacements of valves at the water treatment plant in Iquitos are being implemented gradually within the budget. Meanwhile, as was described in 3.2.1 Outputs, some of the panels in the flocculation tank in the water treatment plant are missing, and the filter basin instruments, generator control panel, SCADA system, etc. are still not in operative condition. The pumps in the intake facilities become damaged quickly because the river water contains a lot of sediment, and replacements tend to be slow. If such situations are left alone, there is a possibility that such situation will eventually generate a significant impact on water production and water quality. In view of the harsh financial situation faced by Iquitos SSC as described above, and the fact that eight years have passed since the completion of the treatment plant under the Project, the MVCS has started to investigate the feasibility of a project for rehabilitation and renewal of the water supply facility.

Sewage treatment efficiency in Cusco is sufficiently high. Operation and maintenance is appropriately conducted. However, as was described in 3.4.2 (1) Environmental and Social Impacts, there is a problem with the strong odor that is generated in the sludge treatment process. Because of damage to motors caused by harmonic current at the sewage treatment plant, a plan to introduce a harmonic current suppression device is being examined. In general, operation and maintenance in the water supply and sewerage network are implemented appropriately.

The water supply and sewerage network in Sicuani is operated and maintained appropriately and no major problems have been reported. The sewage treatment plant was put into trial operation after its completion in July 2016, while it was not yet completed at the time of the second field visit for the ex-post evaluation.

Table 9 Evaluation of Sustainability by Cities

	Sustainability	Project cost ratio
Iquitos	Low	36%
Cusco	High	44%
Sicuani	Low – Fair	20%
Overall	Fair	100%

Note: As the actual cost of some components is unknown, planned values were used for the Project cost ratio.

Summing up about sustainability, Iquitos has minor issues in terms of technology and problems in terms of finances and its sustainability is low. In Cusco, its sustainability is high as there are no problems in operation and maintenance of the Project. In Sicuani, its sustainability

is low – fair as there are institutional, technical and financial concerns regarding the sewage treatment plant. Overall, sustainability of the Project effects has been fair.

4. Conclusion, Recommendations and Lessons Learned

4.1 Conclusion

The Project was implemented in order to improve the water supply and sewerage coverage rate in the Peruvian regional cities of Iquitos (Loreto Region), Cusco and Sicuani (Cusco Region) by means of improving and constructing water supply and sewerage facilities as well as enhancing capacity for water production and sewerage treatment, thereby contributing to improvement of environmental and sanitary conditions in the target area. From the time of the ex-ante evaluation through to the ex-post evaluation, the water supply and sewerage sector remained an important issue for the Government of Peru. At the time of the ex-ante evaluation, needs for water supply and sewerage development in the three target cities were high, and the Project facilities are playing an important role at the time of the ex-post evaluation. Moreover, the Project was consistent with Japan's aid policies at the time of the ex-ante evaluation. Therefore, the relevance of the Project is high. Due to two changes of government and deterioration of the operating conditions by SSC in the target cities following signing of the loan agreement, construction works of the sewerage component in Cusco and the water supply and sewerage components in Sicuani were delayed by more than 10 years, and the Project period was three times longer than planned. Due to price inflation over this period and expansion of the water treatment plants and sewage treatment plants and so forth, the Project cost was roughly 80% greater than planned. Accordingly, the Project efficiency was low. In Iquitos and Cusco, the project has realized water production and sewage treatment capacity greater than planned while expansion of the water supply and sewerage networks has been constructed mostly as planned. Accordingly, the Project has contributed to improvement of environmental and sanitary conditions as planned in both these cities. In Cusco, there has been major improvement in the water supply and sewerage coverage rates and water supply time as well as in prevention of pollution in the Huatanay River. On the other hand, in Iquitos, where issues remain concerning non-revenue water and water shortage continues, no major improvement has been witnessed in water supply services. In Sicuani, water supply and sewerage facilities are not yet completed and had not started operating by the time of the ex-post evaluation. While the project effect is expected to be high in the water supply sector, judgment cannot be made concerning the sewerage sector where concerns exist over operation of the sewage treatment plant. Summing up, effectiveness and impact of the Project have been high. In Cusco, there are no problems concerning operation and maintenance, and sustainability is high. In Iquitos, sustainability is low, as there are some minor issues in technical aspect and concerns in financial aspects. In Sicuani, since concerns remain over the sewage treatment plant in terms of

institution, technology and finance, sustainability is low-fair. Overall, sustainability of the effects realized by the Project is fair.

In conclusion, the Project is evaluated to be partially satisfactory.

4.2 Recommendations

4.2.1 Recommendations to Implementation Agencies

Iquitos SSC

- In order to improve water supply services by fully utilizing the water treatment plant and transmission and distribution facilities that were constructed by the Project, Iquitos SSC should work on securing water intake capacity that is not influenced by river water level, further reducing the non-revenue water rate through sectorization of water distribution, and renewing electrical and mechanical equipment at the treatment plant and distribution reservoirs that have either broken down or reached the end of their lives.
- Iquitos SSC should make use of the Transitional Support Scheme and receive technical assistance from the Technical Organization of Administration of Sanitation Services and financial assistance by the government with a view to immediately consolidate management.

Cusco SSC

- Concerning the foul odor generated in the sludge treatment processes at the sewage treatment plant, Cusco SSC should investigate the cause and urgently examine measures and necessary adjustment of operation and maintenance procedure in order to resolve the problem.
- Cusco SSC should secure means for final disposal of sludge through tying-up with private enterprises and composting.
- Cusco SSC should work to prevent pollution of the Huatanay River through a public investment program in collaboration with MVCS and other local authorities.

Sicuani SSC

- Sicuani SSC should strive to complete the trial operation of the Project and quickly start the operation of facilities.
- It is necessary to secure the funding and human resources for operation and maintenance of the sewage treatment plant by the start of its operation. Since it is difficult to cover the necessary costs through water supply and sewerage tariff

hikes alone, and essential to receive financial assistance from the central government and others, it is necessary to immediately find a realistic solution in consultation with MVCS. Concerning the securing of engineers, it should also examine receiving support from the SSCs in Lima and Cusco.

Ministry of Housing, Construction and Sanitation (MVCS)

- MVCS should examine the technical support and financial assistance that are required by each SSC in order for them to implement the above recommendations. In particular, immediate assistance is required for Sicuani SSC because operation of the sewage treatment plant is about to begin.

4.2.2 Recommendations to JICA

JICA should liaise with and follow up MVCS and each SSC to make sure to implement the above recommendations. Particularly concerning Sicuani, in addition to monitoring activities with a view to realizing the early operation of the Project facilities, it should examine the feasibility of technical support including technical cooperation tied to ODA Loans and dispatch of senior volunteers concerning the operation and maintenance of the sewage treatment plant.

4.3 Lessons Learned

Re-examination of feasibility of delayed projects

In projects where there is a long interval between implementation of the feasibility study that was subject to the ex-ante evaluation and its actual implementation, changes may arise in external conditions such as the necessity of the project, land acquisition and operation and maintenance capacity of the implementing agency, making it necessary to make major changes in the original plan. In such cases, since there is a risk that the basis of decisions at the time of the ex-ante evaluation may be lost, it is necessary to review the background and process of such changes and re-examine the feasibility of the project, including analysis of multiple alternatives if necessary.

In the Project, the treatment technology at Sicuani sewage treatment plant had to be changed because it was not possible to secure the originally scheduled site area. As a result, doubts remained over its sustainability because the resulting change made it necessary to adopt more sophisticated technology and incurred more operation and maintenance costs. Concerning this change of plan, it was necessary to have more thorough examination with a study including review of alternative sites along with analysis of financial sustainability.

Monitoring of works outside the scope of the ODA Loan

As for contracts that use ODA Loan funds, JICA's consent is required in each stage of procurement (tender documents and tender evaluation), signing contracts and contract amendments, and JICA is able to scrutinize the contents and provide advice based on technical review where necessary. However, under the current JICA systems, such consent procedure is not required for contracts that are outside the scope of ODA Loans. Accordingly, it is possible to modify contracts and decide final scope of contracts without detailed knowledge of JICA, and inappropriate changes in plans that impact the project effects and sustainability could be made without any opportunity of appropriate advice by JICA.

In this Project, major changes were made to the plans for Sicuani sewage treatment plant. As the consulting service was funded by the ODA Loan, application for consent was submitted for the extension of consulting service for the abovementioned changes. However, the detailed information of these changes to the sewage treatment plant was not informed to JICA. If construction of the sewage treatment plant had been funded by the ODA Loan, it is possible that JICA could have grasped the details of the changes, conducted technical review and offered appropriate advice. Meanwhile, in Cusco, the water supply facilities and sewage collection facilities were removed from the targets of the ODA Loan. However, JICA was unable to appropriately follow the implementation situation in this case and this became a constraint in the ex-post evaluation.

Accordingly, concerning the contracts under ODA Loan projects that are not funded by the ODA Loan but are included in the scope of the projects, JICA should do more than just scrutinize the progress reports that are submitted by the implementing agency; rather it should strive to confirm the issues in implementation and feasibility to generate project effects upon seeking additional information, conducting on-site inspections and implementing sufficient monitoring. Moreover, in cases where important changes are made to plans within the scope of the project, even if such changes are outside the scope of the ODA Loan, JICA should demand that the implementing agency provide detailed information based on the obligation and rights written in the loan agreement.

Comparison of the Original and Actual Scope of the Project

Item	Plan	Actual Achievement
①Project Outputs Iquitos water supply	・ Intake: reconditioning of intake 2 loc. ・ Water treatment plant: new construction (production capacity 520 liter/sec) ・ Water transmission pipeline: expansion and repair 18 kilometers ・ Clear water reservoirs: new construction 2 locations, repair 1 loc. ・ Pumping stations: new construction 1 location, repair 3 locations ・ Water distribution reservoirs: new construction 10 loc., repair 1 loc. ・ Distribution mains and distribution network:187 kilometers ・ Connections: new construction 11,388 (including meter installation), repair 3,594	・ Mostly as planned ・ New construction (production capacity: 750 liter/sec) ・ Expansion and repair 15 kilometers ・ New construction 3 locations, rehabilitation 1 location ・ As planned. ・ New construction 10 locations, repair1 location ・ 135 kilometers ・ New 11,084, repairs 1,348, meter installations 11,388 ・ Introduction of SCADA system (added)
Cusco water supply Transmission and distribution facility	・ Water distribution reservoirs: new construction 4 locations ・ Pumping stations: new construction and reconstruction 3 locations ・ Water transmission and distribution pipeline: (transmission) new construction 26 kilometers, (distribution) new construction 16 districts, 29 kilometers ・ Connections: new construction 3,564 (including meters)	・ New construction 1 location ・ New construction and reconstruction 2 locations ・ Partially implemented, 9 kilometers out of 26 kilometers, not implemented 8 kilometers; concerning the remaining 9 kilometers, the planned locations and implementation situation are unclear ・ New 3,564 or more
Cusco sewerage Collection facility Treatment facility	・ Sewerage main:15 kilometers ・ Secondary collector:16 kilometers ・ Collector network:16 districts, 23 kilometers ・ Connections: new construction 7,190 ・ Treatment plant:300 liter/sec, oxidation pond system ・ Conveyance pipeline to the new plant:7 kilometers	・ 13 kilometers ・ 14 kilometers ・ 15 districts, extension unclear ・ Unclear ・ 460 liter/sec, trickling filter system ・ None
Sicuani water supply Water projection facility	・ Water intake and conduction facilities: rehabilitation (2 loc., springs) ・ Water distribution reservoirs: new construction 2 loc., rehabilitation 2 loc. ・ Pumping stations: new construction 2 loc. ・ Chlorine injection system (2 locations) ・ Water transmission pipeline and	・ Rehabilitation (3 locations, springs) ・ New construction 2 locations, rehabilitation 2 locations ・ New construction 2 locations ・ 1 location ・ Combined with the water

	distribution mains:6 kilometers ・ Water distribution network: expansion 6 districts, 19 kilometers	distribution network 17 kilometers (plan when the contract was signed; actual situation unclear), expansion 6 districts
<u>Sicuani sewerage</u> Collection facility Treatment facility	・ Sewerage main and collector network:21 kilometers ・ Pumping stations:1 location ・ Connections:7 districts, new 2,125 ・ Treatment plant:77 liter/sec, oxidation pond system	・ 20 kilometers (to be decided) ・ 2 locations ・ 8 districts, number of new connections is unknown. ・ 80 liter/sec, anaerobic lagoon and trickling filter combined system
②Project Period	September, 2000 - May, 2005 (57 months)	September, 2000 - May, 2016 (not completed, 189 months)
③Project Cost ODA Loan Fund by Peru Total (Total *) Exchange Rate	 7,636 million yen 2,545 million yen 10,181 million yen 8,554 million yen 1 US$ = 113.5 yen 1 Nuevo Sol = 34.0 yen	 6,010 million yen (Unknown) (Unknown) 15,216 million yen 1 US$= 101.0 yen 1 Nuevo Sol = 32.7 - 38.4 yen

* The total amount remaining after removing the values for the water supply system and the sewer collection facilities of Cusco, where actual amounts spent are not known, from the total project expense.

Republic of Peru

FY 2015 Ex-Post Evaluation of Japanese ODA Loan Projects

"Lima Marginal Areas Sanitation Improvement Project"

"Lima Marginal Areas Sanitation Improvement Project (II)"

External Evaluator: Hajime Sonoda, Global Group 21 Japan, Inc.

0. Summary

The Lima Marginal Areas Sanitation Improvement Project and the Lima Marginal Areas Sanitation Improvement Project (II) (hereinafter these are together referred to as "the Project") were implemented to expand and improve the water supply and sewerage services in marginal areas of the northern Lima Metropolitan Area (hereinafter referred to as the "LMA") by means of constructing a new water treatment plant (hereinafter referred to as the "WTP") and improving the water supply and sewer networks, thereby contributing to improvement of the living conditions in these areas. The water supply and sewage management sector has consistently been a priority development sector for the Government of Peru since the time of appraisal to the time of ex-post evaluation. At the time of appraisal, there was a great need for the development of water supply and sewer systems, and the facilities constructed or improved under the Project play an important role at the time of ex-post evaluation. The Project was relevant to Japan's ODA policy at the time of appraisal. Based on the above, the relevance of the Project is high. Of the planned facilities under the Project, the construction of the Huachipa WTP and North Branch Water Transmission Line (hereinafter referred to as the "North Branch") was implemented after postponement of six years as a result of review of the water demand in the LMA. Meanwhile, the construction work to connect the North Branch to the existing water supply networks is not fully completed at the time of ex-post evaluation due to cancellation of the relevant contract with the contractor. Because of these delays, the project implementation period has more than trebled compared to the plan. The project cost has almost doubled due to price increases and an increased work volume. Therefore, the efficiency of the Project is low. The expansion of water supply and sewerage services following the consolidation of the water supply and sewer systems under the Project have achieved nearly 90% of the original targets. The intended effects of the Project have been generally achieved as planned. These include the expansion and improvement of the water supply and sewerage services and improvement of the living conditions for households with new connections as well as existing connections. The water production volume of the Huachipa WTP, on the other hand, is currently only one-quarter of the planned volume due to the delayed connection work to the existing water supply networks. Therefore, the effectiveness and impact of the Project is fair. As no specific problems are observed with the institutional, technical and financial aspects of the operation and maintenance of the Project, the sustainability of the Project is high.

In conclusion, the Project is evaluated as being partially satisfactory.

1. Project Description

Project Location

Huachipa Water Treatment Plant

1.1 Background

In the second half of the 1990's, the LMA with the largest population (some 7.5 million in 1998) in Peru was suffering from a severe water shortage in the dry season. According to Lima Sanitation Service Company (hereinafter referred to as "SEDAPAL")[1], while SEDAPAL was making efforts to develop new water sources in the Andes Mountains, the water source area, it found it necessary to enhance the water treatment capacity in parallel.

Meanwhile, the inflow of low income people from rural areas to the LMA accelerated the rapid urbanization of its peripheral areas. In the northern LMA, many of these migrant people with low income occupied public land around the existing urban areas, forming new residential areas. Many of these areas were on hillsides. As their living conditions were very poor and public services including water supply and sewer services were unavailable, the expansion of these services to include these areas was necessary.

Against this background, the Project aimed at improving the water supply and sewer systems in the northern LMA while also constructing a new WTP. In 1999, a fact-finding mission was dispatched to the LMA following a request by the Government of Peru for ODA. This was followed by project appraisal and an ODA loan agreement for the Project (Lima Marginal Areas Sanitation improvement Project) in 2000. To supplement an increased project cost, an additional loan was provided for the second phase of the Project (Lima Marginal Areas Sanitation improvement Project II) in 2010.

1.2 Project Outline

To expand and improve water supply and sewerage services in local residential areas of the northern LMA of Peru by means of constructing a new WTP (intake facility, treatment plant and trunk transmission line) and also developing water supply and sewer networks in the

[1] *Empresa Prestador de Servicio SEDAPAL Sociedad Anónima*

subject areas, thereby contributing to improvement of the living conditions in these areas.

Loan Approved Amount/ Disbursed Amount	(I) 24,854 million yen/24,818 million yen (II) 9,301 million yen/9,301 million yen	
Exchange of Notes Date/ Loan Agreement Signing Date	(I) 4 September, 2000 (II) 15 March, 2010	
Terms and Conditions	Interest Rate	(I) Main component: 1.7%; consulting service: 0.75% (II) Main component: 1.4%; consulting service: 0.01%
	Repayment Period (grace period)	(I) Main component: 25 years (7 years); consulting service: 40 years (10 years) (II) Main component: 25 years (7 years); consulting service: 25 years (7 years)
	Conditions for Procurement	(I) Main component: general untied; consulting service: bilateral untied (II) Main component: untied; consulting service: untied
Borrower/Executing Agencies	Republic of Peru / Lima Sanitation Services Company (SEDAPAL)	
Final Disbursement Date	(I) 25 August, 2011; (II) 20 December, 2010	
Main Contractors (Over 1 billion yen)	CONALVIAS LTDA (Columbia); GYM S.A. Peru); T&D SIGMA ASOCIADOS (Peru); COBRA INSTALACIONES Y SERVICIOS S.A. (Span); CAMARGO CORREA (Brazil); OTV SA (France); GALVAO ENGENHARIA S.A. (Brazil)	
Main Consultants (Over 100 million yen)	Nippon Koei Co. Ltd. (Japan); CESEL S.A. (Peru); OIST (Peru)	
Related Study	Project Formulation Study for the Project for Strengthening of Water Supply in Lima (Huachipa Treatment Plant)	
Related Projects	Project for Optimization of Water Supply and Sewerage in Northern Lima Metropolitan Area [(1) 2009–, (2) 2013–]; Pomacocha – Rio Blanco Water Resource Transfer Project (MARCA II) (terminated after the detailed design)	

2. Outline of the Evaluation Study

2.1 External Evaluator

Hajime Sonoda (Global Group 21 Japan, Inc.)

2.2 Duration of the Evaluation Study

The ex-post evaluation study for the Project was conducted over the following period.

Duration of the Study: March, 2016 – March, 2017

Duration of the Field Survey: 30 July – 16 August and 29 October – 3 November, 2016

3. Results of Evaluation (Rating: C[2])

3.1 Relevance (Rating: ③[3])

3.1.1 Relevance to Development Plan of Peru

At the time of appraisal (2000), many of the poor people accounting for half of Peru's population were concentrated in mountain regions and the LMA. Considering the elimination of poverty to be its biggest challenge, the Government of Peru had been aiming at providing necessary infrastructure, including social infrastructure relating to sanitation, education and health care, throughout the country in addition to assistance for production activities to improve the income level to allow the poor people to participate in the national economy. Emphasis was placed in particular on sanitation-related infrastructure as it was the most essential requirement for everyone's life and water supply and sewerage improvement projects were implemented nationwide.

The Second Garcia Administration inaugurated in 2006 (2006 – 2011) substantially increased the amount of public investment in the water supply and sewerage sector under the slogan of "Water for All"[4]. The Medium-Term Strategy (target period: 2016 – 2021) prepared by the Ministry of Housing, Construction and Sanitation in 2015 adopted "increased access to high quality and sustainable water supply and sanitation services in urban and rural areas" as a strategic objective. In regard to the improvement of water supply and sewerage services in local cities, the strategy plans to strengthen the operational capability of local sanitation service companies, participation of the private sector and consolidation of the sustainability of services were stated. The Kuczynski Administration inaugurated in 2016 upholds the water and sanitation sector as one of its priority sectors.[5]

As such, relevancy of the Project to the development plans of the Government of Peru is high both at the time of appraisal and ex-post evaluation.

3.1.2 Relevance to the Development Needs of Peru

As already described in 1.1 Background of the Project, the development of water resources and enhancement of the water treatment capacity were necessary in the LMA at the time of appraisal. At the time, SEDAPAL predicted that the water demand in the LMA in 2015 would be 33.1 m^3/sec, meaning that the development of new water supply sources and enhancement of the water treatment capacity to provide at least an additional 8 m^3/sec would be needed by 2015. The water supply and sewerage coverage ratio in the LMA at the time was

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2 A: Highly satisfactory; B: Satisfactory; C: Partially satisfactory; D: Unsatisfactory

3 ③: High; ②: Fair; ①: Low

4 According to data provided by the Ministry of Housing, Construction and Sanitation, the ratio of the public investment amount in the water supply and sewerage sector to the GNP has improved to 0.6 – 0.8% in the period from 2009 to 2016 from 0.1% or less up to 2005.

5 The election manifesto of the PPK (*Peruanos Por el Kambio*), the current government party, calls for "Potable Water for All" as part of its social development policies, aiming at providing all people of Peru with water supply and sanitation services by 2021.

approximately 85% and expansion of the water supply and sewerage services to new suburban residential areas experiencing a rapid population increase posed an immediate challenge.

As described later in 3.3 Effectiveness, at the time of this ex-post evaluation, the facilities either improved or newly constructed under the Project are playing an important role of providing water supply and sanitation services in the northern LMA with an acute population increase. The latest water supply and sewerage master plan (2014 – 2029) of SEDAPAL envisages population, water demand and sewerage volume increases by 22%, 18% and 19% respectively in the 15 year period from 2014 to 2030, calling for continuous development of water sources, water treatment, transmission and distribution facilities and sewerage facilities. This means that the importance of the Project has been maintained at the time of ex-post evaluation.

3.1.3 Relevance to Japan's ODA Policies

Japan's *Country Assistance Program for Peru* (2000) at the time of appraisal identifies "poverty reduction", "support for the social sector", "development of economic infrastructure" and "environmental conservation" as priority fields. The relevance of the Project to Japan's ODA policies can be identified through the policy of "poverty reduction" which calls for "the continuous promotion of cooperation primarily centering on the development of water supply and sewerage facilities as basic living infrastructure". The listing of measures to combat water pollution as part of "environmental conservation" is further evidence of the relevance of the Project to Japan's ODA policies.

Based on the above, the Project has been highly relevant to the country's development plan and development needs as well as Japan's ODA policies and, therefore, its relevance is high.

3.2 Efficiency (Rating: ①)

3.2.1 Outputs

The original plan for the Project envisaged that the Project would consist of two components described below. Although a request was made by the Government of Peru for Japanese ODA for each component as two separate projects, these two components were combined into a single project after their discussions at the time of appraisal.

<Component ①>

Construction of the Huachipa WTP Phase 1 (including intake facilities) to draw water from Rimac River and also of the North Branch to convey water from the Huachipa WTP to the northern LMA. The construction of the Huachipa WTP was planned in two

phases (Phase 1 with a treatment capacity of 5 m^3/sec and Phase 2 with an additional treatment capacity of 5 m^3/sec) and the Project corresponded to Phase 1. The capacity of the intake facilities to be constructed under the Project was planned to be 10 m^3/sec on the assumption that the Phase 2 construction of the Huachipa WTP would be implemented at a later stage. In Phase 2 scheduled to start in 2017 or later, the construction of a southern transmission pipeline (the South Branch) to convey water to southern LMA is planned along with the expansion of the treatment capacity of the Huachipa WTP.[6]

<Component ②>

Construction of general and secondary water supply and sewer networks in 18 districts of northern LMA.[7] It was planned that water supply in these 18 districts would rely on such water sources as wells, existing WTPs and the Huachipa WTP to be constructed under the Project. The work for the general water supply and sewer networks included the construction and improvement of wells, distribution reservoirs and principal pipelines. In some districts, connection to the North Branch was included in the scope of work. Meanwhile, the work for the water supply and sewer systems for secondary networks included the work to newly connect water supply and sewer pipes to some 50,000 low income households, mainly in the new residential areas.[8]

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[6] To deal with the increasing water demand of the LMA, SEDAPAL in conjunction with the Private Investment Promotion Agency (*Agencia de Promoción de la Inversión Privadas*: PROINVERSION) is preparing to implement a project of which the scope includes the development of water sources in the Andes Mountains, Phase 2 of the Huachipa WTP (expansion of the treatment facility) and construction of a southern transmission line to convey water to southern LMA through concession contracts with the participation of private sector investors. The contract period of this project and the contract amount are planned to be 30 years and US$ 600 million. Once completed, the Huachipa WTP will achieve a water production capacity of 10 m^3/sec using the intake facilities constructed under the Project. According to SEDAPAL, the procurement procedure started in February, 2014 and the selection of a contractor(s) is in progress. The work may commence some time in 2017 if the project is approved by the new administration.

[7] "Districts" in the target area of the Project were determined at the time of the planning of the Project to reflect the geographical locations of the water supply and sewerage facilities to be constructed or improved within the geographical coverage of the Project and, therefore, do not reflect compartments for water distribution of the SEDAPAL nor administrative divisions of the local government.

[8] The target households for water supply connection and sewer connection are generally the same. However, their respective number slightly differs because some households have an existing water supply or sewer connection.

Intake Facility for the Huachipa WTP

Exit of a Tunnel of the North Branch

Table 1 Comparison between Planned and Actual Outputs

Item		Planned	Actual
<Component ①>			
Huachipa Water Treatment Plant			
Intake facilities:	Intake facility	10 m^3/sec	As planned
	Conveyance pipeline	5 m^3/sec	As planned
Water treatment plant:	Treatment capacity	5 m^3/sec	As planned
North Branch			
Transmission pipelines (length)		26.4 km	As planned
Distribution reservoir (distribution tank)		5 sites	4 sites
<Component ②>			
General water supply and sewer networks			
Water Supply Service:	Construction of well	6 sites	0 sites*
	Improvement of well*	42 sites	61 sites
	Construction of distribution tank	75 sites	64 sites
	Improvement of distribution tank	38 sites	91 sites
	Laying of distribution pipes	174.0 km	134.9 km
Sewerage Service:	Sewer pipelines	19.9 km	51.7 km
Introduction of SCADA and distribution compartments**		No plan	Introduced
Secondary water supply and sewer networks			
Number of new water supply connections		52,000	43,836
Number of new sewer connections		27,000	43,760
(Total number of new connections)		(99,000)	(87,596)

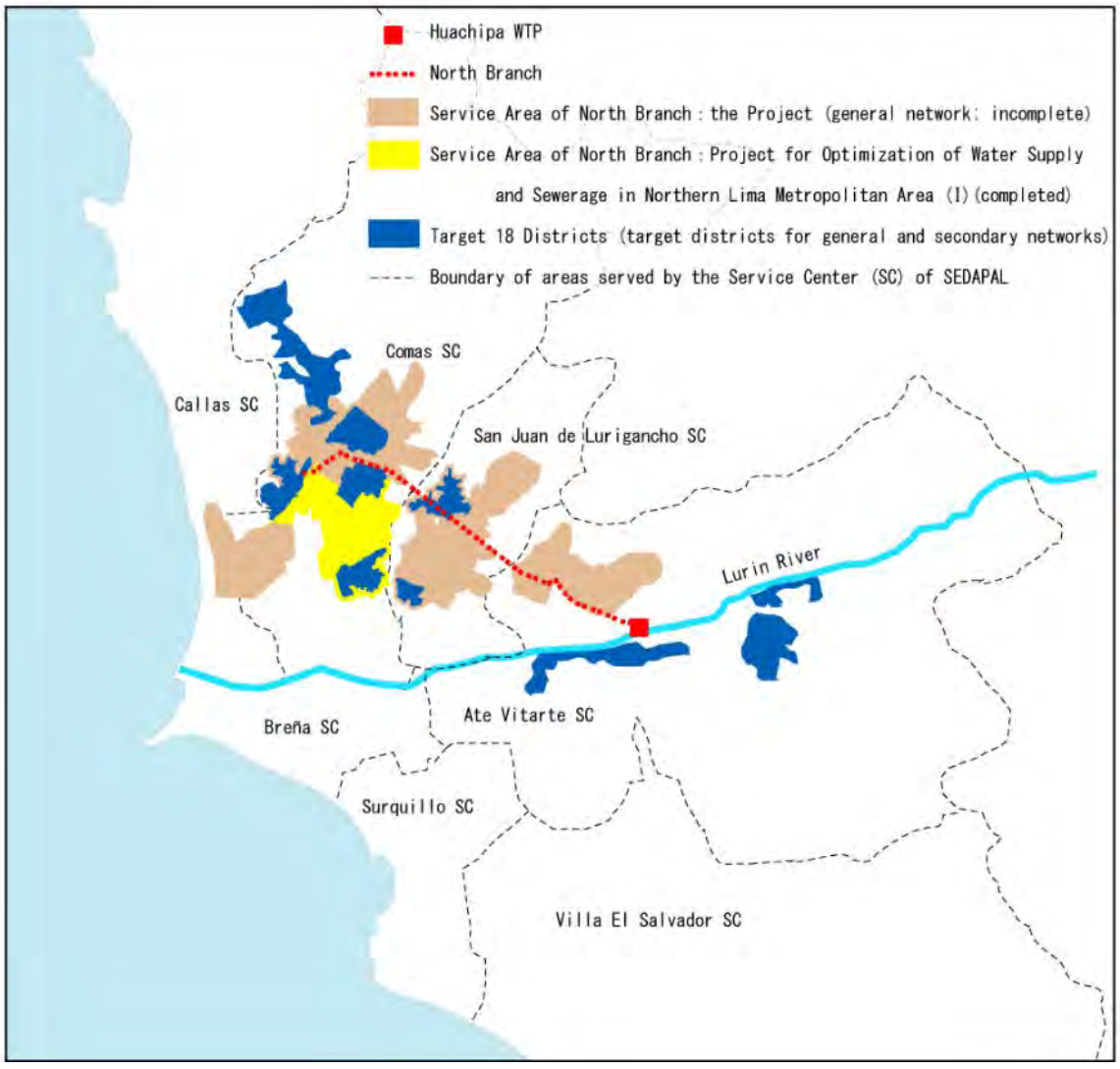
Source: Materials provided by JICA and SEDAPAL

Notes: * At one of the wells for improvement, it was necessary to drill a new well at the same site because of severe damage to the existing well. This newly drilled well is, however, classified under "improvement of well".

** SCADA (Supervisory Control and Data Acquisition) System is a remote supervisory control system using telemetry. The compartmentation of water distribution is conducted for the principal purpose of achieving an adequate and uniform distribution pressure, sophisticating water management and localizing any work or damage due to an accident. It is also called "sectorization". Compartmentation creates many small compartments where water flow can be controlled by valves and meters. SCADA is often introduced together with compartmentation to enable water pressure adjustment in correspondence with the water pressure of the transmission pipelines and level of real-time water consumption. Apart from reducing the water leakage, SCADA can limit the areas and duration of water outage as the closure of individual compartments can be remotely conducted when implementing measures against water leakage or civil works.

New Residential Area with
an Expansion of Networks

Distribution Reservoir constructed
by the Project



Source: Prepared using the materials provided by SEDAPAL

Figure 1 Target Area of the Project and Target Water Supply Areas of the Huachipa WTP

Regarding the relationship between the two components, it was planned that five districts of the 18 subject districts of Component ② would use the Huachipa WTP which constituted Component ① as a water source.[9] Meanwhile, water conveyed through the North Branch from the Huachipa WTP was planned for wider distribution throughout the northern LMA, including the said five districts.

The loan agreement for the Project was signed in September 2000. However, following political and economic confusion caused by changes of the administration twice in the immediate aftermath of the signing, the Toledo Administration inaugurated in July 2001 attempted to tighten the government's financial disciplines and substantial restraint of fiscal expenditure in the public sector.[10] As a result, the water demand forecast for the LMA was recalculated and it was judged that there would be no need to rush for the construction of the Huachipa WTP, considering the water saving effect on the part of users brought about by wider dissemination of water meters, for example.[11] SEDAPAL then made a request to JICA to postpone the construction of the Huachipa WTP and North Branch and JICA agreed with this request in July 2002.

In the following year, a consulting service agreement was signed and improvement of the general and secondary water supply and sewer networks was conducted in 18 districts (Component ②) through 11 contracts from 2004 to 2009. This was followed by the decision of SEDAPAL to construct the Huachipa WTP and North Branch (Component ①) in 2007. The work for this WTP and the North Branch began in October 2008 based on a contract whereby the contractor was responsible for the design, construction and operation of the new facilities for a period of four years after their completion. The construction work was completed in 2014.

The work to construct the general water supply network connecting the North Branch to the existing water supply network (Component ②) began in 2010 and was mostly completed by 2014. The entire work was completed and delivered in seven out of 13 work zones which constitute the contract. However, the work was not completed and delivered in the case of the remaining six work zones because of incompletion of the SCADA system.[12] As the contractor could not complete it, SEDAPAL cancelled the contract in September 2015 after receiving

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9 The planned water sources for the other 13 districts were the existing La Atarjea WTP, Chillon WTP planned under a different project and groundwater.

10 Immediately after the signing of the Loan Agreement in September, 2000, President Fujimori resigned in November, 2000. The Toledo Administration was inaugurated in July, 2001 after a provisional administration. In 2002, the Fiscal Responsibility Act was enacted to restrain fiscal expenditure in the public sector.

11 At the time of appraisal, it was predicted that the water demand in the LMA in 2015 would be 33.1 m^3/sec. As a result of the review, the figure was reduced to 23.5 m^3/sec. However, the latest forecast by SEDAPAL (26.9 m^3/sec based on the master plan prepared in 2014) exceeds this revised figure. In sort, while the actual level of the water demand at present is lower than the forecast made at the time of appraisal, it is considered to be higher than the revised forecast.

12 According to the explanation given by SEDAPAL, one of the reasons for SEDAPAL's non-acceptance of completion and delivery in the six work zones was that water leakage was found at many joints of the newly laid pipes. There is an ongoing dispute between SEDAPAL and the contractor regarding the cause of such leakage and no conclusion has yet been reached at the time of this ex-post evaluation.

JICA's no objection letter. It is currently planned that SEDAPAL will carefully examine the required works to complete and sign a new contract using its own funds for the full completion of the remaining work by the end of 2017.

Planned and actual outputs of the Project are shown in Table 1, and geographical relationship between the target areas and the facilities under the Project is shown in Figure 1.

The Huachipa WTP has achieved the planned intake and water treatment capacities. The actual facilities constructed are compact and use a technology designed to make the footprint as small as possible as the actual size of the site is 5 ha instead of the planned 10 ha due to a problem concerning land registration. This technology enables continuous coagulation, flocculation and sedimentation in one process. Consequently, the operability of the Huachipa WTP is much better than that of the existing La Atarjea WTP located in the downstream. This change of the design is judged to be reasonable in the face of the restrictive site conditions.

Five distribution reservoirs were originally planned for the North Branch. The difficulty of acquiring land at one site and the discovery of ancient remains at another site led to construction of a distribution reservoir with a capacity equivalent to two reservoirs at a different site. As a result, the number of distribution reservoirs actually constructed was reduced to four. Moreover, the tunnel size was enlarged to facilitate speedy construction work and to secure space for maintenance work. These changes are also judged to be reasonable in view of (i) the local conditions at the time of construction and (ii) necessity for construction and maintenance.

The planned contents of the general and secondary water supply and sewer networks underwent many changes in the 18 districts. It is difficult to conduct a detailed comparative analysis of the planned and actual outputs in this regard because of the unavailability of drawing plans prepared at the time of appraisal. The principal changes explained by SEDAPAL are described below.

Water Sources

- The postponed construction of the Huachipa WTP made it necessary to change the planned water sources to wells or other WTPs in five districts where water supply from the Huachipa WTP had been assumed.
- Based on the review of the production volumes of existing wells together with the utilization of the Chillon WTP[13] which was constructed in 2002, no new water source was developed while utilizing those existing wells which were not in use.

[13] The reference materials provided by JICA indicates the use of the Chillon WTP as the water source for multiple districts but the detailed design report compiled after the review of the F/S mentions that the project planned after the F/S assumes only wells as water sources. The evaluator infers that the construction of the Chillon WTP was not finalized at the time of the review of the F/S.

General water supply and sewer networks

- Following the postponement of the construction of the Huachipa WTP and North Branch, construction of the facilities to connect five districts (out of 18 districts) to the water supply network using the North Branch was suspended. These facilities were later included in the scope of the Project when the work was restarted to construct the Huachipa WTP and North Branch. At that time, the subject area for the construction of the general networks was expanded as the scope of the ODA loan under the Project newly included the general water supply networks required for connection with the North Branch in some other districts (other than the 18 districts under the Project) using water from this transmission line.
- Compartmentation of the subject area for water supply distribution and the SCADA system were newly introduced.[14]
- Due to an increased amount of sewage following the expansion of new residential areas and population increase, there were many instances where the existing small diameter sewer pipes had to be replaced by larger pipes, increasing the overall work volume to lay new sewer pipes.
- Other changes included changes of the pipeline routes due to expansion of paved roads, actual ground conditions and changes in location of new distribution reservoirs in response to requests by local residents.
- As the actual improvement work of the distribution reservoirs included relatively minor improvements (for example, erection of fencing) not assumed at the time of planning, the actual number of sites for improvement increased.

New Connections to Water Supply and Sewer systems

- The planned number of new connections was estimated in 2000 and actual new connections were conducted reflecting the actual needs. Because of the expansion of new residential areas, the target number of households for new sewer connection in the project area is believed to have exceeded the planned figure.
- Meanwhile, the Project adopted certain criteria (plot size and income level, etc.) for new household connections so that new connection was especially available at a low cost for low income households. Some of the originally targeted households failed to meet these criteria (for example, due to a high level of income) while others could not be connected due to the lack of document certifying land ownership or land use rights despite meeting the criteria.

[14] SEDAPAL began to conduct compartmentation starting at the central LMA area in1997. In the northern LMA, this practice was first conducted at the time of the detailed design for the Project. Compartmentation is conducted for the principal purpose of achieving an adequate and uniform distribution pressure, sophisticating water management and localizing any work and damage due to an accident. It is also called “sectorization”.

- As a result, the final number of newly connected households was slightly lower than planned. Those households which were not connected within the scope of the Project (not low income households) were later connected under the standard connection procedure used by SEDAPAL.

3.2.2 Inputs

3.2.2.1 Project Cost

Table 2 shows the planned and actual project costs. The total project cost was approximately 58.2 billion yen, exceeding the planned cost by 25.1 billion yen or 76%. The total ODA loan amount was approximately 34.1 billion yen compared to the planned amount of 24.9 billion yen (an increase of 37%). To supplement the increase of the project cost, an additional loan of 9.3 billion yen was extended in 2010. The main reasons for the increase of the project cost are listed below.

- Price increases against the background of the delayed start of construction work by 3 to 8 years[15].
- Increase of construction cost due to the tunnel size expansion for the North Branch, adoption of a water treatment technology requiring less space and an increase of the pipe laying cost necessitated by different geological conditions
- Increase of the consulting service cost due to extension of the construction work period.
- Expansion of the subject areas for the general water supply network to be connected to the North Branch

As for the cost for land acquisition, it was far below the planned amount as there were many cases where public land was obtained without cost.

[15] The consumer price index in Peru increased by more than 50% from 1999 when the project cost was estimated to 2015. In 2008, the transport cost, payment for engineers and prices of such materials as ductile cast iron pipes, etc. considerably increased due to adverse influences of the international financial crisis.

Table 2 Planned and Actual Project Costs

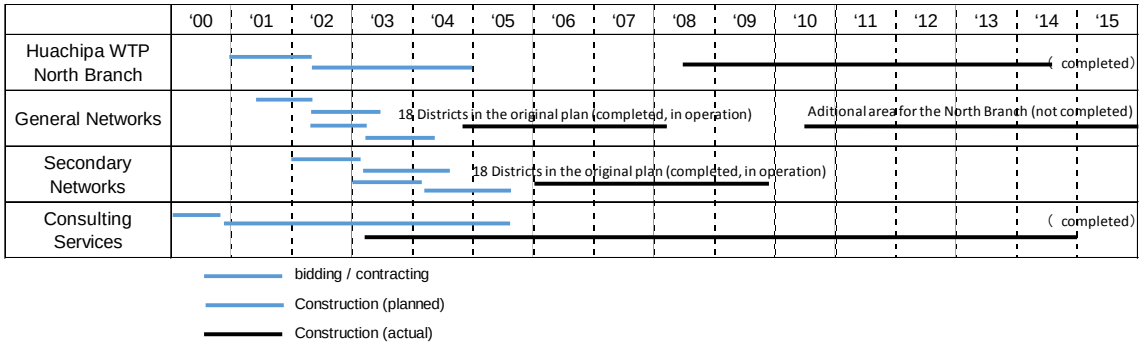
(Unit: million yen)

	Planned (at the time of Appraisal)			Actual			
	Loan	Peru	Total	Loan	Peru	Total	Percentage against Plan
Huachipa WTP and North Branch	12,007	0	12,007	14,865	9,699	24,564	204.6%
General water supply and sewer networks	4,578	0	4,578	7,067	5,138	12,205	266.6%
Secondary water supply and sewer networks	4,850	0	4,850	8,611	266	8,877	183.0%
Land	0	775	775	0	36	36	4.7%
Administration Cost	0	642	642	0	1,369	1,369	213.3%
Contingency Cost	594	1,692	2,286	-	-	-	-
Consulting Service	2,825	0	2,825	3,551	648	4,199	148.6%
Taxes	0	5,175	5,175	0	6,975	6,975	134.8%
Total	24,854	8,284	33,138	34,094	24,132	58,227	175.7%

Source: Data on planned costs by JICA documents and data on actual costs by SEDAPAL documents
Note: The project cost for the general water supply and sewer networks includes the cost of the incomplete work relating to the North Branch. The actual costs are those up to the time of ex-post evaluation.
Foreign exchange rate: (Planned) 1 US$ = 113.5 yen; 1 nuevo sol = 34.0 yen
(Actual) 1 US$ = 101.0 yen (the rate actually applied)

3.2.2.2 Project Period

Following the signing of the loan agreement in March 2000, the Project (the first phase) was scheduled for completion in September 2005 (67 months). In reality, however, a part of the project scope has not yet been completed, meaning a substantial extension of the project period. The actual project period up to the second field survey for the ex-post evaluation was 201 months (March 2000 to November 2016), trebling the originally planned project period.[16] Figure 2 shows the planned and actual project periods.



Source: Data on the planned period by JICA documents and data on the actual period by SEDAPAL

Figure 2 Planned and Actual Project Periods

[16] SEDAPAL plans to complete the construction of all of the facilities by the end of 2017.

As mentioned earlier, the consulting services for the Project commenced in 2003, two and a half years later than planned. In subsequent years up to the end of 2009, a series of work, including the detailed design, procurement and construction of the general and secondary water supply and sewer networks other than the general water supply networks connecting to the North Branch, was conducted in sequence based on 12 separate construction contracts. The work to construct the general and secondary water supply and sewer networks took place in stages due to financial constraints on the part of the Government of Peru, unsuccessful tenders and other reasons. In some areas, the construction period was extended due to changes of the plan for some facilities after the commencement of the work, handling of local residents who refused to agree to the construction of new facilities and handling of local residents appealing to violence to seek employment.

In February, 2007, SEDAPAL decided to commence the once postponed construction of the Huachipa WTP and North Branch and the work started in October 2008 with a DBO (design, build, operation) contract. The operation period included in the contract was four years after the completion of the build stage.[17] Although the planned completion date at the time of the signing of the contract was May 2011, the actual construction work was delayed at some sections of the North Branch due to the change of the number of distribution reservoirs from five to four and the much rockier ground conditions than anticipated for the tunnel sections. Because of this, the construction period was divided into three phases. Phase 1 involving the Huachipa WTP and the adjacent section of the North Branch was completed and delivered in July 2011. A rupture incident in February 2012 at the section handed over of the North Branch required more than one year to amend. All of the planned facilities were completed and delivered in July 2014.[18]

The construction work of the general networks to be installed in districts to receive water supply from the North Branch began in August 2010 after the detailed design and procurement stages. The construction work which was originally planned to last for one year was mostly completed in 2011 despite a slight delay due to changes of the plan for some facilities and a need to conduct additional investigation on newly found ancient remains. A

[17] The Pomachocha-Rio Blanco Water Resource Transfer Project (MARCA II), a ODA loan project which was supposed to supply raw water to the Huachipa WTP, was canceled after the detailed design stage due to the same reason for the postponed construction of the Huachipa WTP. However, the supply of raw water for the Huachipa WTP has been secured by another water source development project (MARCA III Project, commencing operation in 2012).

[18] A section of the North Branch which began operation in July 2011 ruptured, causing a major water leakage in February 2012. SEDAPAL suspended its operation for more than one year to investigate the cause of this incident and to find measures to prevent a recurrence. This investigation concluded that the rupture of the steel pipeline was triggered by an increased inner pressure due to sudden valve operation against the background of; the joint of the steel pipeline being out of alignment due to erosion of the base of the pipeline, the quality of the steel pipes involved and damages to them during transportation and water leakage from the air valve. As emergency measures, the study team recommended drainage of the water around the air valve and slower valve operation. These recommendations were immediately put into practice and the entire North Branch was reopened in August 2014, commencing water supply operation to match the water demand of the newly connected areas.

hydraulic test was conducted in 2014 after the implementation of new measures to deal with the rupture incident with the North Branch. The contract was cancelled in September 2015 as explained earlier even though some work sections were not completed for delivery.

3.2.3 Internal Rate of Return (for reference)

Of the various components of the Project, the financial internal rate of return (FIRR) was recalculated for the Huachipa WTP and North Branch based on a project life of 30 years, such expenses as overall construction cost and maintenance cost and such benefits as the revenue from the water charge and reduction of the cost for the pumping of groundwater. The resulting figure of 8.5% was lower than the 15.9% calculated at the time of planning. Meanwhile, the economic internal rate of return (EIRR) where the taxes are deducted from the expenses was calculated to be 10.8% (the EIRR was not calculated at the time of planning). The main reason for the recalculated FIRR being lower than the previous estimate is believed to be more than doubling of the overall project cost.

Both the project cost and project period significantly exceeded the plan. Therefore, the efficiency of the Project is low.

3.3 Effectiveness[19] (Rating: ②)

3.3.1 Quantitative Effects (Operation and Effectiveness Indicators)

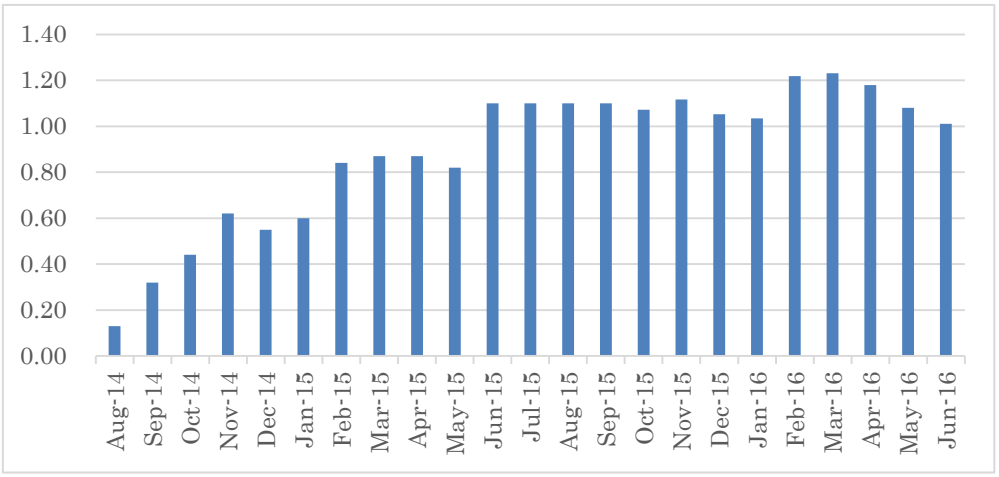
The purpose of the Project was "to expand and improve water supply and sewerage services in marginal areas of the northern LMA of Peru by means of constructing a new WTP (intake facility, treatment plant and trunk transmission line) and also improving the water supply and sewer networks in the subject areas". In the following sections, the state of achievement of the planned objectives is analyzed for each of the two components of the Project.

(1) Construction of the Huachipa WTP and the North Branch (Component ①)

Water production at the Huachipa WTP began in August 2014 and the level of production has been fairly constant at 1.0 to 1.2 m^3/sec since June 2015 (Figure 3). This volume is equivalent to water consumption of roughly, 110,000 to 130,000 households. The maximum production level recorded up to June 2016 was 1.23 m^3/sec recorded in March 2016 which was equivalent to 25% of the planned 5 m^3/sec.[20] The lower production level at the Huachipa WTP than the target is attributed to the slow progress of the construction of the general water supply networks to be connected to the North Branch as explained next.

[19] The effectiveness is rated in consideration of not only the effects but also the impacts.
[20] The plan at the time of appraisal assumed that the production volume of 5 m^3/sec would have been achieved in 2005.

(Unit: m^3/sec)



Source: SEDAPAL

Figure 3 Water Production Volume at the Huachipa WTP

The entire volume of treated water produced at the Huachipa WTP is fed to the North Branch. It is planned to connect the North Branch to the secondary water supply network via the general water supply networks constructed under projects shown in Table 3.[21] Therefore the Huachipa WTP cannot produce a volume of water corresponding to the local demand as water distribution is not possible until such time when the connection facilities are constructed. At the time of the ex-post evaluation, the facilities constructed under the "Project for the Optimization of the Water Supply and Sewerage in Northern Lima Metropolitan Area (1)" (a different project) and facilities constructed under the Project in one work zone out of the 13 work zones constitute the only operational general water supply networks connected to the North Branch. The water production volume at the Huachipa WTP is expected to increase in line with further completion of facilities planned under each of these projects.

The water produced at the Huachipa WTP fully satisfies the required quality standards for residual chlorine and turbidity since the start of its operation. As no E. coli has been detected, there are no problems with the quality of water produced at the Huachipa WTP.

[21] It was originally planned under the Project to construct the necessary facilities for connection to the North Branch as part of the general water supply networks so that five districts could receive water supply from the Huachipa WTP out of the 18 districts subject to the development of the general and secondary water supply networks. Meanwhile, there was no clear indication of which districts other than these five districts would be subject to water supply from the Huachipa WTP and how the connection work to such additional districts would be implemented. Following the postponement and restart of the work to construct the Huachipa WTP and the North Branch, it was decided to include the facilities required for connection to the North Branch in the scope of the Project as part of the development of the general water supply networks in a wider area including the originally planned five districts (as shown in Figure 1 – Service Area of North Branch; the Project).

Table 3 Plan for Water Distribution from the Huachipa WTP

Project Name	Planned Distribution Volume	State of Implementation and Remarks
Project for Improvement of Sanitation in Suburban Residential Areas of the LMA (I and II) (the Project)	2.3 – 2.4 m^3/sec	Operating in one out of 13 work zones (data for the distribution volume is not available). The entire facilities are expected to be completed by the end of 2017.
Project for Optimization of Water Supply and Sewerage in Northern LMA (I)	1.1 – 1.2 m^3/sec	In operation (joint financing project by Japan, World Bank and KfW).
Project for Optimization of Water Supply and Sewerage in Northern LMA (II)	1.1 – 1.3 m^3/sec	Expected to be completed by the end of 2018 (joint financing project by Japan, World Bank and KfW)
Cajamarquilla, Nieveria and Cerro Camote Project	0.3 m^3/sec	Expected to be completed by August of 2018 (loan project of the Inter-American Development Bank)
Expansion and Improvement of Potable Water and Sewer System in Pachacutec, Ventanilla	1.2 – 1.4 m^3/sec	Expected to be completed by the end of 2016; provisional measure until the completion of Phase II of the Chillon WTP (funded by SEDAPAL)

Source: SEDAPAL

(2) Development of general and secondary water supply and sewer networks in 18 districts of the Northern LMA (Component ②)

In the 18 target districts, the Project aimed at expanding and improving the water supply and sewerage services in marginal areas by means of improving the water supply and sewer networks. The subject area of SEDAPAL's water supply and sewerage services in the LMA is divided into seven areas served by respective service centers. The 18 target districts under the Project are included under the jurisdiction area of three (Comas, San Juan de Lurigancho and Ate Vitarte) service centers. Table 4 shows the number of water supply and sewer connections in these three service center areas and also 18 target districts of the Project.

Table 4 Number of Water Supply and Sewer Connections in the Relevant Three Service Centre Areas and 18 Target Districts

	Water Supply	Sewerage
Total number of connections under the three service centers (2015)	742,000	707,000
Total number of connections in the 18 target districts (January, 2016)	146,000	NA
Number of new connections under the Project	43,836	43,760

Source: Prepared using data provided by SEDAPAL

24-hour water supply is now available in nearly three-quarters of the 18 target districts of the Project. However, 24-hour water supply is not granted in order to suppress wasteful water consumption in those marginal areas with a high proportion of low income households, where a fixed water charge is collected due to the lack of local consent to the installation of water meters. Table 5 shows the number of connections by service center, water supply hours and water pressure in the 18 target districts at the time of ex-post evaluation. No similar information for the time before the Project has been obtained.[22]

Table 5 Situation of Water Supply Service by Service Center in the Target Area (18 Districts) of the Project

Service Centre	January, 2016 (Dry Season)			June, 2016 (Wet Season)		
	No. of Connections	Average Water Supply Hours (hrs)	Average Water Pressure (mwc)	No. of Connections	Average Water Supply Hours (hrs)	Average Water Pressure (mwc)
Comas (9 districts)	77,240	15.1	24.8	79,008	20.1	25.6
San Juan de Lurigancho (2 districts)	23,951	15.0	32.4	24,038	23.2	33.4
Ate Vitarte (7 districts)	44,332	22.6	22.1	45,145	22.8	23.0
Total/Average	145,523	17.4	25.3	148,181	21.4	26.0

Source: Prepared using data provided by SEDAPAL.

Note: The unit (mwc) for the average water pressure is the pressure capable of supporting a 1 meter water column. The relevant standard for the water supply pressure in Peru is 15 to 50 MWC.

Expansion of the Water Supply and Sewerage Services to Newly Connected Households

The planned expansion of the water supply and sewerage services in the 18 target districts was achieved by newly installed water supply and sewer connections to 43,836 households and 43,760 households respectively under the Project. The total number of connections of 87,596 is equivalent to 88% of the planned 99,000 connections (52,000 for water supply connections and 47,000 for sewer connections). This number of new connections represents some 3% of the total number of connections in the LMA. The water supply coverage ratio and sewerage coverage ratio in the LMA improved respectively by eight points (85% to 93%) and by 12 points (81% to 93%) in the 16-year period from 1999 to 2015. The Project has contributed three points to each service.

Many of the newly connected households under the Project belong to residential areas spread over sloping land and most of them are low income families who have moved

[22] At the time of appraisal of the additional loan, target figures were set for the rate of non-revenue water, number of connected households, coverage ratio, average water pressure and average water supply hours. The number of connections in the 18 target districts of the Project was only some 20% of the total number of connections under the jurisdiction area of each service center. Moreover, as target figures for improvement under the Project are not clearly set for other indicators other than the number of connected households, it is difficult to quantitatively verify the contribution of the Project. Because of this, no analysis of these indicators was conducted in the ex-post evaluation.

from rural areas to the LMA. The beneficiary survey and group interviews with residents[23] found that many of the residents of these areas used to receive water from a communal tap or water trucks operated by SEDAPAL or a private supplier but did not have any sewer connection before the Project.

Improvement of the Water Supply and Sewerage Services for Households with Existing Connection

The development of the general water supply and sewer networks under the Project is believed to have improved its relevant services for some of those households in the 18 target districts which were already enjoying water supply and sewerage services before the implementation of the Project. It is difficult to concretely determine what kind of improvement was made by the Project in each of the 18 target districts because of the complex system configuration due to the phased facility development in the past assuming more than one water source and also because of the partial and fragmented fashion of facility development under the Project. However, the findings of a series of interviews conducted at SEDAPAL's service centers suggest that there was improvement of the water supply service as a result of the Project in some of these 18 districts thanks to (i) an increase of the water supply volume through effective use of wells and new connection with existing water sources, (ii) improvement of the distribution reservoirs and pumping facilities, (iii) improvement of the existing water supply networks, and (iv) optimization of water distribution through compartmentation and the introduction of the SCADA system. In the beneficiary survey, nearly half of the households with existing connection expressed that the water supply hours, water pressure and water quality improved after the implementation of the Project (Table 6).

In regard to the sewerage service, the beneficiary survey found that one-third of the households with existing connection replied that the spillage of sewage and bad odor in the neighborhood were reduced (Table 7, below). While it is feasible that the sewerage service for already connected households has improved through the renewal of existing sewers or introduction of larger diameter sewers, it was not possible to concretely verify the contribution of the Project.

[23] As a beneficiary survey, a questionnaire survey was conducted with 206 households in the 18 target districts. Households in 13 distribution compartments were selected from 45 distribution compartments comprising the 18 target districts and avoiding geographical bias in the selection. In each distribution compartment, 15 – 16 households were sampled by means of random area sampling. The sampled households consist of 86 newly connected households and 120 households with existing connection and, in terms of the respondents, 20% were in their twenties, 17% were in their thirties, 25% were in their forties and 46% were in their fifties or older by age. In terms of gender, 29% were male and 71% were female. Along with this questionnaire survey, eight individual interviews and seven group interviews with 5 – 7 people per group were conducted targeting those people who were around.

Table 6 Improvement of Water Supply and Sewerage Services for Households with Existing Connection

	Degree of Improvement*
Water Quality	31 points
Water Pressure	26 points
Water Supply Hours	22 points
Frequency of Water Outage	2 points
Customer Service	-6 points
Maintenance	-9 points
Water Charge	-34 points

Source: Beneficiary survey

Note: The degree of improvement is determined by subtracting the percentage of respondents replying that the issue in question had worsened from the percentage of respondents replying that the issue in question had improved.

(3) Summary

Based on the above, the degree of target achievement concerning construction of the Huachipa WTP and the North Branch at the time of ex-post evaluation is low at 25% (based on the water production volume) and the degree of target achievement concerning improvement of the general and secondary water supply and sewer networks in the 18 target districts is high at 88% (based on the number of new connections). Considering (i) the equal importance of the objectives of the two components that are independent from each other and that (ii) the project cost is similar for each component, overall degree of target achievement is calculated as 57% taking an average of the two components. Even taking into consideration the additional improvement effect regarding the water supply and sewerage services for those households with existing connection in the 18 target districts, it is hard to say that the degree of target achievement of the Project is high (meaning 80% or more). Consequently, the degree of project target achievement is judged to be “fair”.

3.3.2 Other Project Effects

The relatively high elevation (390 m) of the Huachipa WTP allows water distribution by gravity, making it possible to reduce the electricity cost compared to the La Atarjea WTP or the use of groundwater.[24] Meanwhile, the water production volume using groundwater in the LMA has been controlled since the peak year of 1997 as its increase in the second half of the 1990s exceeded the sustainable level. If water production volume at the Huachipa WTP progresses as planned, it will be possible to further contain the use of groundwater and to reduce the electricity cost.

[24] According to the trial calculation of IRR mentioned in 3.2.3, 85% of the financial benefit of the Huachipa WTP and North Branch comes from the reduction of the groundwater pumping cost.

3.4 Impacts

3.4.1 Intended Impacts

The Project was expected to contribute to improvement of the environmental and sanitation conditions in the target districts based on the development of water supply and sewerage facilities. According to the beneficiary survey (Table 7), 80% of the households surveyed replied that the sanitation conditions at home had improved. Typical reasons for the perceived improvement are (i) increased availability of water, (ii) improved water quality and (iii) adequate treatment of waste water and rubbish. Such improvement may well be the result of the expanded as well as the improved water supply and sewerage services under the Project. As many respondents mentioned the improvement of sanitary practices (increased frequency of hand washing, bathing, washing and cleaning) as the reason, it appears that the Project contributed to such improvement by making sufficient safe water readily available. Meanwhile, 70% of the surveyed households replied that the sanitation conditions in the neighborhood had improved because of such reasons as “no more spillage of foul water”, “elimination of bad odor” and “elimination of unsanitary toilets” (simple dug-outs in the ground). Such improvement should be considered as another contribution by the Project.

Based on the above, it is fair to say that the expected impacts of the Project regarding improvement of the environmental and sanitation conditions duly manifested as planned.[25] In contrast, manifestation of the expected impacts was low in those areas (other than the 18 target districts) that would receive water from the Huachipa WTP and the North Branch despite expectation of similar impacts as a result of an improved water supply system, as the volume of water supply from the Huachipa WTP is approximately one-quarter of that originally planned at the time of ex-post evaluation.

[25] In the beneficiaries survey, the number of replies that the frequency of occurrence of diarrhea had decreased in the last three years exceeded the number of replies that the said frequency had increased. However, the development of water supply and sewerage facilities under the Project took place 7 – 9 years ago and, therefore, these replies cannot be directly linked to the Project. Comparison between the current state and the state before the Project has not been conducted as it is difficult to obtain reliable replies because of the time span involved. According to data published by the Ministry of Health, the frequency of occurrence of diarrhea in the LMA decreased by approximately 30% between 2008 and 2014.

Table 7 Improvement of Environmental and Sanitation Conditions at Households with Existing Connections

Change of sanitation environment at home	Improved	84%
	No change	12%
	Worsened	4%
Reason for improvement*	Usability of more water	71%
	Improved sanitary practices	64%
	Improved water quality	28%
	Adequate treatment of foul water and rubbish	10%
Change of sanitation environment in the neighborhood	Improved	72%
	No change	17%
	Worsened	9%
Reason for improvement*	No spillage of foul water	38%
	No bad odor	34%
	No unsanitary toilets	20%

Source: Beneficiary survey
Note: For reason of improvement at home and in the neighborhood, the percentage figure represents those selecting the relevant answer from among those replying that the sanitation environment at home (and in the neighborhood) has improved. Multiple answers were allowed. Only the major reasons are listed in the table.

3.4.2 Other Positive and Negative Impacts

(1) Environmental and Social Impacts

In 2009, SEDAPAL conducted an environmental impact assessment (EIA) regarding the intake facilities, the WTP and North Branch and its EIA report was approved by the Natural Resources Management Agency of Peru. Environmental conservation measures regarding more than 40 items were implemented along with monitoring of the water quality, air quality and noise during the construction work in line with the environmental management plan prepared on the basis of the EIA report, and there were no adverse impacts on the environment. According to SEDAPAL, an EIA was also conducted for the construction of the general and secondary water supply and sewer networks (the timing of implementation is unknown) and no adverse impacts on the environment were found in general. No special adverse impacts on the environment by the Project are observed at the time of ex-post evaluation. On the other hand, in the Project, surveys on ruins were conducted prior to the construction according to the government regulations. As a result, the site for reservoir construction of the Northern Branch was changed because a ruin was discovered at the planned site.

As a precondition for the implementation of the Project, land acquisition was necessary at the sites for the intake facilities, the Huachipa WTP, tunnel entrances of the North Branch and the distribution reservoirs. According to SEDAPAL, a total of 12 ha of land were acquired at 57 sites and US$ 374,000 (approximately 40 million yen) was paid as compensation. Most of the affected landowners received cash compensation but some

residents opted for resettlement to an existing house elsewhere. In addition, some 80 households at sites near the tunnel entrances had to temporarily move to avoid vibration due to construction. The process of land acquisition involved such steps as initial briefing, dialogue and social support (vocational training, etc.) by the contractor for the affected communities and the entire process was supervised by SEDAPAL's social support team. According to SEDAPAL, no serious problems were encountered except that verification of the legal basis of land ownership took some time to complete.

(2) Other Impacts

In the beneficiary survey, some 40% of the households which had received water supply from a communal tap or water tanker operated by a private operator or SEDAPAL replied that the cost, labor and time to obtain water had been reduced (Table 8). People of newly or already connected households expressed such opinions during group interviews as (i) the convenience and quality of living had improved as safe water and sanitation facilities became available at home and (ii) it was easier to invite people to their home because of the improved sanitation conditions at home and in the neighborhood.

Table 8 Problems Solved Through New Water Supply Connected

(Newly connected households only; multiple answers allowed)

High cost of obtaining water	37%	Poor water quality	16%
Tiring work of fetching water	22%	Not enough water	14%
Need for extra treatment, such as boiling	21%	Waterborne illnesses	7%
Long time to get water	16%	(No specific problems	20%)

Source: Beneficiary survey

The Project has to some extent achieved its objective in terms of effectiveness, and impacts are inferred to have manifested in correspondence to the level of effectiveness achieved. Therefore, the effectiveness and impacts of the Project are fair.

3.5 Sustainability (Rating: ③)

3.5.1 Institutional Aspects of Operation and Maintenance

SEDAPAL has a staff strength of 2,515 employees and enjoys the highest organizational capability among the sanitation service corporations in Peru. Figure 4 shows the organizational structure of SEDAPAL. The operation and maintenance responsibility for the facilities newly constructed or improved under the Project is divided as described below.

- Production and Primary Distribution Department: Intake facilities, Huachipa WTP and North Branch (WTP Integrated Team); general water supply networks (Primary Distribution Team); pumping facilities (Pumping Operation and Maintenance Team)

- Sewerage Management Department: Main sewer networks (Primary Collection Team)
- Three service centers (Comas, San Juan de Lurigancho and Ate / Vitarte) under the North and Central Service Bureaus: secondary water supply and sewer networks

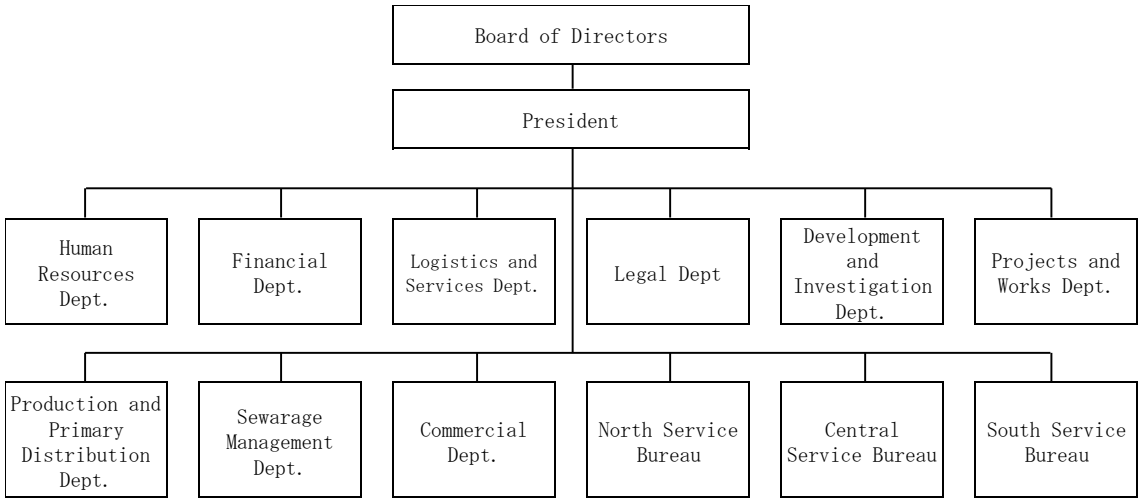


Figure 4 Organizational Structure of SEDAPAL

The contract for the Huachipa WTP and North Branch construction included a four-year post-completion operation period of these facilities by the contractor. Following the completion of this WTP in July, 2011, the WTP and North Branch were operated by the contractor. The Production and Primary Distribution Department of SEDAPAL now directly operate these facilities with a team of 23 staff members. Security, cleaning and the major repair of electrical and mechanical equipment are outsourced. According to SEDAPAL, the current staff strength is adequate but the recruitment of another 5 – 7 operation and maintenance staff members would be necessary if the production volume is increased as planned by 2018. At the Huachipa WTP, the implementation of a Phase 2 project is planned with a concession lasting for 30 years. The scope of the contract for this concession includes expansion of the WTP, construction of Marca II water sources and construction of the South Branch along with the operation and maintenance of the Phase 1 facilities of the Huachipa WTP and the North Branch constructed under the Project. The timing of the contract for the concession has not yet been finalized.

The Production and Primary Distribution Department of SEDAPAL operates the SCADA system for the main water supply networks. It also has two teams for valve-replacement, two teams for SCADA and two teams for pipeline-repair, with 5 – 6 members for each team to respond to emergency. These teams possess the necessary heavy equipment. Once damage to a pipeline or leakage is discovered, the distribution compartment in question is shut down through SCADA and the relevant service center is contacted to work

together for repair. If this work is urgent, an external contractor allocated to each service center involved may assist the repair work. According to a staff member of this department, the number of teams is not sufficient to fully cover the entire LMA.

Each service center in charge of operation and maintenance of the secondary water and sewer networks has emergency response teams to deal with incidents of leakage or blockage. In fact, emergency response is provided 24 hours a day with three shifts for the water supply service and throughout the daytime with two shifts for the sewerage service. Each service center has a high-pressure cleaning vehicle, and other necessary basic equipment to maintain the sewerage service. Workers of an external contractor are deployed at each service center and conduct such work as (i) preventive maintenance of the pipelines (replacement of old pipes and cleaning, sterilization and washing of pipelines) and (ii) emergency repair. When a leakage or blockage of foul water is reported, an emergency response team is dispatched. If repair work is found to be necessary, such work is conducted by an external contractor. While the service centers believe that the current staff strength is generally adequate, reinforcement of the emergency response teams and additional staff members to supervise the work of external contractors are required to improve speed and quality of repair works.

SEDAPAL operates some 1,500 pumping facilities which are operated and maintained by the Water Production and Primary Distribution Department. 80% of these pumping facilities are manually operated by an external contractor while the remaining 20% are operated automatically by the SCADA system. The SCADA system and pumping facilities are subject to preventive maintenance. Repair teams are stationed at three locations in the LMA for the purpose of repairing electrical and mechanical equipment and chlorine injection systems. The central workshop is capable of repairing pumps, motors, power distribution panels and chlorine injection pumps. Some repair work is outsourced.

As described above, although there appears to be some staffing shortage with the emergency response teams, the operation and maintenance system for the facilities constructed or improved under the Project is clearly established, posing no major problems.

3.5.2 Technical Aspects of Operation and Maintenance

SEDAPAL employs many engineers, possesses a human resource strengthening program and has implemented various training courses for its employees. SEDAPAL has been taking a lead to introduce such advanced technologies in Peru’s water supply and sewerage sector as compartmentation for water distribution, SCADA and sewage treatment using the activated sludge process. SEDAPAL has been certified for international standards relating to quality management, environmental management, occupational health and safety, information security management and general requirements for the competence of testing and calibration laboratories. In short, it is fair to say that SEDAPAL has a high level of technical capability in

general.

According to SEDAPAL, the water treatment process at the Huachipa WTP is similar to the process at the existing La Atarjea WTP, posing no technical problems. No technical issues exist in the case of the North Branch operation either. In fact, the operability of the Huachipa WTP is said to be far better than that of the La Atarjea WTP as three treatment processes can be operated simultaneously based on the new technology introduced to cope with the limited size of plot. During the second field survey period for ex-post evaluation, the WTP operation and maintenance manual was under review based on the results of one year of actual operation. Meanwhile, there were such inconveniences as lack of drawings on-site because the trainings and transfer of other information were insufficient due to the hasty handing over of operation and maintenance work from the contractor to SEDAPAL.[26]

In relation to the Project, SEDAPAL operates three SCADA systems for the (i) Huachipa WTP, (ii) general water supply and sewer networks and (iii) pumping facilities. As they have been independently designed and installed, there is no compatibility and there are no mutual connections. However, the control room for each SCADA system can view certain information pertaining to other SCADA systems and it is possible to conduct coordinated operation to a certain extent utilizing telephone and other communication measures together. For each SCADA system, SEDAPAL may outsource the design work for system improvement or expansion and equipment repair work. Based on the explanation given by SEDAPAL on each SCADA system, SEDAPAL has built up its SCADA operating experience for nearly 20 years and it is fair to say that it has the technical capability to operate and maintain the SCADA systems with some support of outsourced contractors.

No special technologies are required for the operation and maintenance of the general and secondary water supply and sewer networks and there do not appear to be any technical issues. The relevant manuals, etc. are provided for the distribution reservoirs and pumping facilities and the daily operation and maintenance management status is recorded. A communication system is in place for emergencies and other events.

3.5.3 Financial Aspects of Operation and Maintenance

The operating profit of SEDAPAL for 2012 through 2015 was in the black with a high operating profit ratio of 20% in 2015. During this period, the current ratio was constantly high above 200%. The debt ratio for 2012 through 2014 was less than 100% in each year but increased to 140% in 2015. This was caused by a decrease in equity capital on book following a change of the accounting standards to match international accounting standards and does not mean a decline of the financial stability as a corporation. On the other hand, non-revenue water

[26] According to SEDAPAL, extension of the period of operation and maintenance by the contractor was considered but a sudden policy change led to the decision to directly manage the facilities by SEDAPAL.

rate and coverage rate of water meter installation of SEDAPL were 29.8% and 88.5% respectively in 2015. Both of these have been improved[27].

In short, the financial situation of SEDAPAL is judged to be sound and stable. Because of the scattered nature of the facilities, separate information for the operation and maintenance expenses of the facilities related to the Project was not obtained. Nevertheless, no serious problems caused by financial constraints were found regarding the operation and maintenance of the facilities constructed or improved under the Project.

Table 9 Financial Status of SEDAPAL

(Unit: 1,000 nuevos soles)

	2012	2013	2014	2015
Operating revenue (i)	1,385	1,472	1,513	1,624
Water supply and sewerage service charge	1,331	1,419	1,409	1,508
Other revenue	54	52	104	115
Operating cost (ii)	1,318	1,224	1385	1300
Cost of operation (a)	1028	904	941	949
Retail expenses	155	180	194	181
Administration cost, etc.	135	140	250	169
Operating profit (iii) = (i) – (ii)	67	248	128	323
Non-operating revenue (iv)	301	154	288	177
Non-operating cost (v)	118	85	115	293
Taxes (vi)	67	90	42	56
Ordinary profit (v) = (iii) + (iv) – (v) – (vi)	182	227	259	151
Working ratio (b)	67%	65%	76%	59%
Operating profit ratio	5%	17%	8%	20%
Current ratio (c)	212%	272%	355%	418%
Debt ratio (d)	77%	80%	82%	140%

Source: SEDAPAL

Notes: (a) Includes the operating and maintenance cost and the depreciation cost
(b) Operation and maintenance cost / operating revenue
(c) Current assets / current liabilities
(d) Liabilities / capital

3.5.4 Current Status of Operation and Maintenance

In September, 2015, it was found that the downstream side of the overflow levee had been severely scoured by the water flow at the intake for the Huachipa WTP and temporary repair work was conducted in November, 2015. SEDAPAL believes that the water flow containing much sediment may have caused a severer impact than that assumed in the project design. SEDAPAL plans to conduct a detailed investigation in due course with a view to implementing permanent measures based on the findings of this investigation.

As the sediment removal pump installed at the sedimentation basin of the Huachipa WTP cannot sufficiently remove sediments due to the minute size of grains containing water, manual removal work is conducted as required. According to SEDAPAL, sediment removal

[27] In 2005, non-revenue water rate was 41.1%, while water meter coverage was 65.8%.

requires much manpower and reinforcement of the manpower will be required when the water production volume increases in the future.

The North Branch experienced the rupture incident (previously described) in 2012. Emergency and temporal measures have been implemented based on the findings of the post-incident investigation and no problems have occurred since then. While this investigation proposed long-term improvement measures, SEDAPAL intends to decide a concrete response after further investigation.

The findings of the field surveys and results of interviews with SEDAPAL officers suggest that the operation and maintenance of the general and secondary water supply and sewer networks and pumping facilities have been adequate as no special problems have been observed with these facilities.

The SCADA systems at the Huachipa WTP and the general water supply networks are functioning properly. According to SEDAPAL, however, the measuring instruments of the SCADA system at the Huachipa WTP were not sufficiently maintained or calibrated by the contractor and they have been maintained and calibrated step by step once they became under the direct management of SEDAPAL. The SCADA system for the pumping facilities is almost 10 years old and its service life has elapsed. There have been many instances of failed radio communication between the facilities and the control room and many facilities can no longer be remotely controlled. Even without the remote control function, however, the pumping facilities do operate automatically, but on-site monitoring by an operator is necessary. The reason why such failure has been left unattended is a technical reason in that this particular SCADA system involves old technologies and the system configuration is very complicated. As some SCADA systems introduced after the Project use equipment of a different manufacturer and the technologies used for the SCADA systems introduced under the Project have become obsolete, the Pumping Operation and Maintenance Team have begun research and examination work to simplify and standardize the entire SCADA system.

No major problems have been observed in regard to the institutional, technical and financial aspects of the operation and maintenance of the Project. Therefore, overall sustainability of the Project effects has been high.

4. Conclusions, Recommendations and Lessons Learned

4.1 Conclusions

The Project was implemented to expand and improve the water supply and sewerage services in marginal areas of the northern LMA by means of constructing a new WTP and improving the water supply and sewer networks, thereby contributing to improvement of the living conditions in these areas. The water supply and sewage management sector has

consistently been a priority development sector for the Government of Peru since the time of appraisal to the time of ex-post evaluation. At the time of appraisal, there was a great need for the development of water supply and sewer systems, and the facilities constructed or improved under the Project play an important role at the time of ex-post evaluation. The Project was relevant to Japan's ODA policy at the time of appraisal. Based on the above, the relevance of the Project is high. Of the planned facilities under the Project, the construction of the Huachipa WTP and the North Branch was implemented after postponement of six years as a result of review of the water demand in the LMA. Meanwhile, the construction work to connect the North Branch to the existing water supply networks is not fully completed at the time of ex-post evaluation due to cancellation of the relevant contract with the contractor. Because of these delays, the project implementation period has more than trebled compared to the plan. The project cost has almost doubled due to price increases and an increased work volume. Therefore, the efficiency of the Project is low. The expansion of water supply and sewerage services following the consolidation of the water supply and sewer systems under the Project have achieved nearly 90% of the original targets. The intended effects of the Project have been generally achieved as planned. These include the expansion and improvement of the water supply and sewerage services and improvement of the living conditions for households with new connections as well as existing connections. The water production volume of the Huachipa WTP, on the other hand, is currently only one-quarter of the planned volume due to the delayed connection work to the existing water supply networks. Therefore, the effectiveness and impact of the Project is fair. As no specific problems are observed with the institutional, technical and financial aspects of the operation and maintenance of the Project, the sustainability of the Project is high.

In conclusion, the Project is evaluated as being partially satisfactory.

4.2 Recommendations

4.2.1 Recommendations for the Implementation Agencies

SEDAPAL should swiftly complete the construction of the relevant general water supply networks for the Huachipa WTP and North Branch under the Project so that these facilities can be fully utilized as soon as possible. SEDAPAL should also conduct an investigation on the damage to the intake of the Huachipa WTP and arrange adequate permanent measures.

4.2.2 Recommendations for JICA

None

4.3 Lessons Learned

Consistency of Water Supply Facility Construction Program

In construction of water supply facilities for large cities, if there is no consistency in the construction program (an overall plan on implementation of multiple construction projects) to develop water source, water production facility and water distribution facilities, there is a possibility of reducing the project effects. Therefore, it is important to ensure sufficient consistency in preparing the construction program including water source, water production and distribution facilities, and also conduct precise progress management to maintain consistency in implementation. If such a construction program contains a project involving donors, it is necessary that the organizations responsible for the improvement of water supply in the city concerned should carry out progress management with due attention to consistency among the projects in close collaboration with the donors. With regard to the Project, while such consistency was ensured within its scope at the planning stage, since the connection works with the secondary networks through the Project as well as other related projects were delayed compared with the completion of the Huachipa WTP and the North Branch, the water production volume remained at a quarter of the planned amount and sufficient effectiveness and impact were not obtained.

Comparison between Plan and Actual Achievement

Item	Plan	Actual Achievement
① Outputs		
Huachipa Water Treatment Plant		
Intake facilities:		
Intake weir	10m^3/sec	As planned
Conveyance pipeline	5m^3/sec	As planned
Water treatment plant:		
Treatment capacity	5m^3/sec	As planned
North Branch		
Transmission pipelines (length)	26.4km	As planned
Distribution reservoir (distribution tank)	5 sites	4 sites
General water supply and sewer networks		
Water Supply Service:		
Construction of well	6 sites	0 sites
Improvement of well	42 sites	61 sites
Construction of distribution tank	75 sites	64 sites
Improvement of distribution tank	38 sites	91 sites
Laying of distribution pipes	174.0km	134.9km
Sewerage Service:		
Sewer pipelines	19.9km	51.7km
Secondary water supply and sewer networks		
Number of new water supply connections	52,000	43,836
Number of new sewer connections	47,000	43,760
② Project Period	March, 2000 - September, 2005 (67 months)	March, 2000 - November, 2016 (Not yet completed, 201months)
③ Project Cost		
ODA loan	23,854 million yen	34,094 million yen
Funding by Peru	8,284 million yen	24,132 million yen
Total	33,138 million yen	58,227 million yen
Conversion rate	1 US$ = 113.5 yen	1 US$= 101.0 yen