Ex-Post Project Evaluation 2017：

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JAPAN INTERNATIONAL COOPERATION AGENCY

GLOBAL GROUP 21 JAPAN, INC.

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Republic of Cuba

FY 2017 Ex-Post Evaluation of Technical Cooperation Project

"Improvement of the Capacity on Urban Solid Waste Management in Havana City"

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

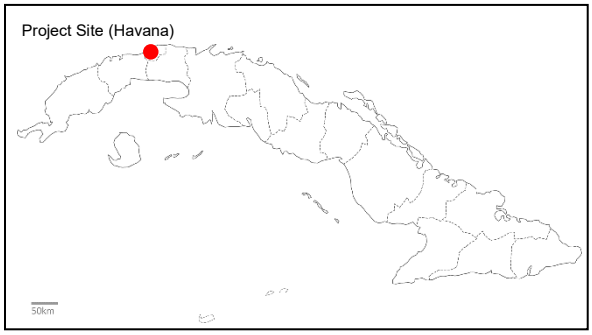
0. Summary

The technical cooperation project entitled "Improvement of the Capacity on Urban Solid Waste Management in Havana City" (hereinafter referred to as "the Project") was implemented with the Project Purpose "to strengthen capacity of DPSC (*Dirección Provincial de Servicios Comunales* / Provincial Direction of Communal Services; hereinafter referred to as "DPSC") on urban solid waste management in Havana City through collaboration among cooperative organizations." and the Overall Goal "to properly implement urban solid waste management in Havana City and improve the city's sanitary environment"[1]. The importance of solid waste management within the policies and development needs of Cuba and Havana City was high both at the time of planning and the time of completion of the Project. The Project was relevant to Japan's ODA policy at the time of planning. Based on the above, the relevance of the Project is high. As a result of the strengthening of collaboration among related agencies, strengthening of solid waste management capacity, the pilot project for composting, strengthening of vehicle maintenance workshop capacity, improvement in the design of a new final disposal site, and improvement in the operation of existing final disposal sites through the Project, the Project Purpose was more or less achieved. However, at the time of ex-post evaluation, waste collection services in the city are unstable due to shortages of waste collection vehicles, waste containers, etc., and no significant improvement in sanitary environment is seen in the City. Following completion of the Project, composting as well as construction of the new final disposal site have been suspended and not much improvement has been made in the operation of final disposal sites. Therefore, the Overall Goal has not been achieved. To sum up, the effectiveness and impact of the Project are deemed to be fair. The inputs of human resources and equipment were appropriate in terms of content and quality, however, because it took a long time for the Cuban side to prepare the compost yard and JICA to procure the equipment, the Project period was longer than planned. In addition, the project cost exceeded the planned budget due to increase of equipment cost. Therefore, the efficiency of the Project is fair. Concerning sustainability, while there are no problems regarding the policy and institutional aspects, there are some technical and financial issues. Since examination of a proposal to nationalize the solid waste management utility and preparations to establish a joint venture are still in progress, the Project is faced with major institutional and financial uncertainties in the medium to long term. Therefore, the sustainability of the Project is deemed to be fair.

In light of the above, this project is evaluated to be partially satisfactory.

[1] In administrative terms, Havana City is a Province composed of numerous Municipalities, however, in this report, it is referred to as "Havana City" according to the official title of the Project.

1. Project Description



Project Location

Night collection in the city by a waste collection vehicle

1.1 Background

Cuba's "National Environmental Strategy 2007-2010" earmarked solid waste management as an important area, and concerning solid waste management in cities, it specified clear numerical goals and activities for solid waste collection, recycling, final disposal site operation, separate collections, etc. for the objective of mitigating, preventing and controlling pollution caused by improper management. In Havana City (population in 2009: 2.14 million), DPSC and Municipal Direction of Communal Services (*Dirección Municipal de Servicios Comunales*; hereinafter referred to as "DMSC") of the 15 administrative municipalities that comprise the city were collecting solid waste and transporting them to outlying final disposal sites for disposal[2]. However, following collapse of the Soviet Union at the beginning of the 1990s, Cuba's economy fell into recession and fuel shortage made it difficult to transport solid waste to final disposal sites

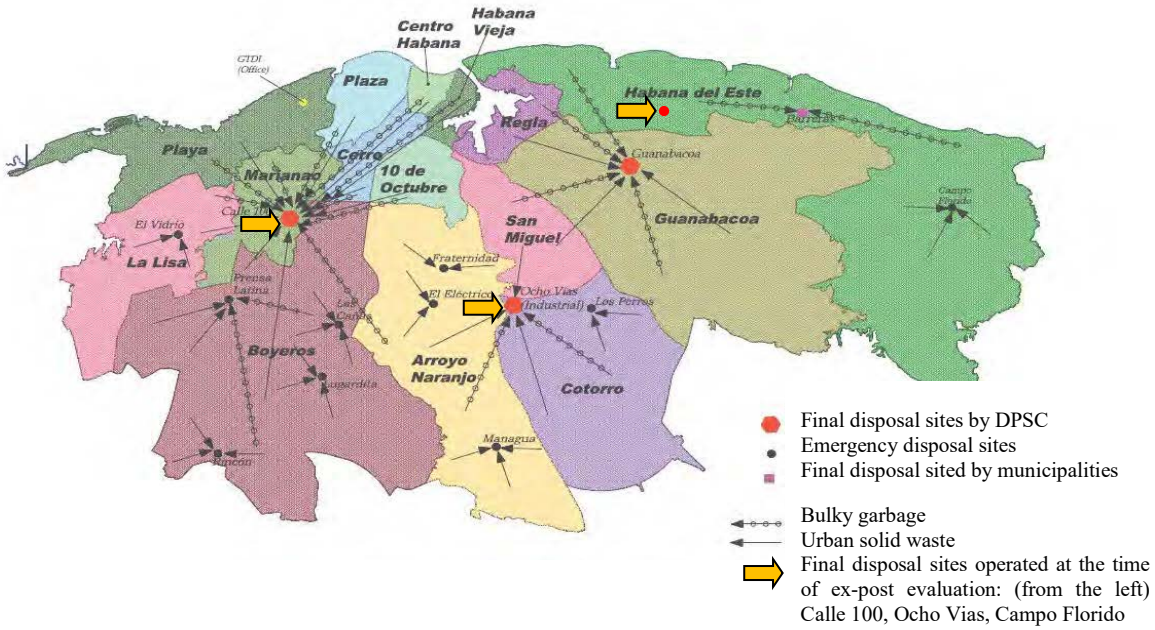
[2] Solid waste management in Havana City is carried out by DPSC and DMSC of 15 administrative municipalities. Provincial Unit of Hygiene (hereinafter referred to as "UPPH"), which is one of the departments of DPSC, has a vehicle maintenance workshop located next to the main final disposal site of "Calle 100". UPPH is allocated with waste collection vehicles as well as arm roll vehicles which are used for collecting construction wastes, etc. As of December, 2017, roughly 25 waste collection vehicles operating based on UPPH conduct waste collection in nine municipalities, while the remaining 12 waste collection vehicles collect waste in six outlying municipalities and receive inspections and repairs in the vehicle maintenance workshop of UPPH as necessary. Roughly half of the solid waste in Havana City is collected by the waste collection vehicles from approximately 20,000 containers that are placed on the city streets. The waste collection vehicles basically conduct patrols so that each container is collected once a day, and the collection work is performed day and night. In outlying areas of the city, trucks, tractors and horse-drawn carts belonging to DMSCs collect waste from individual households. The arm roll vehicles collect waste (general and construction wastes) from dedicated containers that are placed on streets. Several tens of dedicated containers are permanently placed around the city, and containers are also placed at building sites, etc. upon request. UPPH has around 10 waste removal teams each composed of one skid roller and 2-3 trucks, and they remove general and construction wastes discarded on streets and fallen trees and the like in the aftermath of hurricanes as necessary.

DMSC use trucks, etc. to collect general waste in the areas that are not patrolled by waste collection vehicles, and also to clean up the waste that is left behind around containers. Park and street cleansing personnel are assigned to several zone offices located around each municipality. These offices constantly grasp the situations of local waste collection and cleansing conditions, and make requests to DPSC and DMSC if additional waste collections or dispatch of waste removal teams are required.

As of December, 2017, three final disposal sites are operating in Havana City (see Figure 1). The biggest of these is Calle 100 final disposal site situated in the mid-west of the city, and this receives approximately 70% of the city's solid waste. The next biggest is Ocho Vias final disposal site in the east of the city, which receives approximately 25%. Also, in the east of the city is Campo Florido final disposal site, which is small and was originally intended to function as an emergency final disposal site.

in the suburbs. Accordingly, the solid waste was dumped in a number of emergency disposal sites temporarily installed in the city, leading to a deterioration in the living environment for residents. In addition, with major final disposal sites approaching full capacity, the securing of new final disposal sites became an urgent issue.

Against such a background, the Government of Japan implemented a JICA technical cooperation entitled: "The Study on Integrated Management Plan of Urban Solid Waste in Havana City (2004-2006)" (hereinafter referred to as "the prior technical cooperation") based on a request from the Government of Cuba, and a Master Plan having 2015 as the target year was developed for drastic improvement of the solid waste management utility in Havana City. Based on the Master Plan, the Government of Cuba and Havana City authorities carried out such measures as the closure of most of the emergency disposal sites, improvement of existing final disposal sites, procurement of 70 waste collection vehicles and containers, adoption of a decision to construct the new Guanabacoa final disposal site in the east of the city and so on. In addition, in August, 2007, with a view to further improving the solid waste management utility in Havana City, the Government of Cuba requested the Government of Japan to implement a technical cooperation project entitled "Improvement of the Capacity on Urban Solid Waste Management in Havana City" (the Project). In response, the Government of Japan entrusted JICA to implement the detailed project formulation study in 2009, and the Project was commenced in September, 2009 over a scheduled period of three years and six months.



Source: Report of the "Study on Integrated Management Plan of Urban Solid Waste in Havana City"

Figure 1 Scope of Final Disposal Sites and Waste Collection in Havana City
(Positions of the three disposal sites in operation at the time of ex-post evaluation have been added to the figure from 2004)

1.2 Project Outline

The Project aims to strengthen the urban solid waste management capacity of Havana City through collaboration with relevant organizations by improving the waste collection and transportation capacity, the design and operation capacity of final disposal sites, capacity for reducing the quantity of organic waste for disposal of UPPH / DPSC, and the general solid waste management capacity of DPSC.

Overall Goal		Urban solid waste management is properly implemented in Havana City and sanitary environment of the City is improved.
Project Purpose		Capacity of DPSC on urban solid waste management in Havana City is strengthened through collaboration among cooperative organizations.
Outputs	Output 1	Comprehensive management capacity on solid waste of DPSC is improved.
	Output 2	Solid waste source separation at Pilot Project site is promoted and capacity of UPPH in organic waste reduction at the source is strengthened.
	Output 3	Capacity of UPPH in the collection and transportation of solid waste is strengthened.
	Output 4	Capacity of UPPH and DPSC on landfill design and operation of final disposal sites is strengthened.
Total cost (Japanese Side)		480 million yen
Period of Cooperation		September, 2009-February, 2013 Extension period: March, 2013-September, 2014
Implementing Agency		Provincial Direction of Communal Services (DPSC) and Provincial Unit of Hygiene (UPPH) under DPSC in Havana City
Other Relevant Agencies / Organizations		Ministry of Science, Technology and Environment, Havana Office (CITMA-Habana), DMSC of Playa Municipality, Water Resources Research Institute (IHR), Ministry of Agriculture (MINAGRI), Soil Research Institute (IS), Hygiene Research Institute of the Ministry of Health (MINSAP)
Supporting Agency / Organization in Japan		None
Related Projects		“Study on Integrated Management Plan of Urban Solid Waste in Havana City” (development study, 2004-2006), “Improvement of the Capacity on Waste Collection Vehicles Management in Havana City” (dispatch of experts, August 2015-April 2018), Dispatch of a short-term expert (2006)

1.3 Outline of the Terminal Evaluation

1.3.1 Achievement Status of Project Purpose at the Terminal Evaluation

Since the urban solid waste management capacity of DPSC in Havana City has been strengthened through collaboration among relevant organizations, it was deemed that the Project Purpose would be achieved by time of completion of the Project, provided that the Cuban side continues to make appropriate efforts.

1.3.2 Achievement Status of Overall Goal at the Terminal Evaluation (Including other impacts)

It was deemed that the Overall Goal would be achieved in 3-5 years, provided that the Cuban side makes the appropriate inputs. Moreover, the following impacts have been reported: improvement in outline design of the final disposal site in the west, implementation of maintenance for vehicles belonging to other provinces at the vehicle maintenance workshop, reflection of the Project activities in the environmental strategy of Havana City, sharing of national-level information on sanitary landfills.

1.3.3 Recommendations from the Terminal Evaluation

Recommendations applicable by the time of completion of the Project:

- With a view to securing the stable procurement of spare parts for the equipment provided; sort out the suppliers of spare parts; compile operation and maintenance methods for postponing the deterioration of equipment and averting failures into manuals; continue the systematic recording of failures; and establish an organizational unit to take charge of equipment maintenance.
- Finish the training for personnel of DSPC and DMSC as planned.

Medium- and long-term recommendations geared to after the Project completion:

- Update the manual developed in the Project as needed.
- Continue and complete construction of the new Guanabacoa final disposal site.
- Disseminate the knowledge and skills acquired through the Project to other provinces and municipalities.
- Disseminate the revised Master Plan geared to achievement of the Overall Goal to related officials and secure the budget for implementing priority projects.

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: October, 2017-March, 2019

Duration of the Field Survey: November 22-December 21, 2017 and March 28-April 11, 2018

2.3 Constraints during the Evaluation Study

Nationalizing the solid waste management utility in Havana City and establishing a joint venture based on introduction of foreign capital are under examination which may affect sustainability of the Project in future. However, both plans are undecided and, due to the confidential nature of these matters, it was not possible to obtain sufficient information on them. Moreover, again due to issues of confidentiality, it was not possible to obtain sufficient information on the overall budget composition and financial trends of the implementing agencies. Therefore, it was difficult conducting detailed analysis on the medium- to long-term sustainability of the Project.

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

3.1 Relevance (Rating: ③[4])

3.1.1 Consistency with the Development Plan of Cuba

As already described in 1.1 Background of the Project, at the time of planning (2009), environmental preservation and conservation of resources were regarded as priority issues, and solid waste management in Havana City was being advanced according to the Master Plan that had been compiled in 2006 with technical cooperation from JICA.

In *the National Environmental Strategy* (2011-2015) at the time of Project completion (September, 2014), the deterioration of environmental sanitation due to shortages of solid waste collection vehicles and final disposal sites in the major cities was identified as one of the main issues in the environmental field. To remedy the situation, the Strategy pointed to the need for the following measures: appropriate allocation of resources and improvement of organizations and systems in the solid waste management field; drastic improvement in the solid waste management operations of DPSC and DMSCs, and an organized approach to cope with lack of social discipline and compliance with laws and regulations on garbage.

As such, relevancy of the Project to the development plans of the Government of Cuba was high at the time of planning and the time of project completion.

3.1.2 Consistency with the Development Needs of Cuba

According to the Detailed Planning Survey for the Project, issues at the time of planning were

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

[4] ③: High, ②: Fair, ①: Low

as follows: 1) lack of activities for reducing the quantity of general solid waste that largely comprises kitchen garbage, 2) inadequacy of collection and transportation plans, 3) insufficient capacity of vehicle maintenance workshops and repair workshops, 4) technical deficiencies regarding design and operation and maintenance of final disposal sites, 5) insufficient basic capacity regarding planning and management in the planning sections of DPSC and UPPH.

At the time of project completion, there were 48 operational waste collection vehicles in Havana City (December, 2014), equivalent to roughly half of the needed number (92). Moreover, construction of the new Guanabacoa disposal site was suspended, and operation of the four final disposal sites that were operating at the time was not sufficiently improved except for one of the sites. In addition, the reduction in waste achieved as a result of composting in the Project was negligible compared to the overall amount of the waste, so there was a pressing need to further reduce the amount of waste. Therefore, at the time of project completion, there was still a very great need to improve solid waste management in Havana City.

To sum up, consistency of the Project with the development needs of Cuba was high at both the time of planning and the time of project completion.

3.1.3 Consistency with Japan's ODA Policy

At the time of planning, the Government of Japan was actively implementing economic cooperation for Cuba with a view to enabling it to effectively tackle its pressing development issues while striking a balance with social equity. In 2000, JICA dispatched its first Project Confirmation Study Team to discuss policies with the Government of Cuba, and the two sides reached a consensus about conducting cooperation with emphasis on the agricultural and environmental fields. Since then, the two governments have reaffirmed the policy of advancing cooperation centered in these two fields in periodic policy discussions.

Meanwhile, the Government of Japan was steadfastly adhering to actively promoting the 3R Initiative (for reducing, reusing, and recycling solid waste) that had been adopted following a proposal by then Prime Minister Koizumi at the G8 Summit of June, 2004. As well, in the Project, since know-how founded on 3R activities, which had been bolstered by Japan after 2000, came to be utilized, the Project was regarded as an effort geared to the international advancement of the recycling-oriented society.

Accordingly, it is deemed that the Project was consistent with Japan's ODA policies at the time of planning.

Based on the above, this project was highly relevant to the country's development plan and development needs, as well as Japan's ODA policy. Therefore, its relevance is high.

3.2 Effectiveness and Impacts [5](Rating: ②)

3.2.1 Effectiveness

3.2.1.1 Achievement of Outputs and the Process[6]

(1) Strengthening of capacity of DPSC and DMSC (Output 1)

The capacity of counterparts (officials of DPSC and UPPH) in their respective areas of work was strengthened through the Third Country Training in Mexico, domestic training and practical training conducted by the Experts. Although the counterparts were frequently switched during the period of cooperation, it was confirmed at the time of Project completion that capacity of 17 counterparts had been strengthened. However, the degree of strengthening among counterparts that joined midway during the Project was limited. Based on the solid waste management manuals that were developed by the Project, training was conducted for 550 employees of DPSC in Havana City and DMSCs in the municipalities. Also, the Master Plan that had been compiled in 2007 with technical cooperation from JICA was revised together with the counterparts in light of the current conditions. In addition, extracurricular activities for solid waste management education targeting eight elementary and junior high schools in the pilot municipality (Playa) were implemented. Public information activities including production of a TV spot, radio broadcasts, preparation of stickers targeting the general public were conducted as well. In view of the fact that the established indicators were largely achieved, the level of achievement of Output 1 is deemed to be high.

(2) Pilot Project for Composting (Output 2)

A pilot project entailing separate collection of organic waste and manufacture of compost (organic fertilizer) was implemented targeting five large-scale dischargers including hotels, agricultural markets and a tobacco factory. In the prior technical cooperation, survey of solid waste revealed that more than half of the solid waste discharged in Havana City is composed of kitchen wastes, so a “community compost” pilot project targeting general population was implemented with the objectives of reducing the quantity of waste, reducing transportation costs, and extending the useful life of final disposal sites. However, because they failed to conduct thorough separation of wastes, a new pilot project narrowing the targets to large-scale dischargers was implemented in the Project. Small-size trucks for collecting organic wastes were provided and the collected organic waste was carried to a compost yard on the site of UPPH to manufacture compost. Quantity of organic waste collected was unstable because the small-size trucks were used for collecting general waste during the busy tourism season, etc. when priority is given to general waste collections. However, the separation work generally proceeded well, and the planned quantity of compost was more or less manufactured by the end of the Project. Considering the degree of achievement of the indicators, the degree of achievement for Output 2 is deemed to

[5] Sub-rating for Effectiveness is to be put with consideration of Impact.
[6] The degree of achievement of each output at the time of project completion is attached at the end of the report.

be rather high. It should be noted that, while the manufactured compost had high quality and was utilized for maintaining green tracts owned by DPSC, permission to sell the compost could not be obtained by the end of the Project, and there is still no prospect of this happening[7].

Waste collection vehicle undergoing inspection

Parts processing using provided equipment

Arm roll truck

Arm roll truck containers placed on a road

(3) Strengthening of capacity of UPPH for collection and transportation of solid waste (Output 3)

UPPH operates a vehicle maintenance workshop on the grounds of its office located adjacent to the largest final disposal site of Calle 100. Here, it conducts inspections and maintenance of the city's waste collection vehicles and arm roll vehicles. An important issue was to strengthen the capacity of the vehicle maintenance workshop with a view to improve the operating rate of waste collection vehicles of limited quantity. In the Project, maintenance and inspection equipment, parts processing equipment, etc. were provided to the maintenance workshop; vehicle maintenance and inspection standards were established; vehicle maintenance and inspection

[7] DPSC is an administrative organization that does not possess an autonomous source of funding, so recycled materials and composts sales are not included in its jurisdiction. In the Master Plan of 2007, under "strengthening of legal systems", it was recommended that DPSC be allowed to sell recycled resources and compost on the market based on approval from the central government. The Project embarked on procedures to change the system to allow sale of compost six months following the start of separate collections in the Pilot Project. However, it still hadn't acquired permission by the time the Project was completed.

manuals were developed; and training was implemented for mechanics and other personnel. As a result, such results had been attained as shortened maintenance time, enhanced quality of maintenance, shortened waiting time for spare parts due to increased numbers of produced parts, and improved operating rates of waste collection vehicles. Considering that the degree of achievement of the indicators was also high, the degree of achievement for Output 3 is deemed to be high.

Furthermore, there is a strong possibility that this output contributed to lengthening of the service life of waste collection vehicles. To verify this, it is necessary to conduct analysis linking the operating time of each vehicle to the degree of deterioration, however, no such data was acquired in this evaluation. To realize the appropriate operation and maintenance of waste collection vehicles, it is also important to strengthen the capacity of drivers so that they can thoroughly implement inspections before the start of work, replace tires when out of the workshop, and acquire the skill to drive on poor quality roads. However, this was not included within the scope of the Project.

(4) Strengthening of capacity for design and operation of final disposal sites (Output 4)

DPSC was independently conducting basic design of an environmentally friendly final disposal site as proposed in the Master Plan concerning new Guanabacoa disposal site planned in the east of Havana City. However, as Cuba had no prior experience of such final disposal sites, there was room for improvement regarding design of the leachate treatment facilities and other aspects. Following advice provided by the Japanese experts dispatched by the Project, improvements were made to the design of the said disposal site on 12 points, more than the originally planned 11. However, due to the busy schedule of construction firms, lack of budget in the government and other factors, work on constructing the main body of the new Guanabacoa disposal site could not be commenced during the project implementation.

At the four existing final disposal sites, various issues were observed regarding management of incoming waste collection vehicles and loading of waste, management of dumping sites, management of waste pickers (people scavenging for valuable wastes), and frequency and methods of compaction and soil covering. The Japanese experts reviewed conditions of such works and landfilling sites together with the counterparts and gave advices on the methods of landfill work operations and management. They also provided a manual for landfilling. In addition, equipment for maintenance inspection and parts processing were provided to the maintenance workshop that works on the heavy machinery used on final disposal sites. In response to the given advice, UPPH made improvements to access roads, weighbridges, resulting in improved operations at all four final disposal sites. However, due to the frequent reshuffling of personnel, frequent breakdowns in heavy machinery, fuel shortages, lack of soil for covering and so forth, the level of improvement was limited. Accordingly, at the time of Project completion, only Calle

100 final disposal site had reached a standard that could be described as environmentally friendly final disposal site.

To sum up, the degree of achievement for Output 4 is deemed to be fair.

Table 1 Achievement of Project Purpose

Project Purpose	Capacity of DPSC on solid waste management is strengthened through collaboration among cooperative organizations [8] <Largely achieved>
Indicator	Actual
① The training program is formulated and begins to be implemented for DPSC / UPPH's members based on the experience with the trained Core Group	Training programs were prepared and the training was implemented for the core group (out of employees of DPSC, UPPH and DMSC, the heads of municipalities, zone officers, technicians, etc. were targeted; 520 persons in total). Training of other employees was not completed by the project completion in September 2014, but completed by the end of 2014. <Partially achieved>
② Capacity for collaborating with related agencies to conduct solid waste management is improved through the activities. (Additional indicator at the time of the terminal evaluation).	Through the Project, collaboration was commenced with the Ministry of Science, Technology and Environment concerning technical and environmental education, and also with the schools, enterprises, etc. that were involved in the Project. <Achieved>
③ Organic waste reduction achieved in the Pilot Project (to be about 1.5 t/day) to be maintained.	While the collected quantity of organic solid waste only just failed to reach the target (1.432 t/day between February and June, 2014), valuable experience and know-how were gained and cooperation with hotels, agricultural markets, a tobacco factory was established through the Pilot Project. Composting technology was appropriately transferred, and the manufactured compost is utilized in the preservation of the city's parks and green areas. <Almost achieved>
④ Vehicle repair and maintenance system upgraded by trained mechanics using equipment donated by the project to be maintained.	Compared to the target of reducing major repair and maintenance work times among vehicle maintenance workshop mechanics, times were reduced by between 39-77% depending on the work item concerned. <Achieved>
⑤ Improvement of collection and transportation by means of the upgraded average operating of collection vehicles and frequency optimization to be maintained	Compared to the target of increasing the fuel consumption of vehicles from 0.80 ㎥/L in 2008-2009 to 0.90 ㎥/L, the value was improved to 0.86 ㎥/L. <Partially achieved>
⑥ Environmentally friendly landfill design advised by the experts are incorporated in the new Guanabacoa disposal site.	12 items of environmentally friendly technology were adopted. <Achieved>

Source: Materials provided by JICA and DPSC

[8] Cooperating agencies include Ministry of Science, Technology and Environment, Havana Office (CITMA-Habana), Playa DMSC (DMSC Playa), Water Resources Research Institute (IHR), Ministry of Agriculture (MINAGRI), Soil Research Institute (IS), and Hygiene Research Institute of Ministry of Health (MINSAP).

3.2.1.2 Achievement of Project Purpose

Concerning the Project Purpose of "capacity of DPSC on solid waste management is strengthened through collaboration among cooperative organizations", six indicators were set as shown in Table 1 (one of these was added at the time of the terminal evaluation). Four of the indicators were achieved - almost achieved, while the remaining two were partially achieved. Considering that the degree of achievement of the outputs was also generally high (Output 1: high, Output 2: slightly high, Output 3: high, Output 4: fair), the project largely achieved its purpose.

3.2.2 Impacts

3.2.2.1 Achievement of Overall Goal

The Overall Goal of the Project is, "urban solid waste management is properly implemented in Havana City and sanitary environment of the City is improved". Since achievement of this is predicated on the maintenance of the results achieved in the Project, the degree of achievement of the Overall Goal is analyzed upon reviewing the situation regarding continuation of activities under each output from project completion to the time of ex-post evaluation.

(1) Continuation of activities following completion of the Project

① Strengthening of solid waste management capacity, revised Master Plan, solid waste management education (Output 1)

Training based on the solid waste management manuals prepared in the Project continues to be provided for the employees of DPSC and DMSC. Some of the manuals have been introduced around the country through the Ministry of Economic Planning. The Master Plan that underwent revision in the Project is utilized for compiling environmental strategy in Havana City and preparing plans of DPSC based on that. However, due to the diversion of budget funds to measures for reconstruction following the hurricane disaster of 2017, budget constraints for Havana City's environmental strategy investment program have become more acute and implementation has been further delayed. Concerning solid waste management education, the Project activities were continued for one year under the initiative of DPSC following completion of the Project. At the time of ex-post evaluation, teachers in charge at some of the schools involved in the Project were individually continuing the activities.

② Composting based on organic waste separate collection (Output 2)

Following the end of the Project, the director of UPPH was replaced, and the organic solid waste separate collection from hotels, agricultural markets, etc. and composting activities that had been commenced in the Project lapsed. The main counterpart who had worked on these activities (1 person) left the job. According to UPPH, the main reasons for the lapse of activities were as follows: 1) large human and mechanical burden entailed in conducting separate collection and

composting; 2) failure to secure permission to sell products; and 3) diversion of dedicated collection vehicles to general waste collection work due to the shortage of general waste collection vehicles. The compost yard that was constructed in the Project is now used as a site for keeping materials[9].

Wastes scattered on the street

Construction wastes illegally disposed on the street

Waste cleaning outside of containers by DMSC

Skid roller used by a waste removal team

③ Strengthening of maintenance capacity for waste collection vehicles (Output 3)

Although there has been reshuffling of counterparts and mechanics, the UPPH vehicle maintenance workshop is generally operating appropriately except for some items of equipment. The indicators on operating times and repair times of waste collection vehicles are being maintained within the target scope. One year following completion of the Project, JICA commenced the technical cooperation project entitled "Improvement of the Capacity on Waste Collection Vehicle Management in Havana City" (hereafter referred to as the "follow-up technical

[9] At the time of ex-post evaluation, DPSC is examining plans to restart the separate collection of organic waste and production of compost and biogas based on the experience of the Project, etc. On the premise of UPPH, in addition to the composting by the Project, a biogas plant (using organic waste) constructed through cooperation of the United Nations Industrial Development Organization was operating. However, its operation has been suspended since 2014. In the case where production of compost and biogas is restarted, it is scheduled for compost to be used in the upkeep of UPPH green areas and biogas to be used for generating power for internal use.

cooperation") with the goal of realizing high-level maintenance centered on preventive maintenance. In this project, establishment of preventive maintenance and inspection standards for vehicle accessories, improvement of maintenance techniques, preparation of maintenance manuals for new waste collection vehicle models (made in China), development of digitized ledgers were carried out. As a result, it is thought that capacity of the vehicle maintenance workshop has been strengthened even more after the end of the Project.

Meanwhile, the deterioration of waste collection vehicles had been accelerated by various factors including the following: 1) frequent tire punctures were caused by the poor quality of roads inside final disposal sites; 2) following the start of nighttime collections in 2012, due to the shortage of waste collection vehicles, the daily operating time of vehicles reached as high as 18 hours per day on an average; and 3) mixing of rubble and other heavy items into household waste placed a heavy load on hydraulic systems. Furthermore, the number of operating vehicles declined by the fact that it took a long time to import parts for certain vehicle models. While DPSC introduced 48 Chinese-made collection vehicles over four years between 2014-2017, due to the factors described above, the number of operable waste collection vehicles is around 40 (out of a fleet of 90 vehicles), even lower than the figure of around 50 at the time of Project completion. According to DPSC, this is less than half the required number of vehicles, meaning that it cannot provide stable waste collection services. Meanwhile, if more waste collection vehicles can be introduced through Japan's non-project grant aid, it anticipates that it can break the negative cycle of: shortage of vehicles → excessive operation → acceleration of deterioration → further decline in number of vehicles[10].

According to a series of interviews with DMSCs, heads of administrative zones and residents[11], waste collections are basically conducted once per day in Havana City, however, this can drop to once every two or three days when there are vehicle shortages. Moreover, many voices

[10] According to DPSC, it is estimated that 92 large-size waste collection vehicles (16 tons) are required to conduct waste collection in Havana City. It is scheduled for approximately 70 medium-size collection vehicles (12 tons) to be procured under Japan's non-project grant aid by the end of 2019. Also, it is scheduled for arm roll vehicles, skip loaders and trucks (numbers to be decided) to be procured under Japan's non-project grant aid in 2020. It should be noted that, since the number of operable waste collection vehicles is affected by the number of vehicles that are renewed every year, this cannot be used as an indicator to directly reflect the improvement in the capacity of maintenance workshops as a result of the Project.

[11] In this ex-post evaluation, the following survey was implemented with the aim of analyzing the factors of effectiveness and impacts.

- Targeting five major municipalities out of those where UPPH conducts collection services using waste collection vehicles, interviews were conducted with each DMSC (including municipal solid waste management corporation in two of the municipalities), one or two municipal officers (9 persons in total; significant extraction on the streets of visited districts), and one or two residents (9 persons in total), and the conditions of local waste collection were inspected in each municipality.
- Individual interviews were held with residents living around two final disposal sites (4 persons in total).
- Interviews were held with one hotel and one agricultural market that participated in the Pilot Project for separate collection and composting.
- Interviews were held with teachers in charge at the elementary and junior high schools that participated in the Project's environmental education (2 teachers at 2 schools), and conditions were inspected at one school.
- Hearings were conducted with Havana provincial government, the Ministry of Science, Technology and Environment, and Havana City Health Department.

said that the waste collection services conducted by collection vehicles have deteriorated in recent years. Moreover, it was pointed out that operation of the same waste collection vehicles by multiple drivers working on different shifts may impair awareness of the need for appropriate operation and maintenance inspections and lead to further decline in operating rates.

④ Strengthening of capacity for design and operation of final disposal sites (Output 4)

Following completion of the Project, the decision was made to construct the new Guanabacoa final disposal site under a new joint venture with foreign capital, and the project for new Guanabacoa final disposal site was transferred to the Ministry of Industry. At the time of ex-post evaluation, the new joint venture has not been established and the construction has been suspended. It is scheduled for the past plans and design to be fundamentally revised.

Concerning existing final disposal sites, a new access road and administration office were built and the weigh bridge (truck scale) functions were restored at Calle 100 disposal site, which was conducting the most appropriate landfill disposal at the time of Project completion. Although the responsible counterparts and personnel in charge were subsequently replaced, the know-how and experience obtained through the Project have been sustained to a certain extent through the manuals and final report that were prepared in the Project.

According to observation of Calle 100 disposal site and hearings with responsible personnel at UPPH, waste compaction is conducted to a certain extent, while it is not enough. The minimum required soil covering is conducted. However, due to the shortage of soil, construction wastes (rubble) are frequently used instead[12]. As a result, organic wastes heat up due to biodegradation caused by coming into contact with air, leading to constant emission of smoke and even occurrence of fires during the dry season. Furthermore, collection vehicles experience frequent punctures as a result of driving over waste that hasn't been sufficiently compacted and covered with soil.

Because of the difficulty in dumping waste at night due to absence of lights and during rainfall due to the muddy roads, trucks were observed dumping waste beside access roads and at the final disposal site entrances at the time of the first site survey (November, 2017, rainy season). However, by the time of the second site survey (April, 2018, dry season), a system for confirming appropriate disposal based on issuing cards to drivers who dump in the proper place had been adopted at the disposal site exit. While collection of valuable wastes on this disposal site by UPPH was stopped, numerous waste pickers still unofficially scavenge for valuable items[13]. Such

[12] According to DPSC, it has been decided to use residual soil from a mine on the outskirts of Havana City for use in soil covering at Calle 100 disposal site, however, as of April 2018, the method of transporting soil is still under examination.

[13] An enterprise for recovery of raw materials purchases all collected valuable resources. This enterprise, which is under the jurisdiction of the Ministry of Industry, purchases recyclable plastics, paper, metal and so on from factories, businesses, recyclable resource exchange houses in each municipality, DPSC, UPPH, etc. in Havana City and sells them to industry. The enterprise does not collect organic wastes. According to explanation given by UPPH, since the

activities are violations of the law, and the proactive management of registrations and training is not implemented.

Summing up the general situation, the operation and maintenance of existing final disposal sites is deemed to be largely unchanged since the time of Project completion.

(2) Achievement of Overall Goal

The Overall Goal of the Project is "urban solid waste management in Havana City and sanitary environment of the City is improved". As is shown in Table 2, none of the four indicators that were set concerning the Overall Goal have been achieved at the time of ex-post evaluation.

Table 2 Achievement of Overall Goal

Overall Goal	Urban solid waste management in Havana City and sanitary environment of the City is improved. <Not achieved>
Indicator	Actual
① Two or more entities in Havana City consider introducing the waste reduction model practiced in the Pilot Project.	The Pilot Project activities were suspended six months after the end of the Project. At the time of ex-post evaluation, DPSC and UPPH are examining the resumption of compost manufacture. <Not achieved>
② Volume of solid waste for recycle recovered by DPSC and UPPH from waste in Havana City reaches 6,400 t/year from the current level of 4,000 t/year.	At the time of ex-post evaluation, DPSC and UPPH do not collect recyclable resources or organic wastes, and there is no contribution from the Project. <Not achieved>
③ The level of satisfaction among Havana's citizens in terms of the integrated solid waste management increases.	Reduction in the number of complaints from residents, which was regarded as the representative indicator (from 60 complaints per municipality per year to 36 complaints per municipality per year) had already been achieved at the time of Project completion. However, judging from the interviews with the DMSC and residents (see the main text), it cannot be said that the level of satisfaction that citizens of Havana City hold towards solid waste management has improved. <Not achieved>
④ Number of environmentally friendly final disposal landfill sites which are properly maintained is two or more at the end of the Project while there was only one at the beginning of the Project.	Generally speaking, the maintenance situation of the three final disposal sites in operation at the time of ex-post evaluation has not changed much compared to the time of Project completion. The new Guanabacoa disposal site still hasn't been constructed. Therefore, at the time of ex-post evaluation, only Calle 100 disposal site is properly maintained. <Not achieved>

adoption of purchase prices which are more advantageous to individual pickers than UPPH, it has become harder for UPPH to collect recyclable materials on final disposal sites.

Calle 100 disposal site soil covering (left); waste pickers operating in the waste dumping zone (right)

Composting by UPPH was suspended six months after the end of the Project (Indicator ①). At the time of ex-post evaluation, the idea of restarting composting in tandem with the biogas production by another project is being examined, while there are no concrete prospects as yet (see footnote 9). Concerning recovery of solid wastes on final disposal sites (Indicator ②), collection of valuable waste materials (recyclable resources) by UPPH has been suspended, while collection by unofficial waste pickers is continuing. On the other hand, collection of recyclable wastes (cardboard, bottles, metal, etc.) by the Enterprises for Recovery of Raw Materials increased from 16,000 tons in 2005 to approximately 53,000 tons in 2017 due to the fact that collections were extended from public enterprises to private sector enterprises and individuals[14]. Even so, recycled resources still account for less than 1% of the total amount of solid waste collected by DPSC (approximately 6,800,000 tons in 2016)[15]. Therefore, waste reduction through recycling and compost manufacture activities is negligible, and the contribution made by the Project is no longer around.

In the districts where waste collection vehicles provide services, imported plastic waste containers have been installed. Locally made containers were partially introduced from 2015 on trial bases. UPPH is trying to solve some design issues (the covers were too heavy, and the containers were prone to falling over), but it is not yet fully successful due to constraints in manufacturing technology. Many containers are rendered useless and few are in good condition due to breakage, theft and so on. While UPPH plans to renew roughly 50% of all containers every year[16], according to the DMSC, the shortfall in the number of containers is large. Moreover, because containers are not cleaned, waste tends to stick and attracts flies, etc.

As was mentioned previously, the number of operable waste collection vehicles has declined

[14] In recent years, the number of recyclable resource exchange houses in the city has increased, and purchasing of valuable waste materials from the general public has become more common. The organic waste collection and compost manufacturing activities targeted by the Project are not included in this enterprise's work.

[15] In the M/P, it was planned to recycle approximately 17% of solid waste by 2015 with a view to reducing the quantity of waste.

[16] In 2018, it is planned to procure approximately 12,000 containers (7,000 made in Cuba and 5,000 imported).

following the end of the Project. Only half of the required number of vehicles are operable, resulting in destabilization of waste collection services. Combined with the large shortfall of containers, the containers are filled to overflowing before collections and the areas around containers become littered with the wastes that cannot fit in. Such cases were numerously observed around the city. Furthermore, due to the sharp increase in house building and reforms under the subsidy system that was introduced in 2015, the quantity of construction wastes increased a lot and has led to more waste being discarded on streets. The lack of discipline among residents concerning waste discharge further exasperates the problems. In contrast, such problems are relatively uncommon in districts that contain government offices, embassies and tourist districts that have been prioritized for the allocation of containers and waste collection vehicles. Personnel of DMSC daily grasp waste collection conditions within the municipalities. However, it has been difficult to analyze the appropriateness of waste collections and quantitative changes over time due to the absence of indicators for directly reflecting these situations[17].

According to interviews with responsible personnel in DMSC and municipalities, there have been no noticeable improvements in the services by waste collection vehicles in recent years. They report that vehicles frequently cannot be assigned on schedule due to punctures and various other reasons, while many people even said that the level of services had worsened recently. In interviews with residents, almost half of the respondents said that waste collection services had deteriorated over the past five years, while the other half said services had remained the same. Considering that the various problems described above regarding waste collection, it cannot be said that the level of satisfaction that citizens of Havana City hold towards solid waste management services has improved (Indicator ③). Moreover, as was described above, no major changes have been observed in the operation of final disposal sites following completion of the Project (Indicator ④).

To sum up, it is deemed that the Overall Goal of the Project has not been achieved.

3.2.2.2 Other Positive and Negative Impacts

(1) Social and environmental impacts

According to interviews with the DMSC and residents, no major impacts (improvement or deterioration) have been confirmed in terms of environmental sanitation in Havana City. According to the Provincial Direction of Public Health of Havana City incidences of diarrhea in the city declined in 2017, and there is no evidence that disposal of wastes on roads due to unstable collections is imparting negative impacts in terms of environmental sanitation or diseases.

According to residents who live around the final disposal sites, there have been no improvements in the environment around sites. There were reports of more smoke affecting daily

[17] DMSC reports to DPSC about its street cleaning and waste collection activities, quantities of waste collection containers according to their condition, the number of containers still needed, and so on.

life and numbers of rats increasing around some final disposal sites, however, nothing concrete was ascertained. The Project did not entail any relocation of residents or land acquisition.

(2) Other impacts

UPPH vehicle maintenance workshop sometimes unofficially gives advices upon request from other municipalities on maintenance and repairs on special types of waste collection vehicles. It sometimes shares information based on the maintenance manuals that were prepared in the Project. Meanwhile, sanitary landfill concepts and training contents have been introduced to officials of other provinces via national training, while no concrete extension activities have been conducted.

The outputs and experience acquired from JICA's technical cooperation activities including the Project have been referred to in formulating the Havana City environmental strategy, nationalization of the city's solid waste management utility and establishment of a joint venture (described in detail in the section on Sustainability)[18].

In summary, the degree of achievement of the Project Purpose is high. However, manifestation of the outputs and Project Purpose following the end of the Project has not been good and the Overall Goal has not been achieved. Accordingly, effectiveness and impact of the Project are fair.

3.3 Efficiency (Rating: ②)

3.3.1 Inputs

The following table shows the planned and actual inputs in the Project by the Japanese side and the Cuban side.

[18] According to DPSC, the results of the first solid waste survey in Havana City conducted in the prior technical cooperation and the basic direction indicated in the Master Plan have been regarded as important sources of information up to the time of ex-post evaluation.

Table 3　Comparison of Planned and Actual Inputs in the Project

Inputs	Plan	Actual (time of Project completion)
Inputs on the Japanese side		
(1) Experts	Chief advisor / integrated solid waste management, composting / segregated collection of waste, machinery at maintenance workshop, final disposal landfill, vehicle maintenance	Chief advisor / integrated solid waste management, composting / segregated collection of waste, machinery at maintenance workshop, final disposal landfill, vehicle maintenance, coordinator (8 persons, 84 man-months)
(2) Trainees received	Training in Japan Third country training	Training in Japan: none Third country training: 10 persons
(3) Equipment	Organic waste collection vehicles, community compost yard construction materials, organic waste containers, collection vehicles repair equipment, landfill heavy machinery maintenance equipment	Ditto: Total Approximately 88 million yen
(4) Overseas project strengthening costs	(Planned amount unknown)	Approximately $1,470,000
Japanese Side Total Project Cost	Total Approximately 350 million yen	Total 480 million yen
Inputs on the Cuban side		
(1) Assignment of counterparts	(Planned number of personnel unknown)	48 persons in total
(2) Facilities and equipment	Office, equipment and materials installation facilities, etc.	Office, vehicle maintenance workshop, compost yard
(3) Onsite costs		Donated equipment installation works costs, lighting and heating expenses, telephone and traffic expenses, etc.

Source: Prepared by the evaluator based on materials provided by JICA

3.3.1.1 Elements of Inputs

According to the counterparts, the experts were deemed to have high capacity and the quantity of expert man-months was appropriate. Also, the equipment was appropriate in terms of both type and quantity. Judging also from the contents and quality of the Project completion report, it can be gathered that the team of experts strived to conduct careful and attentive technology transfer. Due to the impact of the United States' policy regarding Cuba, machine tools that make use of the latest technology (processing equipment based on numerical control, etc.) were not introduced. However, according to the counterparts, the technical standard of the provided equipment was appropriate and consistent with actual conditions in Cuba.

According to the experts, although the assigned counterparts were appropriate in terms of

their numbers and quality, the results of the technology transfer were not fully accumulated due to subsequent frequent replacement of the counterparts without making adequate preparations for transferring duties. Moreover, the efficiency of activities was affected by the fact that much time was required in acquiring visas, preparing for appointments with relevant organizations and getting equipment through customs, and the fact that means of communication (email, telephone, etc.) with the counterparts when the experts were out of the country were limited. Also, since construction of the new Guanabacoa disposal site was greatly delayed due to the construction firm's busy schedule, non-execution of budget and inability to arrange for heavy machinery and other reasons, an opportunity for the experts to offer advice during execution of the construction works was lost.

3.3.1.2 Project Cost

The Project cost on the Japanese side was planned as 350 million yen but actually amounted to 480 million yen (131% compared to the planned value). Out of the increased cost, 70% arose because of the additional dispatch of experts made necessary by extension of the period of technical cooperation (described in the next section), and 30% arose from the increase in the amount of donated equipment.

3.3.1.3 Project Period

The Project period was planned to be 42 months from September 2009 to February 2013. The Project was commenced on schedule in September 2009, however, for the reasons given below, delays arose and the Project period was extended by 19 months to 61 months (145% compared to the planned value).

- Because it took a time for the Cuban side to secure a compost yard site, the time required for its preparation increased from the planned five months to 15 months.

- Equipment provided by the Japanese side for the vehicle maintenance workshop had to be procured in three installments due to constraints in the procurement procedure on the JICA side. Moreover, some equipment that was initially thought could be procured in Cuba proved to be unavailable and had to be procured from outside the country. As a result, procurement and installation of the workshop equipment took 19 months, three times longer than planned.

In summary, because both the project cost and project period exceeded the plan, the efficiency is fair.

3.4 Sustainability (Rating: ②)

3.4.1 Policy and Political Commitment for the Sustainability of Project Effects

In the latest National Environmental Strategy (2016-2020: draft pending approval as of April 2018), urban solid waste management is earmarked as an important issue. The following strategies are proposed in connection with this: 1) control and prevention of pollution arising from inappropriate final disposal sites, 2) assuring resources to urban solid waste management, and 3) adoption of more efficient and modern technologies in investment projects in the urban solid waste management sector.

The latest Havana City Environmental Strategy (2016-2020) was compiled in accordance with the above National Environmental Strategy. The objectives are given as follows: 1) construction of a new organizational structure in solid waste management, 2) implementation of sanitary landfilling (appropriate compaction and soil covering) at final disposal sites, 3) reduction in the quantity of waste through recovery of valuable materials, and 4) securing of equipment for waste collection (waste collection vehicles, etc.), and annual plans for the achievement of these goals are indicated.

Based on the above, urban solid waste management is an important policy area in Havana City, and the Project sustainability is high in terms of policy and systems.

3.4.2 Institutional / Organizational Aspects for the Sustainability of Project Effects

Concerning the maintenance of collection vehicles, after completion of the Project, DPSC has newly signed contracts with multiple maintenance workshops under the jurisdiction of the Ministry of Industry so that it can outsource major repairs, engine retrofitting and other maintenance works geared to extending service life. This has made it possible for UPPH maintenance workshop to concentrate on regular inspections / maintenance works and minor repairs. In weekly meetings held with related agencies (representatives of DPSC, UPPH, and maintenance workshops under the jurisdiction of the Ministry of Industry), UPPH confirms maintenance conditions and discusses maintenance works. Moreover, UPPH has established a dedicated section in charge of vehicle maintenance according to the recommendation made in the terminal evaluation. On the other hand, organic waste separate collection and composting have been suspended and the responsible section has been disbanded.

UPPH is one unit of an administrative organization that receives a budget allocation from the government, and it does not possess an autonomous source of funding but rather depends entirely on the government budget. However, the Government of Cuba, which greatly depends on tourism revenue which is not stable, is faced with a difficult fiscal situation, and budget allocations to solid waste management in Havana City are subject to numerous constraints. Therefore, plans are being examined for nationalizing the solid waste management functions of UPPH and DMSC and strengthening finances through collecting sufficient tariffs from enterprises and businesses.

According to DPSC, a feasibility study for this was implemented in 2017, and options regarding the organizational structure and tariff system were proposed at this time. Since the target areas comprise the city and multiple administrative municipalities, the proposed contents are complicated and will require revision of legislation, so the examination work requires time.

On the other hand, due to the financial constraints, it has been difficult to secure sufficient funding for large-scale investments including construction of the new Guanabacoa disposal site. As a result, in 2014, the government decided on a policy to establish a foreign capital-based joint venture centered on the Enterprise for Recovery of Raw Materials under the jurisdiction of the Ministry of Industry, and it has advanced preparations for this. According to the explanation given by DPSC, it is projected that the new enterprise will construct and operate the new Guanabacoa disposal site, conduct recycling and biogas generation, and conduct separate collection, etc. in areas where ample profitability based on tariffs collected from enterprises and businesses can be anticipated. Numerous foreign corporations based mainly in Europe and America have expressed an interest in establishment of the joint venture, and the selection process for partners is in progress at the time of ex-post evaluation. The concrete business plan will be examined after the partner enterprises have been selected. Meanwhile, UPPH will continue to implement the operations that will not be transferred to the joint venture including collection and transportation in certain areas, operation and closure of existing final disposal sites, etc.

As was mentioned previously, the latest environmental strategy for Havana City mentions construction of a new organizational setup for solid waste management. In the Master Plan of 2007, as well, the necessity for this was raised from the viewpoint of securing financial sustainability. If the abovementioned changes can be realized, they could become an important step in improving the city's solid waste management utility and securing its financial sustainability. However, the success of such plans cannot be judged at the time of ex-post evaluation until the specific business plans of both sides are compiled.

To sum up, concerning the institutional/organizational sustainability of the Project, no short-term problems are expected regarding UPPH vehicle maintenance workshop and final disposal sites. However, overall there are major uncertain aspects in the fair to long term.

3.4.3 Technical Aspects for the Sustainability of Project Effects

As with other public servants in Cuba, employees of DPSC and UPPH have lower salaries than private sector or self-employed workers. As a result, only around 70% of approved management posts and technical posts are filled, and many workers move overseas or switch to the private sector. Out of the counterparts who were employed at the time of Project completion, only around 30% are still in employment at the time of ex-post evaluation.

Concerning the strengthening of solid waste management capacity, the revised Master Plan, and solid waste management education, etc. (Output 1) and strengthening of maintenance capacity

for waste collection vehicles (Output 3), the main counterparts have remained in at their posts and technical continuity can be observed on the work. Moreover, the revised Master Plan, the Project Completion Report, and collection vehicle maintenance manuals bequeathed by the Project are referred to and fully utilized. Also, roughly half of the repair mechanics who received training at the maintenance workshop have continued to work there after completion of the Project[19]. It is thought that their technical capacity has been enhanced even further thanks to the training conducted in the JICA follow-up technical cooperation. Concerning operation of final disposal sites (Output 4), although the counterparts have left their posts, know-how and technical information have been passed on to successors to a certain extent via the manuals and the Project Completion Report. On the other hand, concerning composting based on the separate collection of organic waste (Output 2), although the manuals and completion report remain, the section in charge has been disbanded and the counterparts are no longer involved.

To sum up, there are partial issues regarding the Project sustainability in the technical aspect.

3.4.4 Financial Aspects for the Sustainability of Project Effects

Execution of the investment program for the Havana City environmental strategy has been delayed due to the harsh fiscal situation facing the Government of Cuba and constraints arising from the fact that funds have been diverted to the recovery effort in the aftermath of the hurricane disaster of 2017. [20]

At UPPH vehicle maintenance workshop, the budget for imported spare parts was reduced over the three years between 2014-2016. The budget for domestically procured parts and repairs outsourced to the Ministry of Industry is increasing gradually. However, according to UPPH, it is still not enough. Moreover, the limited number of suppliers and availability of spare parts and materials for fabricating parts is major constraints for the workshop.

Meanwhile, the annual budget required for renewing collection vehicles, other vehicles, and heavy machinery that exceeds the service life, renewing waste containers, and conducting operation and maintenance of disposal sites is secured to a certain extent, although it cannot be described as adequate. Since waste collection vehicles and arm roll vehicles will be donated under Japan's non-project grant aid, this will alleviate the budget constraints in the short term.

Information could not be obtained concerning the overall budget allocations and total expenditures of DPSC and UPPH. It should be also noted that, if the aforementioned organizational changes are executed, it is anticipated that the financial constraints placed on maintenance in the Project will be alleviated.

To sum up, there are some issues regarding the Project sustainability in the financial aspect.

[19] Since repair mechanics are paid wages according to the amount of work they do, they have higher salaries than personnel in managerial and technical posts. This leads to a higher retention rate of personnel.

[20] Since the collapse of the Soviet Union in 1991, the financial situation of the Cuban Government continues to be severe as a result of the strong influence of US policy against Cuba.

Based on the above, although there are no issues regarding the Project sustainability in the policy and institutional aspects, there are some issues in technical and financial terms, and major uncertainty exists in the medium to long term regarding the organizational and financial aspects. Taking into account the fact that some activities have been discontinued following completion of the Project, the Project sustainability is deemed to be fair.

4. Conclusion, Recommendations and Lessons Learned

4.1 Conclusion

The Project was implemented with the Project Purpose "to strengthen capacity of DPSC on urban solid waste management in Havana City through collaboration among cooperative organizations." and the Overall Goal "to properly implement urban solid waste management in Havana City and improve the city's sanitary environment". The importance of solid waste management within the policies and development needs of Cuba and Havana City was high at both the time of planning and the time of completion of the Project. The Project was relevant to Japan's ODA policy at the time of planning. Based on the above, the relevance of the Project is high. As a result of the strengthening of collaboration among related agencies, strengthening of solid waste management capacity, the pilot project for composting, strengthening of vehicle maintenance workshop capacity, improvement in the design of a new final disposal site, and improvement in the operation of existing final disposal sites through the Project, the Project Purpose was more or less achieved. However, at the time of ex-post evaluation, waste collection services in the city are unstable due to shortages of waste collection vehicles, waste containers, etc., and no significant improvement in sanitary environment is seen in the City. Following completion of the Project, composting as well as construction of the new final disposal site have been suspended and not much improvement has been made in the operation of final disposal sites. Therefore, the Overall Goal has not been achieved. To sum up, the effectiveness and impact of the Project are deemed to be fair. The inputs of human resources and equipment were appropriate in terms of content and quality, however, because it took a long time for the Cuban side to prepare the compost yard and JICA to procure the equipment, the Project period was longer than planned. In addition, the project cost also exceeded the planned budget due to increase of equipment cost. Therefore, the efficiency of the Project is fair. Concerning sustainability, while there are no problems regarding the policy and institutional aspects, there are some technical and financial issues. Since examination of a proposal to nationalize the solid waste management utility and preparations to establish a joint venture are still in progress, the Project is faced with major institutional and financial uncertainties in the fair to long term. Therefore, the sustainability of the Project is deemed to be fair.

In light of the above, this project is evaluated to be partially satisfactory.

4.2 Recommendations

4.2.1 Recommendations to the Implementing Agency

(1) Improvement of waste collection services

Although a certain degree of improvement can be anticipated in the waste collection of Havana City with the new waste collection vehicles, etc. to be introduced through Japan's cooperation, there are still many issues to be solved and the streets are still littered with waste. DPSC will need to continue striving for improvement of waste collection services while making full use of the experience gained through the Project. It will be necessary to tackle the issues described below.

- Monitoring of waste collection: As an indicator which directly reflect waste collection performance in the city, it is proposed that new indicators be adopted regarding the quantity, types and number of container sites of wastes discarded outside of containers, and that monitoring be conducted according to each administrative zone and municipality. Doing so will clearly show the extent of improvement of waste collection services in quantitative terms and provide a specific basis regarding needs for resource allocation. Alternative indicators could be set based on the number of dispatches of waste removal teams, the quantity of waste collected by DMSC in those areas served by waste collection vehicles (the amount of waste separately collected by DMSC because it couldn't be collected by the waste collection vehicles)[21].

- Continued procurement and appropriate management of waste containers: It is necessary for DPSC to accurately gauge the required number of waste containers and procure them every year in an ongoing effort. Also, it needs to examine a method for efficiently cleaning containers and disseminate information on sanitary waste disposal methods such as discharging raw waste in plastic bags to avoid direct dumping with a view to ensuring the sanitary use of containers.

- Improvement of social discipline concerning waste: It will be necessary to establish and disseminate guidelines about waste discharge and container handling methods for waste dischargers and improve the discipline of residents concerning solid waste management. It will be necessary for Havana City and DPSC to collaborate with related agencies and effectively implement activities while referring to the experience of the Project. For this purpose, it will be necessary to assign dedicated employees to DPSC. In view of the fact that a large number of waste collection vehicles will be newly introduced leading to a certain degree of improvement in waste collection services in 2018-2019[22], one idea will

[21] These services would not be required if services by waste collection vehicles and arm roll vehicles were properly provided, except in cases where fallen trees, etc. need to be cleared in the wake of hurricanes and so on.

[22] It is difficult to improve social discipline without making any improvements to waste collection services. In this

be to implement a clean campaign to coincide with the 500th anniversary of Havana City in 2019.

- Appropriate operation and maintenance of waste collection vehicles: To ensure the appropriate and long-term operation of the newly introduced large number of waste collection vehicles, it will be necessary to limit the daily operating time of vehicles to an appropriate range and strive to secure ample time for inspections and maintenance[23]. At the vehicle maintenance workshop, in addition to supplying sufficient consumables for maintenance equipment, it will be necessary to leverage the know-how gained in the Project and follow-up technical cooperation to ensure that the newly introduced vehicle models undergo proper maintenance, inspections and repairs.

- Assignment and training of waste collection vehicle drivers: It will be necessary to train drivers in methods for conducting routine inspections and maintenance, driving on poor quality roads without harming vehicles, appropriately repairing punctures on roads or at final disposal sites. Taking the upcoming increase in the number of vehicles as an opportunity, the number of drivers should also be adjusted so that each vehicle has one driver with a view to motivating drivers to have more awareness and a greater sense of responsibility.

(2) Appropriate operation of final disposal sites

Since it will still take at least a few more years before the new Guanabacoa disposal site can commence operation, extending the useful life of existing final disposal sites that are approaching their landfill limit is an important issue that requires urgent attention. Concerning Calle 100 disposal site, which will require ongoing investment for a considerable period, it will be important to leverage the information and experience acquired in the Project to assess the remaining landfill capacity[24], promptly examine a life extension plan and landfill plan, and conduct programed operation and maintenance with an eye on upcoming site closure. Moreover, it will be necessary to efficiently maximize the remaining landfill capacity through securing heavy machinery and soil for covering, and conducting highly concentrated landfill by appropriately implementing compaction, soil covering and dumping site management while amply referring to the Project manuals and the Project Completion Report.

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regard, the introduction of new waste collection vehicles is considered to provide a good opportunity.

[23] In the Master Plan, it was proposed that the operating time of each vehicle, which was 9 hours per day on average in 2006, should be reduced to 8 hours so that inspection and maintenance time can be secured.

[24] In the prior technical cooperation, simple GPS was used to measure elevation in a number of locations on landfill sites in 2013. For example, it should be possible to analyze the residual capacity of the same disposal sites based on changes in altitude at the same locations that were measured in 2013 and the amount of landfill that has been conducted up to 2018.

(3) Consolidation of solid waste management organizations

If nationalization and establishment of a joint venture in Havana City's solid waste management services are successful, this could lead to the medium to long-term sustainability of the Project. It is desirable for this to be realized upon fully examining their technical, financial and institutional feasibility. For this purpose, it will be necessary for the Cuban side to acquire the ability to fully understand comprehensive and appropriate solid waste management. It will also be important for it to learn international experiences regarding urban solid waste management.

4.2.2 Recommendations to JICA

It will be necessary for JICA to examine the necessity and feasibility of technical cooperation geared to supporting the Cuban side in implementing the above recommendations upon taking the following factors into account: 1) solid waste management in Havana City still faces numerous issues; 2) JICA has store of experiences accumulated through the prior technical cooperation, the Project, and the follow-up technical cooperation; 3) it is scheduled for new models of waste collection vehicles, arm roll vehicles, etc. to be donated through non-project grant aid.

4.3 Lessons Learned

<u>Prior gauging of the degree of employee retention in implementing agencies and preparation of countermeasures</u>

When developing a technical cooperation project, it will be necessary to assess in advance to what extent employees are retained in the implementing agencies. More specifically, possible measures for assessing the degree of retention will include; confirming the length of service of every employee in the implementing agencies, analyzing transfer destinations and reasons for switching jobs. In organizations where the degree of retention is not high, it is also necessary to grasp handover conditions when employees leave posts or switch jobs and check on the existence of organized initiatives for training successors. In addition, based on the above information, it is necessary to include in the scope of cooperation measures for improving employee retention and strengthening the capacity of the organization so that it isn't impacted by job separations and transfers of employees.

In the Project, the main implementing agencies were DPSC and UPPH, and, because numerous employees left their posts in search of higher salary without handing over their duties in a satisfactory manner, the frequent turnover of counterparts during the Project had a negative impact on the efficiency of the technology transfer. Furthermore, following completion of the Project, 70% of the counterparts who were employed at the time of Project completion have left their posts by the time of the ex-post evaluation, and this has greatly impacted sustainability.

Achievement of Outputs

Indicator	Degree of achievement
Output 1: Comprehensive management capacity on solid waste management of DPSC is improved. <Degree of achievement is high>	
① Master Plan is updated by the end of the Project with two component projects, namely "construction of the new landfill in east and innovation of the workshops for vehicles & heavy machineries" physically completed at the rate of completion of 100% and 100% respectively. ② Management process is improved in three aspects. ③ Quality of DPSC management-related report on plan, monitoring, and evaluation is improved by establishing two kinds of management reports. ④ Core Group: approximately 520 people are trained. ⑤ Manuals (Textbooks) are prepared (3 kinds) ⑥ Solid waste education is conducted for six elementary schools and two junior high schools of the Popular Council of Miramar through the "Red de Formación Ambiental" while there was no such activity at the beginning of the Project. ⑦ Solid waste education for the employees of the hotels and agricultural markets in Havana City is conducted at 10 entities while there was no such activity at the beginning of the Project.	① Partially achieved: Procurement of equipment for vehicle maintenance was completed, however, full completion was not possible due to the delay in starting work on the new sanitary landfill site. Updating of the Master Plan is expected to be completed. ② Achieved: Improvements were observed in the three processes of solid waste management planning, monitoring, and evaluation of detailed contents in DPSC and UPPH. ③ Achieved: Five management report formats, i.e. i) project planning sheet, ii) project monitoring chart, iii) progress check sheet, iv) minutes of meeting, and v) indicators for project evaluation, resulting in improvement of the quality of reporting. ④ Almost achieved: The number of directors of municipalities and communal zones who received training exceeded the target, however, the number of engineers who received training was 91% of the target. ⑤ Achieved: Three types of manuals, i.e. "Economical management and management techniques", "Comprehensive solid waste management", and "Work safety" were developed. ⑥ Achieved: Solid waste management education was conducted at six elementary schools and two junior high schools ⑦ Achieved: Training was implemented for the employees of 10 entities.
Output 2: Solid waste source separation at the Pilot Project site is promoted and capacity of UPPH/DPSC in organic waste reduction at the source is strengthened. <Degree of achievement is slightly high>	
① Organic waste for composting in Pilot Project Site is collected by 1500 kg per day ② Compost in Pilot Project Site is produced to 650 kg per day. ③ Percentage of foreign material in organic waste to compost plant is reduced by 50 % as compared to the percentage at the beginning of the project. ④ Behavior change of local institutions in Pilot Project Area on waste reduction and separated collection reaches 5 institutions while there was no such institution at the beginning of the project.	① Almost achieved: On average, 1,432 kg per day of organic waste was collected (February-June 2004), however, the amount of collected organic waste varied greatly because it was sometimes necessary for the collection vehicles to be used for general waste collection. ② Achieved: On average, 667 kg per day of compost was manufactured between November 2011 - July 2013. ③ Partially achieved: The target value regarding the percentage of foreign material in organic waste was 8.3%. In reality, the value was 25.4% at agricultural markets, 2.3% at the tobacco factor, and 0% at hotels. It will be possible to achieve the target in future if collections by UPPH are stabilized. ④ Achieved: Five institutions participated in the Pilot Project activities for reducing and separating waste.

Output 3: Capacity of UPPH in the collection and transportation of solid waste is strengthened. <Degree of achievement is high>	
① Average availability (CDT) of working collection vehicles is improved to 63.2% or more; time for repair (TR) is reduced to 8.38 hours per month; and time for waiting to be repaired (TE) is improved to 5.46 hours per month. ② Frequency of waste collection and transportation by UPPH is optimized with the index of VF (rate of functioning vehicles to number of collection routes) at 90% and NC (rate of necessity of container to planned number of containers) at 15%. ③ In the seven main areas of the maintenance workshop (chassis, welding, machine tool room, tire repair shop, electricity, hydraulics, and injection pump lab), 20 mechanics are trained to correctly operate the equipment donated by the Project. ④ Seven technical maintenance manuals are prepared for the main areas of maintenance workshop.	① Achieved: The CDT value was improved to 63.8% (77.5% excluding scrapped vehicles); TR was 6.83 hours per month; and TE was 1.57 hours per month. ② Partially achieved: In 2014, the index of VF was 93% (achieved), however, the NC was 20% (not achieved). ③ Achieved: All 50 mechanics who received training passed the test of understanding. ④ Achieved: 12 types of maintenance manuals were prepared.
Output 4: Capacity of UPPH and DPSC on landfill design and operation of final disposal sites is strengthened. <Degree of achievement is fair>	
① The existing final disposal sites are properly operated and managed in terms of dumping, surface compaction, soil cover, slope protection and leachate treatment at three sites, not only one as at the beginning of the Project. ② Design of the new final disposal site is revised in an environmentally friendly way for 11 improvements as opposed to zero at the beginning of the Project.	① Partially achieved: According to monitoring in 2014, some improvements were observed at four final disposal sites, however, proper management was deemed to be implemented at only one final disposal site. ② Achieved: 12 improvements were made to the new final disposal site.

Republic of Nicaragua

FY 2017 Ex-Post Evaluation of Japanese Grant Aid Project

"The Project for Construction of the Santa Fe Bridge in the Republic of Nicaragua"

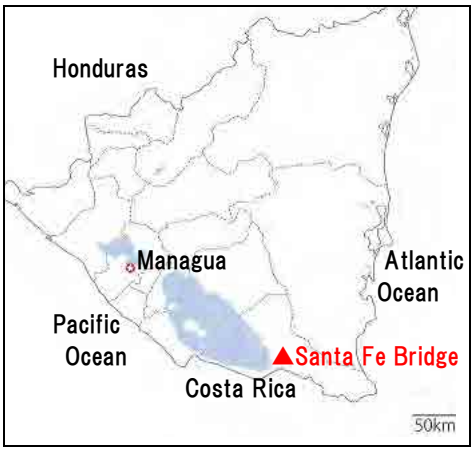
External Evaluator: Hiromi SUZUKI S., IC Net Ltd.

0. Summary

The Project for Construction of the Santa Fe Bridge in the Republic of Nicaragua (hereinafter referred to as "the Project") was implemented to construct the Santa Fe Bridge in Nicaragua's Rio San Juan Department, over San Juan River which runs along the border between Nicaragua and Costa Rica, in order to guarantee the safe and smooth flow of traffic crossing San Juan River, thereby contributing to the vitalization of the international flow of goods, the local economic growth, and the improvement of the living standard of local residents. The Project was sufficiently consistent with the national development plan, transportation sector policies, development needs of Nicaragua at both the time of planning and the time of ex-post evaluation, as well as Japan's ODA policy at the time of planning. However, even though the Project consisted in the construction of a bridge with the functions of an actual international bridge, the external conditions concerning border opening with Costa Rica were not adequately analyzed at the time of planning. Thus, the relevance of the Project is fair. The Project outputs were generally as planned, and the Project cost was lower than planned, however, because the Project period was longer than planned due to time spent on making design changes and opening the border, the efficiency of the Project is fair. As a result of the Project, targets regarding increase of weight capacity of passing vehicles and reduction of river crossing time were achieved; furthermore, it is recognized that there has been a certain impact in terms of local economic growth and improvement of the living standard of local residents. However, because border facilities on the Costa Rica side are still not complete, the increase in traffic volume, the main indicator of the Project, has not achieved the target; and international cargoes utilizing the Project have been limited, hence vitalization of the international flow of goods has not been realized sufficiently. Therefore, the effectiveness and impacts of the Project are fair. The organizational, technical, financial aspects and current status of the operation and maintenance of the Ministry of Transport and Infrastructure (Ministerio de Transporte e Infraestructura: MTI), the Road Maintenance Fund (Fondo de Mantenimiento Vial: FOMAV), and the Corporation of Regional Construction Companies (Corporación de Empresas Regionales de la Construcción: COERCO), which are responsible for the operation and maintenance of the Project, are generally satisfactory, hence, the sustainability of the Project is high.

In light of the above, this Project is evaluated as partially satisfactory.

1. Project Description



Project Location

Santa Fe Bridge
(looking from the national border towards Managua)

1.1 Background

The Acoyapa-San Carlos-Costa Rica international highway (hereafter called the "Acoyapa Highway"), along which the Project is located, is the only arterial road that runs through the agricultural region of Central Nicaragua and reaches the border with Costa Rica (San Pancho-Las Tablillas border[1]). Passing by Lake Nicaragua on the east side, it forms part of the "Atlantic Corridor" that leads to neighboring Costa Rica in the south (Figure 1). The Atlantic Corridor is an international arterial road that connects from Tegucigalpa, capital of Honduras in the north, all the way to San Jose, capital of Costa Rica in the south, and it is expected to play a role in complementing and substituting the "Pacific Corridor" which is the main land transportation route between Nicaragua and Costa Rica. However, although the Atlantic Corridor north of Acoyapa had been improved thanks to an assistance from the Danish International Development Agency (DANIDA), the Acoyapa Highway going south from Acoyapa was unpaved and had poor runnability; and roadside areas tended to be excluded from development, hindering socioeconomic development. In view of this situation, in 2006, the Interamerican Development Bank (IDB) decided to provide a loan for the construction and improvement of Acoyapa Highway with the objectives of promoting international traffic with Costa Rica; improving links between roadside areas and domestic markets; and vitalizing the economy through promoting tourism development and so forth in the southern region of Nicaragua. However, since there was no bridge in the point where the Acoyapa Highway intercepted San Juan River, and vehicles needed to use a small ferry to continue their journey along the highway. Because the IDB road construction and improvement project did not include the construction of a bridge at this point, it was necessary to

[1] The border between Nicaragua and Costa Rica on the Atlantic side is called the "San Pancho border" in Nicaragua, and the "Las Tablillas border" in Costa Rica. At the request of the executing agency, the border is referred to as the "San Pancho-Las Tablillas border" in this report.

construct the "Santa Fe Bridge" to carry the highway across San Juan River and thereby enhance the project effect. Against this background, the Government of Nicaragua made a request for a grant aid cooperation to the Government of Japan for the construction of the said bridge.

1.2 Project Outline

The purpose of the Project was to construct a new bridge in Nicaragua's Rio San Juan Department over San Juan River that runs along the border between Nicaragua and Costa Rica, in order to guarantee the safe and smooth flow of traffic crossing San Juan River, thereby vitalizing the international flow of goods; the local economic growth and improving the living standard of local residents.

Source: JICA "The Project for Construction of the Santa Fe Bridge in the Republic of Nicaragua Preparatory Survey Report", 2009.

Figure 1 Relation of Santa Fe Bridge to International Corridors in Central America

Grant Limit/Actual Grant Amount	Detailed Design: 76 million yen / 75 million yen Construction: 2,753 million yen / 2,476 million yen
Exchange of Notes Date/ Grant Agreement Signing Date	Detailed Design: December 2009 / December 2009 Construction: May 2010 / May 2010
Executing Agency	Ministry of Transport and Infrastructure
Project Completion	August 2014
Main contractor	Hazama Ando Corporation
Consultant	Central Consultant Inc.

Preparatory Survey	December 2008 to November 2009
Related Projects	[Technical cooperation] "Project for the Study of National Transport Plan in the Republic of Nicaragua" (2012- 2014) [Grant aid] "Project for the Reconstruction of the Bridges in Arterial Highway" (E/N: May 2000); "Project for the Reconstruction of the main Bridges in National Highway 7" (E/N: June 2007); "Project for Reconstruction of Bridges on Managua – El Lama Road" (E/N: June 2011) [Projects by other agencies] "National Highway 7 Improvement Project" (IDB, 2003-2004), "National Highway 25 Acoyapa-San Carlos-Costa Rica Border Highway Integration Program" (IDB, 2006-2015), "Comprehensive Border Program (2017-)", "National Highway 7 (Atlantic Corridor north from Acoyapa) Improvement Project" (DANIDA, 2000-2002)

2. Outline of the Evaluation Study

2.1 External Evaluator

Hiromi Suzuki S. (IC Net Ltd.)

2.2 Duration of the Evaluation Study

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

Duration of the Study: October 2017 to March 2019

Duration of the Field Survey: February 14, 2018 to March 5, 2018

2.3 Constraints during the Evaluation Study

In this ex-post evaluation study, it was intended to implement two field surveys, however, protests against the presentation of a bill to reform the Social Insurance Institute in April 2018 triggered the activation of demonstrations led mainly by students, which originated into clashes with security forces throughout the country[2]. These events forced to the cancelling of the second field survey by the Japanese consultant which was substituted with a partial survey by a local consultant. As a result, confirmation of the latest information and collection of supplementary information that were scheduled in the second field survey were limited.

[2] Based on safety information issued by the Japanese Embassy in Nicaragua. URL: https: //www.ni.emb-japan.go.jp/itpr_ja/nicaragua.html/ (accessed on July 10, 2018)

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

3.1 Relevance (Rating: ②[4])

3.1.1 Consistency with the Development Plan of Nicaragua

At the time of planning, in Nicaragua's *National Plan for Human Development* (2008-2012), "improvement of the economic infrastructure base such as roads, bridges, etc." was regarded as an important means of "improving productivity". Based on this, the *National Transportation Plan* (2001-2020) that was formulated by the Ministry of Transport and Infrastructure (Ministerio de Transporte e Infraestructura; hereinafter referred to as "MTI"), mentioned the improvement of Acoyapa Highway where the Project is located, and the construction of Santa Fe Bridge (the Project). Also, the *Mesoamerica Integration and Development Project*, which is a wide regional development project that aims to vitalize distribution of goods in Central America, includes the International Network of Mesoamerican Highways (Red Internacional de Carreteras Mesoamericanas; hereinafter referred to as "RICAM") connecting the region from Mexico to countries in Central America including Nicaragua, Costa Rica, and Panama, and the Project constitutes part of that[5]. In all these plans, emphasis is placed on the development of the "Pacific Corridor" and the "Atlantic Corridor" where the Project is located, from the viewpoint of building a network of arterial road transportation that includes international arterial roads.

At the time of ex-post evaluation, improvement of transport infrastructure was earmarked as one of 12 strategy guidelines in Nicaragua's *National Plan for Human Development* (2012-2016)[6], and the Project was included as one of 12 top priority undertakings in the transport infrastructure sector. The MTI's *Long-term National Transportation Plan* (2014-2033), viewing roads and bridges as necessary infrastructure for the sustainable growth of the national economy and correction of disparities between eastern and western areas, proposes a strategy of constructing a reliable road network, strengthening the arterial road network and international corridors, bolstering road functions to address vulnerability to disasters, strengthening road maintenance systems and so on. Also, regarding the Atlantic Corridor in which the Project is located, it considers its importance for building an efficient access route to areas on the Atlantic side and vitalizing communications and economic activities between areas in the said region. Concerning the *Mesoamerica Integration and Development Project*, at the time of ex-post evaluation it also

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

[4] ③: High; ②: Fair; ①: Low

[5] The *Mesoamerica Integration and Development Project*, which is the successor to the *Puebla-Panama Plan*, was announced in June 2001 by Mexico, six Central American countries, and Belize. This plan for integrated and sustainable regional development stretching from Mexico to Panama, crossing eight Central American countries including Nicaragua and Costa Rica, focuses on eight major issues including roads, electric power, communications, trade, human development, tourism, and environment, among others.

[6] The *Draft National Plan for Human Development* (2018-2021) was announced in December 2017 as the draft successor to the current *National Plan for Human Development*. The basic policy remains unchanged from the present plan, the main goals being employment creation, mitigation of poverty, correction of income disparities, etc. based on stable economic development. The social infrastructure sector remains a priority area with plans to further develop the road network and border facilities.

intends to vitalize the flow of goods and tourism in Central America, and thus, improvements continue to be made to the Atlantic Corridor, to which the Project belongs, as part of RICAM.

Based on the above, both at the time of planning and the time of ex-post evaluation, all development plans in Nicaragua consider transport infrastructure including bridges as an essential infrastructure for economic growth and improving productivity; hence, consistency of the Project is sustained.

3.1.2 Consistency with the Development Needs of Nicaragua

As was described in "1.1 Background", the Atlantic Corridor which includes the Project, complements the Pacific Corridor, and it was anticipated that the Project would help relieve congestion at the Peñas Blancas border located on the Pacific Corridor. On the Atlantic Corridor, the IDB had been implementing road improvement and construction, however, the only means to cross San Juan River had been small ferries for small vehicles. Accordingly, in order to carry cargoes across San Juan River, it was necessary to reload goods between trucks and pontoon boats (flat bottom boats) at piers on both sides of the river. Meanwhile passengers and cyclists had to cross using a small boat. Thus, the construction of Santa Fe Bridge was necessary to enhance the effects of the development of Acoyapa Highway.

At the time of ex-post evaluation, the entire Atlantic Corridor in Nicaragua is complete. Work is still in progress on border facilities and the Atlantic Corridor on the Costa Rica side.[7] Also at the time of ex-post evaluation, the road that bypasses the capital San Jose directly connecting San Pancho-Las Tablillas border to Limon Port on the Atlantic side is being constructed. This road will connect eventually to Moín Port which is scheduled to open in 2019 located right in the north of Limon Port. However, as is described in detail in "Impacts", because the said border is not entirely opened, the effects of the Project anticipated as part of the Atlantic Corridor have not been fully realized, and congestion at Peñas Blancas border has not been relieved either. Meanwhile, judging from interviews to the freight transportation association, there is a high demand for opening of the San Pancho-Las Tablillas border, so it can be said that the need for the Project remains high at the time of ex-post evaluation.

3.1.3 Consistency with Japan's ODA Policy

The *Country Assistance Plan* compiled in 2002 through consultations with the Government of Nicaragua earmarked mitigation of poverty and correction of disparities, development of

[7] At the time of ex-post evaluation, the IDB has signed loan agreements with Central American countries since 2017 towards the implementation of a "border integration program" geared to promoting integration in the region and has either been preparing or has already started the implementation of investment programs. This program includes the development of border facilities between Nicaragua and Costa Rica. Construction of facilities at the San Pancho-Las Tablillas border on the Nicaragua side is scheduled to be implemented with a grant aid by the European Community which is complementing this Program. Thus, concrete initiatives are being advanced for a full-scale realization of the effects of the Atlantic Corridor. (Based on interviews to IDB Nicaragua Office).

socioeconomic infrastructure, support for democratization, and strengthening of disaster prevention capacity as the basic policies, considering that the country was still beset by the impacts of many years of civil war and it has struggled with numerous natural disasters. At the same time, it also took into consideration the consistency with the regional integration initiatives based on the Central American Integration System. The Plan sets six priority sectors including development of road and transport infrastructure; and the Project is highly consistent with it as a road and transport infrastructure development undertaking.

3.1.4 Appropriateness of the Project Plan and Approach

By the time of ex-post evaluation, the Acoyapa Highway in the Nicaragua side including the Santa Fe Bridge has been entirely finished, leading to a major improvement in access from the capital Managua to the border with Costa Rica. Facilities at the San Pancho-Las Tablillas border on the Nicaragua side, including freight truck weighing facilities, parking area, immigration bureau, customs, quarantine station, and national police facilities have been completed. Meanwhile, on the Costa Rica side, temporary facilities for immigration, customs, and police have been installed, however, there are still no quarantine station and customs weighing facilities. Due to this, only limited passenger vehicles and freight vehicles are permitted to pass, significantly hindering the manifestation of the Project impacts (see “Impacts”).

As a factor behind the above, it may be said that analysis of the external conditions (risks) assuming that the Project would function as an international bridge at the time of planning was insufficient. The Project is located in Nicaragua, 8 kilometers from the border, but the space in between the two points is occupied only by the office and orange plantations of Frutales San Juan, S.A., and apart from the company’s workers, the use of the Project as part of the daily lives of the residents is very few. Moreover, passage times over this bridge are limited in line with the open hours of the border facilities which mainly serve to the purpose of controlling illegal immigrants between Nicaragua and Costa Rica and other security control. Accordingly, the Project is that of the construction of a bridge which in real terms has the function of an international bridge, and a complete border opening of both Nicaragua and Costa Rica had an important effect for its effects to be realized. Attention should have been paid at the time of planning to the following points based on a more careful analysis of this fact:

- ✓ Confirmation should have been made concerning plans and policies for development of roads, border facilities and other infrastructure not only for Nicaragua, but also for Costa Rica.
- ✓ Confirmation should have been made concerning the existence of a legal framework or institutions (or plans) for cooperation geared to border installation and coordination and

integration of border traffic management[8]. In particular, because relations between Nicaragua and Costa Rica have historically been constantly tense, it was important to confirm initiatives related to bilateral cooperation to both countries at the time of planning.

- ✓ Compared to Nicaragua, due to the difference in their political systems[9], longer time tends to be required to deliberate and approve affairs in the national diet in Costa Rica, as such, a proper assessment of the risks that would limit the realization of the Project's effects should have been conducted, after considering the possibility that the development and legal preparations for the establishment of the San Pancho-Las Tablillas border would drag on past the starting of operations of the Project.

The lack of analysis concerning the above points eventually resulted in the limited manifestation of the Project effects; hence, it is thought that partial issues existed regarding the Project plan and approach.

In light of the above, this project has been highly relevant to Nicaragua's development plan and development needs, as well as Japan's ODA policy, but there have been partial issues regarding the Project plan and approach; hence, the Project relevance is fair.

3.2 Efficiency (Rating: ②)

3.2.1 Project Outputs

Outputs of the Project at the time of planning were the bridge (length 362 meters, two-lane roadway plus sidewalks), access roads (total length of 58 meters), revetment (left bank only), incidental works (drainage works, traffic safety facilities, signposts, bridge nameplates), and consulting services. The actual outputs were almost as planned. There were some changes to the type, height, etc. of the bridge piers, however, these were all only minor design changes. The outputs borne by the Nicaragua side were: securing of site land, provision of temporary yards,

[8] Without such a framework, even if the infrastructure is constructed, the Project effects cannot be effectively exerted. At the time of the ex-ante evaluation, the two countries concerned had no agreements related to border establishment and management of border traffic, and it was not possible to acquire information that could indicate the existence of a plan on whether such an agreement would be adopted. (See "Impacts" concerning the situation at the time of ex-post evaluation).

[9] Nicaragua is a nation with a republican government like Costa Rica. However, in 2011, the current Ortega administration abolished the law that prohibits consecutive reelection of the president which was prohibited originally in the constitution, and since 2006 government administration authority has continued to be concentrated in the president. Approximately 78% of the unicameral national assembly (seven parties, total of 92 deputies) is occupied by the Sandinista National Liberation Front which is the party in power. On the other hand, consecutive reelection of the president is prohibited in Costa Rica, and there is no political party that accounts for the majority of the unicameral national assembly (eight parties, total of 57 deputies (White Paper of Japan's Ministry of Foreign Affairs, National Assembly of the Republic of Nicaragua website URL address http://www.asamblea.gob.ni/ (accessed on July 10, 2018) and the Legislative Assembly of Costa Rica web site URL address http://www.asamblea.go.cr/ (accessed on July 10, 2018). These differences in the political system have been affecting the Project's degree of progress and speed as a result. These facts are not limited to this Project, but according to interviews, it was confirmed that it has been affecting IDB projects as well.

preparation of an earth dump, and provision of a waste materials dump. It has been confirmed that all these items were implemented.

Summing up, except for some minor design changes, the Project outputs were generally implemented as planned.

3.2.2 Project Inputs

3.2.2.1 Project Cost

The total Project cost at the time of planning was 2,835 million yen. The actual total cost was 2,551 million yen, which was 90% of the planned amount, meaning that the Project cost was lower than planned. (See Table1).

Table 1 Project Cost: Plan and Actual

(Unit: million yen)

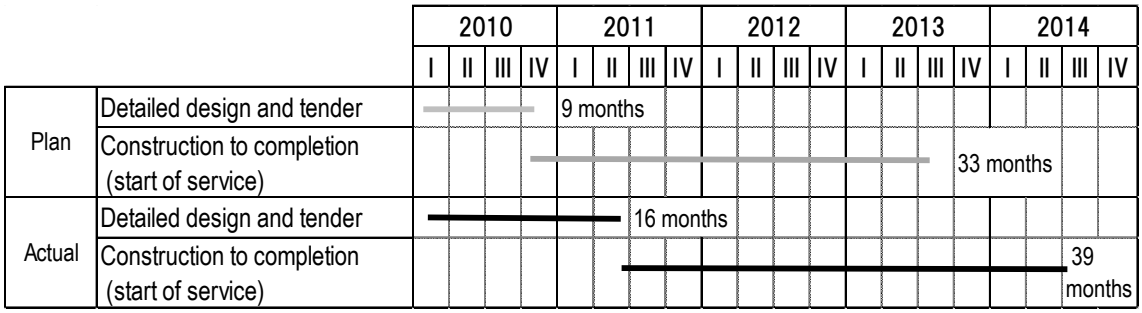
Item	Planned	Actual
[Japanese Portion]		
Detailed design	76	75
Facilities, etc.	2,753	2,330
Implementation design and construction supervision		146
Subtotal	**2,829**	**2,551**
[Nicaragua Portion]		
Bank charges	2.9	0.1
Site acquisition cost	2.9	0
Land rental cost	0.1	0.6
Subtotal	**5.9**	**0.7**
Total	**2,835**	**2,552**

Source: The planned cost of the Japanese portion is the amount stated in the E/N. The planned cost of the Nicaragua portion and the actual cost of the Japanese portion are based on materials provided by JICA. The actual cost of the Nicaragua portion was provided by the executing agency.
Exchange rates: (At the time of planning): February 2009 / 1US$ = 100.42yen / Cordoba exchange rate: 1US$ = 19.68 Cordoba (in both cases the average value over the past 6 months from January 31, 2009).

The Project cost of the Japanese portion was less than the planned amount as a result of the competitive tender. The works amount increased as a result of design changes, however, since some of the changes were based on the contractor's proposal, the contractor bore the additional cost and there was no major increase in the Project cost. Concerning the Project cost of the Nicaragua portion, mainly because the two companies that owned the land offered the land free of charge, no land acquisition costs arose among other reasons, the Project cost was less than the planned amount.

3.2.2.2 Project period[10]

The Project was scheduled to last from February 2010 to July 2013 (3 years 6 months, 42 months), however, in reality, it lasted longer than planned, from February 2010 to August 2014 (4 years 7 months, 55 months, 131% compared to the planned period). The main reasons for the delay were that in the process between the outline design, detailed design and construction, design changes to improve construction efficiency, omissions, checking procedures of the design and estimation arose, all of which resulted in more time required in the design estimation examination (Project period increased approximately by seven months); and also that it took four months between the completion of works in April 2014 to the starting of service due to a delay in the complete opening of the San Pancho-Las Tablillas border, which had been scheduled by Nicaragua and Costa Rica for May 2014[11].



Source: Based on materials provided by JICA and interviews to the executing agency and the consultant.

Figure 2 Project Period: Plan and Actual

Summing up, although the project cost was within the plan, the project period exceeded the plan. Therefore, efficiency of the project is fair.

3.3 Effectiveness and Impacts[12] (Rating: ②)

The objective of the Project is to "guarantee the safe and smooth flow of traffic crossing San Juan River", while its impacts are intended to be the "vitalization of the international flow of goods; revitalization of the local economy, and improvement of the living standard of local residents".

The former part is analyzed in 3.3.1 Effectiveness and the latter part is analyzed in 3.3.2 Impacts.

[10] The start of the Project was assumed to be the detailed design, which provides a clear start point both for the planned and the actual work, while the Project completion was assumed to be the start of service on the bridge.

[11] The Government of Nicaragua advanced work on the border facilities according to schedule, however, facilities on the Costa Rica side were delayed, leading to a request by the Government of Costa Rica to delay the border opening until the second half of 2014, and the Government of Nicaragua consented to this. It must be noted that during the period following the completion of works until the starting of services, the bridge was not in use. Moreover, the Government of Costa Rica only constructed the minimum necessary facilities for opening the border, and its work on subsequent improvements has continued to be slower compared to those of Nicaragua.

[12] Impacts are also taken into consideration when determining the effectiveness rating.

3.3.1 Effectiveness

3.3.1.1 Quantitative Effects (Operation and Effectiveness Indicators)

At the time of planning, the following were indicators were adopted as indicators for the "safe and smooth flow of traffic crossing San Juan River": (1) Weight capacity on the bridge (total weight of vehicles), (2) Traffic volume, and (3) River crossing time. In the ex-post evaluation, based on other effects that were examined at the time of planning, the following five auxiliary indicators related to the Project objective were added and analysis was attempted from multiple directions: (4) Average time required for persons to cross San Juan River on foot (minutes/person), (5) Average number of hours during which it is possible to cross the San Juan River using the bridge (hours/day) , (6) Average travel speed on the bridge (km/h), (7) Number of times when traffic on the bridge is stopped (times/year), (8) Number of accidents on the bridge (cases/year). Table 2 shows the reference values, target values, and actual values for each indicator.

Table 2 Effectiveness: Planned and Actual Operation and Effectiveness Indicators

Indicator	Reference Value (2009)	Target value 2014 (1 year following completion)	Actual	
			2015 (1 year following completion)	
[Main indicators]				Degree of achievement
(1) Weight capacity of the bridge (maximum value, tons)	1.4	Design load: 40.8	Design load: 40.8	100%
(2) Traffic volume*1, 2 (Annual average daily traffic volume: vehicles/day)	480	825 (Target value at 1 year following completion)	2015: 414 2016: 443 2017: 745 2018: 750	50% (1 year following completion)
(3) Time required for vehicles to cross San Juan River*1 (minutes)	Minimum 15 minutes by ferry	15 seconds by car	16.3 seconds by car	92%
[Auxiliary indicators]				
(4) Average time required for pedestrians to cross San Juan River (minutes/person) *1	Minimum 15 minutes by ferry	10 minutes on foot	Maximum 10 minutes on foot	100%
(5) Hours during which it is possible to cross the San Juan River using the bridge (hours/day)	10 hours (from 08:00 to18:00)	24 hours	2015: 10 hours 2017: 12 hours	42% (1 year following completion)
(6) Average travel speed on the bridge* (km/h)	—	60-80km/h	2017: 63km/h	100%
(7) Number of times when traffic on the bridge is stopped (times/year)	—	Zero	Zero	Achieved
(8) Number of accidents on the bridge (cases/year)	—	Zero	Zero	Achieved

Source: Main indicators are from the ex-ante evaluation sheet and the Project's Preparatory Study Report. Concerning Auxiliary indicators (4) to (7), items stated in the Preparatory Survey Report as the Project effects were added. Indicator (8) was added by the evaluator.

*1: In the ex-ante evaluation sheet, "(2) Traffic volume" is stated as the "Increase in the passable traffic volume", however, because this is the traffic volume based on the traffic volume survey implemented at the time of the Preparatory Survey, the name of the indicator was changed to "Traffic volume". Similarly, "(3) River crossing time"

was stated as “reduction in required time”, however, “Time required for vehicles to cross San Juan River” was adopted to indicate that it refers to the time required for crossing the river.
*2: The target traffic volume of 825 vehicles/day is the target value at one year following completion of the Project based on the traffic volume forecast at the time of planning. The actual values for 2015 to 2017 are based on measurements made by the executing agency, and the actual value for 2018 is based on the traffic volume survey implemented in the ex-post evaluation study (February 22 to 24, 2018, 12 hours per day on weekdays and weekends) converted to the annual average daily traffic volume (AADT).

(1) Increase in the weight capacity on the bridge (tons)

The target value of 40.8 tons is the design load for this bridge. Since the actual value was as designed, the degree of achievement is 100%. According to MTI, the monthly average weight of trucks being weighted at the Lovago weighing station which is the closest to the Project, was 29.8 tons/month in 2017. However, cases where the design load was exceeded have also been observed[13]; hence it will be necessary to ensure strict observance of the design load from the viewpoints of maintaining the service life of the bridge and preventing accidents.

(2) Traffic volume

Compared to the target value one year following completion of the Project of 825 vehicles/day, the actual average daily traffic volume in 2015 was 414 vehicles, meaning that the degree of achievement was only 50%.

The target value was a projection of the future traffic volume one year following completion of the Project based on the assumption that the San Pancho-Las Tablillas border facilities would be completed on both the Nicaragua and Costa Rica sides, making it possible for all vehicles, cargoes and people to pass 24 hours a day at the moment of Project completion. The breakdown of this traffic was as follows: (1) increase in existing traffic volume (Frutales de San Juan-related vehicles (cargoes), immigrant taxis (private)), (2) developed traffic volume (traffic induced by the road construction between Acoyapa-San Carlos-Costa Rica border and construction of Santa Fe Bridge: mainly international and domestic cargoes of farm produce), (3) diverted traffic volume (traffic volume switching from waterborne border traffic: individual persons using taxis), and switching traffic volume (international, freight and buses) from Peñas Blancas border (Pacific Corridor), and (4) induced traffic volume (inbound tourists travelling overland from Costa Rica: individual persons using minibuses).


Truck transporting wood

However, because the border facilities on the Costa Rica side in 2016 were limited to

[13] Although the frequency in which it occurs is not clear, during the traffic volume survey conducted in this ex-post evaluation, a succession of 24-ton trailers crossing the bridge was observed.

immigration, customs and police, only one type of farm product (oranges), which was permitted since before the Project, and individuals were permitted to pass the San Pancho-Las Tablillas border. From December 2016, customs clearance and quarantine were permitted for three farm products, i.e. timber, pineapples, and bananas on the Costa Rica side, enabling these products to cross the border and leading to increased traffic volume in 2017 and 2018, however, apart from these products, other freight vehicles are not allowed to cross the border. Moreover, even though individual passenger cars are allowed to cross the border, passenger buses are not. Because of that, passengers travelling on passenger buses have to change to taxis and minibuses at the San Carlos bus terminal before heading to the border. As for passengers, those with Nicaraguan nationality require a visa to enter Costa Rica, however, passengers of Costa Rican nationality are not required to have a visa to enter Nicaragua, and the gentle increase in inbound tourists to Nicaragua is thought to be contributing a little to the increase in traffic volume. From the above, the traffic volume is slowly increasing and, according to the traffic volume survey conducted in the ex-post evaluation study, the annual average daily traffic volume in 2018 was 750 vehicles/day (195 trucks, 555 passenger cars and motorbikes)[14].

(3) Time required for vehicles to cross San Juan River

Before the Project, it took at least 15 minutes to cross San Juan River using a ferry. According to MTI data, time required for vehicles to cross San Juan River has been reduced to 16.3 seconds thanks to the Project. Since the planned target was 15 seconds, the degree of achievement is 92% (15 seconds divided by16.3 seconds), indicating that the target has been more or less achieved.

(4) Average time required for pedestrians to cross San Juan River (minutes/person)

Before the Project, whereas it took at least 15 minutes to cross San Juan River using a ferry, it became possible to cross the river on foot thanks to the Project. According to MTI data, compared to the target value of 10 minutes, the maximum crossing time is 10 minutes, indicating that the target has been achieved. However, not many local residents walk across Santa Fe Bridge on an everyday basis, and pedestrians are limited to local residents simply walking for recreation purposes[15].

(5) Hours during which it is possible to cross the San Juan River

[14] In the preparatory study, no planned values that can be used for comparison against the actual value at the time of ex-post evaluation (2018) were calculated, however, upon using the rates of increase used in the traffic volume projection in the said study (7.8% per year for freight traffic, 10 to 20% per year for passenger traffic) to make an estimate, the traffic volume in 2018 (planned value) is 691 vehicles/day for freight (assuming a rate of increase of 8%) and 554 vehicles/day for passengers (assuming a rate of increase of 15%), giving a total of 1245 vehicles/day. In comparison, the actual passenger traffic was almost as projected, however, the freight transport was only 28% while the overall traffic volume was 750 vehicles/day or 60% of the forecast.

[15] Based on the interviews conducted to Nicaragua's border police and military, the Mayor of San Carlos, the Ministry of Tourism San Carlos Office, taxi associations, and local residents. Also, the executing agency does not collect information regarding pedestrians, however, according to the traffic volume survey conducted at the time of ex-post evaluation, there were only 22 common pedestrians per day on weekdays and 6 per day on weekends.

Before the Project, it was only possible to cross San Juan River between 08:00 in the morning and18:00 in the evening, 10 hours a day, when the small boats and pontoon ferries (flat bottom boats) were operating. At the time of ex-post evaluation, the hours in which it is possible to cross de river is a total of 12 hours between 05:00 in the morning and17:00 in the evening in line with the work hours of the San Pancho-Las Tablillas border facilities[16]. The hours in which the bridge, which is inside Nicaragua, can be used is not supposed to be limited by the operating time of border facilities, however, with the main purposes of controlling illegal immigration between Nicaragua and Costa Rica and security control, the Government of Nicaragua limits river crossing to the operating time of border facilities[17].

(6) Average travel speed

Since the maximum speed limit in Nicaragua is 80 km/h, the design speed target value was set at 60-80 km/h. Since a checkpoint was established immediately after crossing the bridge in the direction toward the border, at the time of ex-post evaluation, it is necessary for vehicles to slow down on the bridge. Because of this among other factors, according to MTI data, the actual average speed is 63 km/h, which is within the target range[18].

(7) Number of times when traffic on the bridge is stopped

According to interviews to residents, before the Project was implemented, ferry services were sometimes suspended, and traffic was stopped when the river became flooded and so on. Following the Project, traffic has not been stopped; hence, the target has been achieved.

(8) Absolute number of traffic accidents per year

The target value was zero and the actual value is also zero; hence, the target has been achieved. A major factor in this is the checkpoint close to the Santa Fe Bridge, which has encouraged drivers and pedestrians to generally follow traffic rules[19]. Incidentally, as indicated above, crossing of San Juan River has been suspended due to flooding in the past, but there have been no reports of fatal accidents.

Summing up the above points, out of the three main indicators, traffic volume one year following

[16] "Hours during which it is possible to cross the San Juan River" refers to the hours in which the users (beneficiaries) can actually use the road. Although it is possible to physically cross the river 24 hours a day thanks to the Project, at the time of the ex-post Evaluation it is limited to 12 hours. Incidentally, the Peñas Blancas border also operates for 18 hours a day from 06:00 in the morning to 12:00 at night.

[17] Based on interviews to police and military personnel at the San Pancho border facilities on the Nicaragua side. At the time of ex-post evaluation, the checkpoint was installed at the end of the access road after crossing the bridge in the direction towards the border, and the police was stationed during open hours and the military the rest of the times. In addition, through to the group interviews conducted to local residents in this ex-post Evaluation, it became clear that in the future, "enabling 24-hour use of the bridge" was the most desired improvement area (details on the group interviews to local residents please refer to footnote 25)

[18] However, because a maximum speed of 86 km/h was recorded in 2017 according to MTI, it is desirable to strengthen speed control in order to prevent accidents.

[19] However, as was mentioned previously, since there have been cases of speeding and overloading by vehicles crossing the bridge, there are risks related to traffic safety.

completion of the Project was only around half of the target value. The main factor behind this was that the San Pancho-Las Tablillas border was not fully opened, making it difficult for the traffic to switch from the Peñas Blancas border. Meanwhile, the targets regarding increase in maximum weight capacity on the bridge and river crossing time have been achieved.

3.3.1.2 Qualitative Effects (Other Effects)

At the time of planning, it was envisaged that "completing the Atlantic Corridor that has the function of augmenting and providing an alternative to the Pacific Corridor would boost freight vehicle traffic volume and freight transportation quantities over the international transportation corridor connecting the three countries of Honduras-Nicaragua-Costa Rica, and contribute towards maintaining and developing the flow of goods and economic relations between not just the said three countries, but all Central American countries". In addition, it was envisaged that, "full opening of the Acoyapa Highway together with the Project would lead to the securing of a stable passenger and freight transportation route throughout the year, thereby boosting the economy in roadside areas and vitalizing social and economic activities in Nicaragua". All these points were analyzed as the Project impacts.

3.3.2 Impacts

3.3.2.1 Intended Impacts

The Project impacts are "the vitalization of the international flow of goods; local economic growth and improvement in the living standard of local residents". These are analyzed from the three aspects described below.

(1) Vitalization of the international flow of goods

At the time of planning, completing the Atlantic Corridor that has the function of augmenting and providing an alternative to the Pacific Corridor[20] would boost freight vehicle traffic volume and freight transportation quantities over the international transportation corridor connecting the three countries of Honduras-Nicaragua-Costa Rica.

[20] As indicated in "Effectiveness", to augment and provide an alternative to the Pacific Corridor, specifically was supposed to be the diverted freight and passenger traffic from the Peñas Blancas border. As for the diverted freight traffic, it was thought that the majority of the freight that goes from Peñas Blancas to Limon Port was going to be diverted to the San Pancho-Las Tablillas border. As for the passenger traffic it was thought that private cars and passenger buses from Peñas Blancas would be diverted. In addition, the traffic volume (mostly agricultural production freight) induced thanks to the construction of the Acoyapa Highway which includes the Project was also included (based on the Preparatory Survey Report). The targets of these to be achieved one year after project completion were set under "Effectiveness", however, there were no specific targets set for impact, their upward trends since project completion was taken as an evaluation criterion.

According to MTI data, the annual average daily traffic volume on the Acoyapa Highway increased by approximately 60% from 4,438 vehicles/day in 2013, to 7,063 vehicles/day in 2015 (Table 3). Although it has been flat since then, the annual average daily traffic volume of the San Carlos San Pancho-Las Tablillas section of the Acoyapa Highway which includes the Project, has increased by approximately 30% from 2,655 vehicles/day in 2015 to 3,443 vehicles/day in 2017. Meanwhile, the quantity of freight passing through the San Pancho-Las Tablillas border increased greatly from 3,746 tons in 2015 to 65,053 tons in 2017. The freight is mostly limited to four commodities: oranges, timber, pineapples and bananas, which are shipped from the area nearby the San Pancho-Las Tablillas border on the Acoyapa Highway. In addition, as is shown in Table 3, almost all the trade that used the San Pancho-Las Tablillas border in 2017 were exports from Nicaragua to Costa Rica, and no freight passing through this border intended for export through Limon Port could be seen.

Tractor heads (without containers) from Limon Port waiting in line in the Santa Fe Bridge checkpoint

Table 3 Impact (1): Increase in Freight Vehicles and Freight Transportation Quantity on the Atlantic Corridor

	2015	2016	2017
Acoyapa Highway Annual Average Daily Traffic (vehicles/day)	7,063	No	7,058
Out of the above, San Carlos - San Pancho-Las Tablillas border (vehicles/day)*	2,655	information	3,443
Atlantic Corridor:			
Transported cargoes through San Pancho-Las Tablillas border (tons/year)	3,746	64,483	90,851
Out of the above, exports from Nicaragua to Costa Rica (tons/year)	2,060	63,193	87,217
imports from Costa Rica to Nicaragua (tons/year)	1,686	1,290	3,634
Pacific Corridor:			
Total transported cargoes through Peñas Blancas border (tons/year)	968,686	925,732	961,799
Out of the above, cargo from Peñas Blancas border to Limon Port (tons/year) *	131,759	70,682	92,640

Source: MTI, Nicaragua Immigration Bureau and Customs

*: Quantity of freight transportation that is forecasted to immediately switch to the Atlantic Corridor in case San Pancho-Las Tablillas is fully opened.

According to the traffic survey conducted at the time of ex-post evaluation[21], 26% of the traffic

[21] The traffic survey was implemented from February 22 to 24 (Thursday, Friday, Saturday) 2018, and it entailed measuring traffic volume for 12 hours per day, conducting an origin-destination survey, and implementing a survey of driver awareness. In the origin-destination survey and driver awareness survey, 112 persons, selected randomly choosing vehicles crossing the bridge, were surveyed (98% male, 2% female, 81% in the 30s-50s age group, 19% aged 60 or over). Traffic going from Nicaragua to Costa Rica accounted for 66% of traffic volume. 73% of drivers said they had never crossed San Juan River before the Project, from which 26% said they had previously used the Pacific Corridor.

using the Project bridge comprised freight vehicles, and trucks heading for Costa Rica mainly carried oranges and timber, however, most of the trucks entering Nicaragua were empty, especially the trailers did not have containers loaded, or were moving empty containers. It was expected that the Atlantic Corridor would help realize an increase in trade between Nicaragua and the United States and Europe via Limon Port, however, at the time of ex-post evaluation, it was found that there were no vehicles going to Limon Port from Nicaragua and all the freight passing over the Project bridge was intended for processing as raw materials inside Costa Rica. In addition, some vehicles (mainly trucks and trailers) originating out of Limon Port were observed entering Nicaragua, however, such vehicles enter Costa Rica from the Peñas Blancas border on the Pacific Corridor, unload at Limon Port, and return home with no cargo via the San Pancho-Las Tablillas border, where waiting time is shorter. Accordingly, at the time of ex-post evaluation, although the Atlantic Corridor including the Project bridge contributes to the bilateral trade of limited commodities with Costa Rica, its role in supplementing the Pacific Corridor is limited.

According to interviews to logistics operators[22], respondents said that, when exporting from areas along the Acoyapa Highway either to Costa Rica, or to Europe or the United States of America via Limon Port , if the number of commodities handled at the San Pancho-Las Tablillas border were increased and it became possible to freely use that border, it would be possible to conduct transportation more efficiently via the Atlantic Corridor, which offers better roads and bridges, cheaper transportation costs and shorter travel times, compared to using the Pacific Corridor which entails longer border passing time, longer distances and travel over badly deteriorated roads[23]. Also, according to interviews to Nicaragua customs, the immigration bureau and MTI, when the San Pancho-Las Tablillas border is fully opened, there is a forecast that approximately 40% of freight from Nicaragua that currently utilizes the Peñas Blancas border on the Pacific Corridor will switch to the San Pancho-Las Tablillas border. Meanwhile, international

[22] In the ex-post evaluation study, interviews were conducted to 10 companies introduced by the Nicaragua Logistics Association. These comprise three companies that use the Santa Fe Bridge, and seven that do not. The three companies that use the Project bridge export oranges and timber from areas around the bridge to Costa Rica, saying that it is better to use the San Pancho-Las Tablillas border in terms of travel time and transportation cost, and that they intend to continue increasing freight volume. The companies that do not use the bridge use the Pacific Corridor to export goods to Costa Rica and American and European markets because they currently cannot pass through the San Pancho-Las Tablillas border. However, if conditions are relaxed, and it becomes possible to freely use the San Pancho-Las Tablillas border, they would be able to save fuel by approximately 15-20%, a total cost savings of approximately 25-30%, and reduce average travel time (currently one-week roundtrip) by roughly three days, so they wish to use the Atlantic Corridor. They cited sugar, palm oil, fruits, cereals, among others as possible goods for switching to the San Pancho-Las Tablillas border.

[23] According to the Nicaragua Customs Department, the total number of freight vehicles using the Peñas Blancas border in 2017 was 200,000 vehicles, of which 3,882 vehicles (2%) either started or finished their journeys at Limon Port in Costa Rica. According to an interview to Peñas Blancas customs, it takes 6 to 12 hours to pass through the border, and travel time to Limon Port is approximately 3 hours longer compared to passing through the San Pancho-Las Tablillas border. If the San Pancho-Las Tablillas border is fully opened, there is a high possibility that such vehicles will switch to the Atlantic Corridor.

passenger transport operators[24] said that, unless passage of large buses into Costa Rica is permitted and tourism is developed in San Juan Department, there is little merit in using the Acoyapa Highway.

Summing up, at the time of ex-post evaluation, although the Atlantic Corridor has been completed due to the implementation of the Project, it has not been able to completely augment and provide an alternative to the Pacific Corridor as intended at the time of planning due to the limited operation of the San Pancho-Las Tablillas border among other factors; hence the Project's impact in terms of vitalizing the international flow of goods has been limited. However, since logistics operators hold high expectations with respect to the Atlantic Corridor, if the San Pancho-Las Tablillas border is fully opened, it is possible that the freight traffic volume will increase and the originally intended impacts will be realized.

(2) Boosting of the economy in roadside areas

The mayor of San Carlos, the city located closest to the Project site, says that promotion of the local economy due to Acoyapa Highway including the Project is currently limited because the border has not yet been fully opened, however, he anticipates economic growth when it does so. At the time of ex-post evaluation, the services sector (hotels, restaurants, taxi services) is growing relatively quickly in this city. According to the city's hotel and restaurant association and taxi cooperative, more and more hotels for truck drivers are being opened close to the San Carlos municipal bus terminal and alongside Acoyapa Highway. According to data from the San Carlos branch office of the Ministry of Tourism, the number of accommodation facilities has increased from 77 in 2014, when the Project was completed, to 91 in 2017, while the number of restaurants has increased from 68 to 95 over the same period.

A truck picking up
Frutales de San Juan workers

Summing up, impacts on the economic promotion thanks to the development of Acoyapa Highway have been confirmed only in limited sectors, however, it is thought that these will further increase when the border is opened and traffic volume increases.

[24] In the ex-post evaluation study, interviews were conducted to seven Nicaraguan international passenger bus companies that offer services covering from Panama to Mexico. The companies operate an average of 38 vehicles/day. On average approximately 18,300 people use such buses to travel within the Central America region every month. At the time of ex-post evaluation, passenger buses are not permitted to pass through the San Pancho-Las Tablillas border. On ascertaining the feasibility of conducting business via the Atlantic Corridor to Costa Rica from now on, when the main destination of the international passenger buses is Costa Rica, since most of their final destination is the capital city of San Jose, there is little merit in switching from the Pacific Corridor to the Atlantic Corridor. However, if tourism develops in areas along the Atlantic Corridor from now on, the companies said that they would also consider an Atlantic route connecting to Costa Rica using the Atlantic Corridor.

(3) Improvement in the living standard of residents living in the nearby area of Sant Fe Bridge

According to residents who live in the area around Santa Fe Bridge[25], for workers of Frutales de San Juan, who use the bridge every day (workers who cross San Juan River on company buses and work in plantations in the border region), impacts of the Project are shorter hours, greater convenience and greater safety. For other local residents, since they do not frequently use the bridge, there are no major impacts that could be generalized, however, their satisfaction level was high in terms of shorter travel time, lower cost, and greater convenience and safety whenever they do use the bridge[26].

3.3.2.2 Other Positive and Negative Impacts

(1) Impacts on the natural environment

The Environmental Impact Assessment (EIA) for the Project was approved on October 26, 2007 by the Ministry of the Environment and Natural Resources San Carlos Branch. However, because there was a delay in the starting of the Project, when the condition was to start the Project within 18 months from the above approval date, the EIA was approved again on November 3, 2011. In the Project's environmental management plan and monitoring plan an environmental management plan which included measures to address construction waste, noise, vibration, water pollution and air pollution, as well as afforestation was formulated, which were implemented as planned. In addition, the status of implementation was reported on a monthly basis and an appropriate monitoring was conducted. Interviews to local residents, to Frutales de San Juan, and Santa Fe de Melchora also confirmed that the Project had not caused any major impacts on the environment.

(2) Resettlement and land acquisition

In the Project, land had to be acquired for the access roads, however, there was no need to resettle residents. The land in question was owned by two private companies, however, in both cases, the land was donated smoothly to the state free of charge following consultations between the executing agency and landowners based on the corresponding law.

(3) Other impacts:

A number of post-tensioned T-girder bridge frames and hydraulic jacks used in the Project works were donated to MTI and COERCO, and these are used in bridge construction and repair works

[25] Group interview was conducted with 45 residents (24 women and 21 men) of five communities (La Melchorita, La Argentina, Laureles, Los Chiles, and La Azucena) in the vicinity of the Project.

[26] There are a lot of families with members living on both sides of the border between Nicaragua and Costa Rica (90% of the residents who participated in the group interviews said they have family or relatives living in Costa Rica). Although they do not use the bridge frequently, many of them said that, previously, it was necessary to use boats and travel over difficult routes, but now it is possible to safely cross the river and due to a shortened travel time, it is possible to travel back and forth in the same day.

at the time of ex-post evaluation. Moreover, some engineers who belong to the executing agency voiced their opinion that they acquired a lot of new knowledge by frequently listening to explanations on construction methods by the Japanese contractor and consultant when they visited the Project works site.

Summing up the above, the Project has resulted in greater weight capacity on the bridge and shorter river crossing time as planned. However, due to the slow development of facilities on the Costa Rica side and failure to fully open the San Pancho-Las Tablillas border, the traffic volume is less than planned, and the role of the Project as an international arterial road supplementing the Pacific Corridor has been limited. Accordingly, contributions in terms of vitalizing the international flow of goods; local economic growth and improving the living standard of local residents have not been that large. This project has achieved its objectives to some extent. Therefore, effectiveness and impacts of the project are fair.

3.4 Sustainability (Rating: ③)

3.4.1 Institutional Aspects of Operation and Maintenance

Periodic maintenance work for the Project is implemented by contractors outsourced by FOMAV under the supervision of MTI. Large-scale repairs and emergency measures in response to natural disasters and so on are implemented by COERCO, which is a state-owned company controlled by MTI.

The Road Maintenance Unit of the MTI Road Department has 284 employees (at the time of ex-post evaluation), and four members are in charge of maintenance planning and monitoring of the Project. The responsible employees of the Road Maintenance Unit check the monthly reports submitted by FOMAV and conduct on-site visual checks and monitoring every three months.

Based on an annual agreement signed with MTI, FOMAV implements routine inspections and periodic maintenance work (early repair of sidewalks, cleaning of side ditches, repair of paving, transfer and installation of road and traffic signs and bus stops, among others) of roads and bridges in relatively good state, classified as being in either “good” or “ordinary” condition, by outsourcing these tasks to micro-enterprises. FOMAV has approximately 54 employees, 12 of whom place orders for maintenance work related to the Project and conduct supervision and monitoring of these micro-enterprises. FOMAV consigns monitoring of the status of maintenance of roads divided into sections and subcontracted to micro-enterprises to private consultants. FOMAV also directly conducts monitoring as well.

At the time of ex-post evaluation, maintenance of the road section that includes the Santa Fe Bridge is consigned to “Las Tablillas Micro-Enterprise”. This company has 18 employees in total and conducts periodic maintenance work. Judging from the state of maintenance in site inspections and interviews to employees of the contractor at the time of ex-post evaluation, the

contractor was confirmed to have an adequate organization for conducting maintenance work. Since the road and bridge maintained by the micro-enterprise also happens to be the local road and bridge of the area where the company's employees live, it is possible to say that they have a relatively high sense of ownership.

COERCO has four business offices, i one per each region of the country. It has approximately 1,200 employees and approximately 300 units of maintenance equipment. The Managua Department Southeast Office, which has jurisdiction over the Project, has approximately 400 employees, of whom one engineer and nine workers are directly involved with the Project.

Based on the above, it was confirmed that with respect to the maintenance structure of the Project, the organization, command lines, division of roles, etc. of the three entities, that is the MTI, the state-owned company under MTI's control COERCO, and the independent administrative corporation FOMAV, are clearly specified, and a comprehensive structure that secures the implementation of maintenance is in place. Thus, no issues in particular are observed regarding the institutional aspects of Project operation and maintenance.

3.4.2 Technical Aspects of Operation and Maintenance

The personnel of MTI, FOMAV and COERCO in charge of maintaining this bridge are all engineers who have graduated university or postgraduate school, and they all have long work experience. Since appropriate maintenance work is conducted and the facilities are in good condition (as described later), these entities are deemed to possess appropriate technical competence. Supervisors in the micro-enterprises subcontracted by FOMAV are either university, high school or technical college graduates, which are appropriate education levels for supervising cleaning, weeding and inspection. As with the majority of government agencies in Nicaragua, MTI does not have a systematic and formal human resources development scheme, however, isolated training programs are implemented irregularly based on donor contributions as well as its own budget[27].

Cleaning work done in the side ditches by FOMAV

MTI hopes to boost its technology as well as its materials and equipment for conducting the maintenance work that needs to be done over the coming five and 10 years, however, according to the Japanese consultant of the Project[28], the maintenance required in the medium to long term

[27] Examples of training implemented in 2017 are as follows: "Bridge design, construction, and maintenance", "Responding to climate change and reducing risks (postgraduate)", "Measures for strengthening infrastructure in order to reduce vulnerability of road networks to climate change (masters)". These programs last from 8 to 16 months; lectures are conducted twice a week; and participants are selected from MTI, FOMAV, and COERCO.

[28] As part of the ex-post evaluation study, interviews were conducted to the Japanese consultant. The said consultant also implemented JICA's "Information collection and confirmation study on the introduction of high-quality

can fully be conducted with the materials and equipment that COERCO has, and the technical level of the human resources that currently belong to COERCO. In sum, no issues in particular are observed regarding sustainability in terms of technical aspects.

3.4.3 Financial Aspects of Operation and Maintenance

FOMAV, which mainly obtains funds from the fuel tax (0.16US$/gallon, as of 2018) that is imposed on gasoline and light oil, has operated in the black for the past three years (Table 4). Maintenance costs of the Project are approximately 0.4 million Cordoba and considering that this represents less than or equal to 0.1% of FOMAV's total revenue in 2016, with respect to the Project, there are no concerns regarding the financial capacity of FOMAV.

Table 4 FOMAV Revenue and Expenditure Balance

(Unit: million Cordoba)

		2014	2015	2016
Revenue	Fuel tax	1,028	1,207	1,211
	IDB, World Bank	18	26	25
	Other	221	170	213
	Subtotal	1,267	1,403	1,449
Expenditure	Administration and personnel	18	12	13
	Clerical and finance department	16	15	13
	Procurement department	4	3	3
	Technical department (maintenance)	19	17	17
	Subtotal	57	47	46
Operating profit		1,210	1,356	1,403
Other expenditure and project expenses		962	1,189	773
Profit		246	167	630

Source: MTI, FOMAV. 2016 values are up to November.

Meanwhile, COERCO receives an annual budget from MTI based on each fiscal year's road and bridge maintenance plan, so there are no major financial issues. MTI's budget increased from 3,883 million Cordoba in 2014 to 6,023 million Cordoba in 2016. Its large-scale maintenance budget decreased from approximately 350 million Cordoba in 2014 to approximately 180 million Cordoba in 2016, however, no major limitations are expected to arise because the need for large-scale repair works is receding as the nationwide road network (including bridges) expands and there is also a system for MTI to make special budget requests to the Ministry of Finance in emergencies.

From the above, it can be said that there are no issues in particular regarding the financial aspects of Project operation and maintenance.

3.4.4 Current Status of Operation and Maintenance

infrastructure in Central America (2017)" after the Project, in which it obtained new information concerning MTI's technical, materials and equipment capacity.

At the time of planning, it was envisaged that bridge maintenance would comprise: “inspection and maintenance required every year”, “maintenance implemented over multiple years”, and “emergency inspections at times of flooding. Judging from the maintenance records (monthly reports) submitted by FOMAV to MTI, site inspections, and interviews to employees of Las Tablillas Micro-Enterprise, it has been confirmed that “inspection and maintenance required every year” continues to be implemented every week following the Project completion up to the time of ex-post evaluation. Concerning maintenance implemented over multiple years, based on the road and bridge assessment implemented by MTI every year, it is scheduled to decide the work contents as required and incorporate such contents into COERCO’s maintenance plans for implementation. Concerning emergency inspections at times of flooding, none have been implemented between Project completion and the time of ex-post evaluation because there have been no natural disasters including floods, however, it was confirmed that organization and procedures for responding to emergencies are in place.

Access road and the Bridge

Checking the status of maintenance of the Project through site inspections, also because it is still only three years since completion, no problems that require emergency measures were observed, and maintenance status is good (Table5).

Table 5 Santa Fe Bridge Status of Maintenance

Item	Time of Ex-post Evaluation
Bridge superstructure	There are no major deformations, etc. in the main structural components such as main girders, floor slabs, and cross girders. All sections of the bridge remain in the good condition as when it was completed.
Bridge surface	No problems have arisen in the bridge surface paving, expansion devices, drainage facilities, among others, and they are in good condition. A number of cracks can be seen in the sidewalks on both left and right sides, however, since the sidewalks do not contain reinforcing bars, there is no risk of corrosion even if water infiltrates from the cracks, and there is no need for any particular measures.
Bridge substructure	No particular problems are observed over the scope that can be checked visually.
Access roads	There are some graffities on the guard rails, however, the asphalt paving, banking slopes, and drainage facilities are in good condition.
Revetment	There are no deformations and damages. No problems were observed.
Gate signposts on abutments	There has been no theft, vandalism or breakage, and they are in good condition.
Other	Since there are no lights on the bridge and the roads before and after the bridge, it is necessary to secure safety especially at night and early morning (installation of lights or lane lights, etc.)

Source: The status of maintenance was visually confirmed. Parts of the explanations are based on materials provided by JICA and interviews conducted to the Project consultant.

In addition, in the Project defect inspection report, it was indicated that, to ensure the effective utilization of the Project, there is a need to construct a heated asphalt mixture manufacturing plant in the local area in readiness for future repairs, overlaying, re-laying, etc. of the asphalt paving on roads leading up to the bridge[29], however, no such plant has been constructed yet.

From the above, no major problems have been observed in the institutional, technical, financial aspects and current status of the operation and maintenance system. Therefore, sustainability of the project effects is high.

4 Conclusions, Recommendations and Lessons Learned

4.1 Conclusions

The Project for Construction of the Santa Fe Bridge in the Republic of Nicaragua (hereinafter referred to as "the Project") was implemented to construct the Santa Fe Bridge in Nicaragua's Rio San Juan Department over San Juan River which runs along the border between Nicaragua and Costa Rica, in order to guarantee the safe and smooth flow of traffic crossing San Juan River, thereby contributing to the vitalization of the international flow of goods, the local economic growth, and the improvement of the living standard of local residents. The Project was sufficiently consistent with the national development plan, transportation sector policies, development needs of Nicaragua at both the time of planning and the time of ex-post evaluation, as well as Japan's ODA policy at the time of planning. However, even though the Project consisted in the construction of a bridge with the functions of an actual international bridge, the external conditions concerning border opening with Costa Rica were not adequately analyzed at the time of planning. Thus, the relevance of the Project is fair. The Project outputs were generally as planned, and the Project cost was lower than planned, however, because the Project period was longer than planned due to time spent on making design changes and opening the border, the efficiency of the Project is fair. As a result of the Project, targets regarding increase of weight capacity of passing vehicles and reduction of river crossing time were achieved; furthermore, it is recognized that there has been a certain impact in terms of local economic growth and improvement of the living standard of local residents. However, because border facilities on the Costa Rica side are still not complete, the increase in traffic volume, the main indicator of the Project, has not achieved the target; and international cargoes utilizing the Project have been limited, hence vitalization of the international flow of goods has not been realized sufficiently. Therefore, the effectiveness and impacts of the Project are fair. The organizational, technical, financial aspects and current status of the operation and maintenance of MTI, FOMAV, and COERCO, which are responsible for the operation and

[29] In the defect inspection report, it was recommended that an asphalt plant be newly constructed immediately, because of the large transport distance and time from the existing plant, which results in a decline in the temperature of the heated asphalt mixture while being carried to the worksite.

maintenance of the Project, are generally satisfactory, hence, the sustainability of the Project is high.

In light of the above, this Project is evaluated as partially satisfactory.

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

(1) Thorough implementation of routine maintenance: If routine inspection can be thoroughly implemented, excluding times of flooding and other natural disasters, it is possible to keep the medium-term and long-term maintenance to a minimum. In the Project, it is necessary to frequently implement routine inspections that include removing sand and debris accumulated in the drainage such as pipes, intercepting drains and side ditches, among others, and removing grass and weeds from road shoulders and slopes, and so on. Therefore, it will be important for FOMAV to continue implementing thoroughly such routine inspections, and for MTI to conduct periodical monitoring. The executing agency expressed concerns about detailed methods, equipment and materials concerning the maintenance required over the coming five and 10 years, however, according to the Japanese consultant of the Project, the equipment and materials that were acknowledged during the "Information collection and confirmation study on introduction of high-quality infrastructure in Central America" were deemed sufficient to implement inspections and maintenance. The results of this study have already been shared with MTI, and it is desirable that they also share them with FOMAV and COERCO.

(2) Control of overloaded vehicles: In the traffic volume survey conducted at the time of ex-post evaluation, trucks were seen carrying loads over the maximum capacity. To maintain the service life of Santa Fe Bridge from now on, it will be necessary to take measures to thoroughly prohibit overloading. At the time of ex-post evaluation, all trucks undergo weighing at the Lovago weighing station for the purpose of preventing overloading, however, this weighing station is located approximately 110 kilometers from the Project site closer to Managua, and there are no weighing stations located any closer than this to the bridge. There is a weighing station at the San Pancho border facilities, however, it is currently not in use. Therefore, in the future, it is desirable to make effective use of the weighing station at the San Pancho border facilities simultaneously as to the complete opening of the said border; and especially according to how much the freight volume that is transported from Nicaragua to Costa Rica increases, it will be desirable to consider the installation of a new weighing station on the Acoyapa Highway halfway between the current Lovago weighting station and the Project's bridge.

(3) Readiness for medium to long-term maintenance: The recommendation made in the defect

inspection report pointed to the need to construct a heated asphalt mixture plant close to the Project site, and the need for such a facility was also confirmed at the time of the ex-post evaluation study. Considering that repairs will also be needed on Acoyapa Highway, this recommendation is thought to be relevant. It is desirable to consider this heading towards periodic maintenance allowing enough time and incorporating it in the budget.

4.2.2 Recommendations to JICA

It is desirable for JICA to monitor the status regarding the opening of the San Pancho-Las Tablillas border between Nicaragua and Costa Rica and continue to exchange information regarding developments on regional integration with the IDB and other donors, and appeal to the governments of Nicaragua and Costa Rica to ensure effective utilization of the Atlantic Corridor.

4.3 Lessons Learned

Confirmation of relevance, risk assessment and measures in cases where the opening of a border is a precondition for the realization of the Project effects

Although the Project was a domestic undertaking in Nicaragua, the Santa Fe Bridge is part of the Atlantic Corridor, which is an international arterial route, and it was anticipated that the target bridge, being located so close to the border with Costa Rica, would essentially function as an international bridge. Therefore, at the time of Project formulation and planning, in order to secure the realization of the Project effects, it was necessary to confirm the consistency of the Project with the national development policies and sector policies of not only Nicaragua but also of Costa Rica. In addition, it was necessary to verify the existence of important conditions for the realization of the Project effects such as both countries' border policies, border cooperation agreements, and any possibility of diplomatic issues arising between both countries, and the probability and risks surrounding the conditions for the manifestation of the Project effects should have been analyzed carefully.

For similar projects in the future, it will be necessary to not only confirm the cooperation with neighboring countries and legal frameworks as well as the level of maturity of such frameworks (existence of political will and infrastructure in each of the allied nations) at the time of the project planning, but also consider with even greater caution the risks such as the status of the international arterial road in both countries' national and sector policies, and the status of the relations between both countries, in particular the existence of a border cooperation agreement or initiatives geared to the signing of such an agreement. After these considerations it is necessary to check the project relevance and points requiring caution and measures towards the realization of the project effects. In addition, in the event where territorial issues occur or worsen, it is desirable to ascertain the impacts at that precise moment, closely share information with related parties including other donors, and examine the points that need caution as well as measures

necessary towards the manifestation of the project effects.

END

Republic of Peru

FY 2017 Ex-Post Evaluation of Japanese ODA Loan Project

"North Lima Metropolitan Area Water Supply and Sewerage Optimization Project (I)"

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

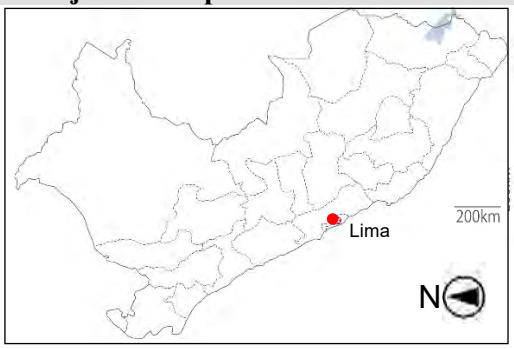
0. Summary

"North Lima Metropolitan Area Water Supply and Sewerage Optimization Project (I)" (hereinafter referred to as "the Project") was implemented with the objective of optimizing water supply and sewer systems to improve the quality of water supply and sewerage services and thereby contribute to improving the sanitation environment for residents of Comas-Chillon area within the service area of Huachipa Water Treatment Plant (WTP) in the Lima Metropolitan Area (hereinafter referred to as the "LMA"). The water supply and sewage sector has consistently been a priority issue 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 in the LMA, and the facilities under the Project play an important role at the time of ex-post evaluation. In addition, 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. Although the scope of water supply network rehabilitation was reduced and other revisions including an increase in the number of sectors were made at the time of the detailed design[1], the Project cost was roughly as planned. Meanwhile, due to delay in completion of the North Branch Water Transmission Line (hereinafter referred to as the "North Branch") as the water source, the Project was completed two years behind schedule. Therefore, the efficiency of the Project is fair. The intended effects of the Project, including 24-hour water supply based on appropriate water pressure, major improvement in the non-revenue water rate, and reduction of sewerage blockages, have generally materialized as planned. In addition, the sanitation environment has been improved for residents, while the 24-hour water supply has resulted in greater convenience and flexibility in the lives of residents. Therefore, the effectiveness and impacts of the Project are high. As no 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.

To sum up, the Project is evaluated to be highly satisfactory.

[1] In the Project, "sectorization" was carried out whereby the water supply network was divided into independent sectors (water distribution zones). Sectorization makes it possible to ensure appropriate and uniform water distribution pressure, manage non-revenue water and water leakage, and conduct efficient water supply management and operation and maintenance through localizing works and damage arising from accidents. Through controlling and measuring the volume of water supply in each sector and introducing SCADA (Supervisory Control and Data Acquisition - a remote management system using telemetry), it is possible to regulate the water pressure according to the volume of water consumption, reduce water leakage, and rapidly close sectors in remote control when executing water supply works, thereby making it possible to limit the areas and duration of water outages. The sectorization in the LMA was started in 1997. It is planned for the entire metropolitan area to be divided into almost 400 sectors. At the time of the ex-post evaluation, more than 300 sectors have been compartmented.

1. Project Description



Project Location

Distribution tank rehabilitated by the Project

1.1 Background

The LMA, which has the largest population in Peru (some 9 million in 2008), has a desert climate with hardly any rainfall all year round. In the latter half of the 2000s, it experienced severe water shortages as a result of rapid increase in the demand for water brought about by population concentration. In particular, compared to the non-revenue water rate of central area (36%) and southern area (22%), where water supply pipeline and sewer networks have been rehabilitated and sectorization has been implemented, the northern area, where the increase in population has been especially marked, experienced a high non-revenue water rate of up to 50% and daily water supply time of only around 12 hours, shorter than the water supply time of around 22 hours and 24 hours in central and southern areas respectively. With a view to resolving the water shortage in the Northern LMA, Lima Sanitation Services Company (hereinafter referred to as "SEDAPAL"[2]), which is responsible for water supply and sewerage services in the LMA, advanced construction of Huachipa WTP and the North Branch with cooperation from JICA[3]. Even so, to realize the effective utilization of water made available by these facilities, it was also necessary to renew water distribution facilities and improve the non-revenue water rate.

Against this background, the Project aimed at optimizing water supply and sewer systems[4] to improve the quality of water supply and sewerage services and thereby contribute to improving the sanitation environment for residents in the Comas-Chillon area, which belongs to the service area of Huachipa WTP in the LMA.

1.2 Project Outline

To improve the quality of water supply and sewerage services through optimizing water supply

[2] *Empresa Prestador de Servicio SEDAPAL Sociedad Anónima*
[3] In 2000, the "Lima Marginal Areas Sanitary Improvement Project" (yen loan) was implemented.
[4] "Optimization of water supply and sewer systems" refers to reducing physical water leakage through rehabilitating the water supply and sewer networks, while at the same time sectorizing the water supply system, and thereby building infrastructure that enable efficient water supply management and operation and maintenance.

and sewer systems, thereby contributing to an improvement of sanitation environment for residents in the Comas-Chillon area which belongs to the service area of Huachipa WTP in the LMA.

Loan Approved Amount/ Disbursed Amount	5,500 million yen / 5,398 million yen	
Loan Agreement Signing Date	September 2009	
Terms and Conditions	Interest Rate Repayment Period (grace period) Conditions for Procurement	Main component: 1.4% Consulting service: 0.01% Main component: 25 years (7 years) Consulting service: 25 years (7 years) Main component: general untied Consulting service: general untied
Borrower / Executing Agencies	Republic of Peru / Lima Sanitation Services Company (SEDAPAL)	
Project Completion	September 2015	
Main Contractors	A&R Sociedad Anónima Cerrada Contratistas Generales (Peru) / Ortiz Construcciones y Proyectos S.A. Sucursal del Perú (Spain), Constructora MPM S.A. (Peru) / COMSA S.A. Sucursal en Perú (Peru)	
Consultants	Nippon Koei LAC, Inc. (Japan), Nippon Koei Co., Ltd. (Japan)	
Related Study	Feasibility Study (2008, SEDAPAL)	
Related Projects	Lima Marginal Areas Sanitation Improvement Project (2000-, yen loan), North Lima Metropolitan Area Water Supply and Sewerage Optimization Project (II) (2013-, yen loan), Project for Capacity Strengthening for Non-Revenue Water of SEDAPAL (2012-2015, technical cooperation)	

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 was conducted with the following schedule.

Duration of the Study: October 2017-March 2019

Duration of the Field Survey: 8-22 November, 2017, 21-28 March, 2018

3. Results of the Evaluation (Overall Rating: A[5])

3.1 Relevance (Rating: ③[6])

3.1.1 Consistency with the Development Plan of Peru

At the time of appraisal (2009), the Garcia Administration, which regarded the expansion and improvement of water supply and sewerage services as important, was implementing the "*Agua para Todos*" (Water for Everybody) program. In the "*National Sanitation Plan (2006-2015)*", the government identified the following goals: promotion of the modernization of management of water supply and sewerage sectors, improvement in the sustainability of water supply and sewerage services, improvement in the quality of services, improvement of the financial condition of water and sanitation companies, expansion of water supply and sewerage facilities.

Viewing the water and sanitation sector as a top priority, the Kuczynski Administration that came to power in 2016 has promoted measures such as consolidating local service providers of water and sanitation and strengthening technical support through OTASS[7]. Moreover, under the "*National Water Supply and Sewerage Plan (2017-2021)*", which primarily aims to realize "universal and sustainable access to high-quality water supply and sewerage services", efforts are being made to expand access to water supply and sewerage services, secure financial sustainability, and strengthen the capacity of water and sanitation companies and other service providers. Under this program, it is intended to achieve 100% water supply coverage, water supply time of 22 hours/day, 100% sewerage coverage, and 100% sewage treatment rate in urban areas by 2021.

As such, relevance of the Project to the development plans is high both at the time of planning and ex-post evaluation.

3.1.2 Consistency with the Development Needs of Peru

As already described in 1.1 Background of the Project, at the time of appraisal, the non-revenue water rate in the northern LMA was at a critically high level and the daily water supply time, as well, was lower than other areas. To maximize the impact of Huachipa WTP and North Branch, which were intended to supply water to the northern LMA, the most important issue was to optimize the local water supply and sewer systems of the same area.

At the time of ex-post evaluation, as described later in 3.3.1 Effectiveness, the facilities improved or newly constructed under the Project are playing an important role in providing water supply and sanitation services in the northern LMA where population growth is acute. Meanwhile, SEDAPAL envisages increases in population, water demand and sewerage volume of 22%, 18%

[5] A: Highly satisfactory; B: Satisfactory; C: Partially satisfactory; D: Unsatisfactory
[6] ③: High; ②: Fair; ①: Low
[7] OTASS: Organismo Técnico de la Administración de los Servicios de Saneamiento

and 19% respectively in the 15-year period from 2014 to 2030, and it plans 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 Consistency with Japan's ODA Policies

Japan's Country Assistance Implementation Report for Peru (2009) identified "reduction of poverty and inequity" as one of the priority fields. As the means for achieving this, regarding "water (water supply and sewerage)", the policy of "implementing development of water supply and sewerage facilities primarily through loan aid to cater to diverse needs in large cities, medium-size cities and provincial areas" was specified. Therefore, the relevance of the Project to Japan's ODA policies can be confirmed.

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

3.2 Efficiency (Rating: ②)

3.2.1 Project Outputs

The Project constructed a water transmission line linking the newly constructed North Branch to the existing water supply network. It also carried out sectorization of the existing water supply network in the target area (sectorization of the water distribution network, repair of distribution reservoirs, connections to SCADA, installation of pressure reducing valves, air valves, etc.), and rehabilitation of the water supply and sewerage networks and connections (see Figure 1). In addition, consulting services related to detailed design, tender assistance and construction supervision were also implemented. Incidentally, since SEDAPAL was working on a major program to introduce water meters over the entire LMA in tandem with the Project, installation of water meters was not included in the Project[8].

The Project was financed by the yen loan of JICA, as well as loans provided by the World Bank and KfW (Kreditanstalt für Wiederaufbau) of Germany. Under the contracts for civil works subject to the yen loan, the yen loan portion (water supply) and KfW portion (sewerage) were implemented under the same contract based on the JICA procurement guidelines. Meanwhile, the

[8] In the target area of the Project, water shortage was serious, water supply time was limited to about 12 hours, since there were lot of water leakage due to aging of distribution network and wasteful use of water by fixed rate users without water meter. The Project aimed to improve water supply service by eliminating water shortage by reducing water leakage through rehabilitation and sectorization of the water distribution network and by increasing water supply through the north branch. Also, at the time of appraisal, SEDAPAL agreed with JICA to set the water meter coverage rate of the target area to 100% by 2012. In the Project, the water supply system was planned and designed with supply capacity corresponding to the suppressed water consumption after the installation of water meters.

contract subject to the loan from the World Bank was implemented based on the World Bank's procurement guidelines, and is scheduled to undergo separate ex-post evaluation by the World Bank. Accordingly, in this ex-post evaluation, out of the whole scope of the Project at the time of appraisal, analysis is only conducted on the scope covered by the JICA and KfW loans.

Figure 1 Water Supply Area of the Project

Table 1 shows the planned and actual outputs of the Project. According to SEDAPAL, there were no major issues in the quality of design and construction. As well, no specific problems were identified through the field visit. The two major revisions of the outputs are as described in the following paragraphs[9]. Both revisions are deemed to have been implemented based on adequate technical review and are considered to be appropriate.

[9] These revisions were made during the detailed design. The SEDAPAL side reviewed and decided the consultant's proposals and reported them to JICA.

Table 1　Outputs (excluding the World Bank portion)

Plan at time of appraisal		Actual
Construction of new water transmission pipelines from the North Branch	22.5km	21.0km
Rehabilitation of distribution reservoirs	19 sites	23 sites
Rehabilitation of water supply network	325.5km	211.3km
Rehabilitation of sewer network	Unknown*	163.5km
Rehabilitation of water supply connections	Approx. 37,000 sites	36,650 sites
Rehabilitation of sewer connections	Unknown*	22,938 sites
Sectorization	9 sectors	14sectors
Consulting services		
Detailed design, preparation of tender documents and tender assistance, environmental impact assessment, advice on activities for raising awareness of local residents, construction supervision, establishment of a water supply and sewerage inventory, preparation of an asbestos cement pipe handling manual		Generally, as planned** 3 high-pressure cleaning vehicles (Outside of the scope of the yen loan)
Others (no plans)		

Source: Materials provided by JICA; figures on actual performance provided by SEDAPAL.

Notes: * It wasn't possible to obtain planned values for the sewerage component excluding the World Bank portion. On conducting trial calculation in reference to the planned figures for water supply, it is estimated that the planned extent of sewer network rehabilitation was approximately 190km and 24,000 household connections.

**As the water supply and sewerage inventory, drawings of facilities were digitally prepared in the Project. It is subsequently planned for inputting to SEDAPAL's geographic information system (GIS) to be completed in 2018. No asbestos cement handling manual could be confirmed. It should be noted that the consulting services under a single contract was provided for the entire project including the World Bank portion.

(1) Downsizing of water supply network rehabilitation

In the feasibility study implemented by SEDAPAL, it was planned for the existing water distribution network to undergo total rehabilitation based on technical and economic analysis taking such aspects as occurrence of water leakage / breakages in the existing water supply network, and age of pipes into consideration[10]. In the subsequent detailed design stage, the maximum water pressure in the pipeline design was lowered by increasing the number of sectors (due to reduction in elevation disparities within the same sector), eliminating the necessity to replace some of the pipelines that had sufficient strength to withstand the maximum water pressure. As a result, the overall length of rehabilitated pipelines was reduced to 65% of the total distribution network. While, the water supply connections that had been experiencing numerous leaks were 100% repaired as planned. Concerning the sewer network, no major changes were

[10] 90% of the existing water purification network comprised asbestos pipes. In the feasibility study, consideration was given to the cancer risk of asbestos in water, however, according to SEDAPAL, between then and the time of the detailed design, it became widely accepted in implementing agencies that use of asbestos pipes in the water supply network posed no major health risk.

made to the plan, however, repairs were partial (roughly 70% of the total).

(2) Increase in the number of sectors and rehabilitation of distribution reservoirs

The target area has hilly districts with relatively large elevation disparities. Therefore, at the time of the detailed design, in order to secure appropriate water pressure and water supply time even in districts at high elevation, sectors including hills were finely compartmented according to elevation. As a result, the number of sectors increased by approximately 1.5 times. In line with the increased number of sectors, the number of distribution reservoirs requiring rehabilitation also increased[11].

3.2.2 Project Inputs

3.2.2.1 Project Cost

Table 2 shows the planned and actual project costs. Compared to the planned total project cost of 15,309 million yen (yen loan 5,550 million yen), the actual total project cost was 14,779 million yen (97% of the planned amount). The loan amount used was 5,398 million yen (97% of the planned amount) and it fell within the plan. Even considering the changes in outputs, the Project cost was roughly as planned[12].

Table 2 Planned and Actual Project Cost (Excluding the World Bank Portion)

(Unit: million yen)

	Planned		Actual	
	Overall	Yen loan	Overall	Yen loan
Civil works	12,591	4,313	10,245	3,562
Consulting services	1,021	1,021	2,248	1,836
Physical contingency	630	216	-	-
Taxes	866	0	1,844	0
Interest during construction / charges	202	0	442	0
Total	15,309	5,550	14,779	5,398

Sources: Materials provided by JICA and SEDAPAL
Exchange rate: (Planned) 1 US$ = 111 yen = 3.16 nuevo sol
(Actual) 1 US$ = 100 yen = 2.77 nuevo sol (the rate actually applied)

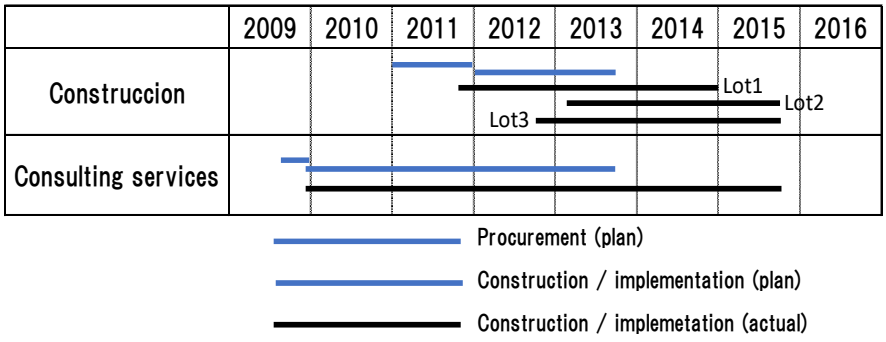
The main reasons for the increase or decrease in the Project cost were; reduction in the length of rehabilitation in the water supply network, increase in the quantity of works due to increase in the number of sectors and rehabilitated distribution reservoirs; miscellaneous changes in the

[11] Most of the sectors established in the Project receive water supply from separate reservoirs for each.
[12] The adjusted planned amount considering the fact that repairs were limited to 65% of the water supply network is calculated at approximately 14.3 billion yen, which means that the actual cost is 103% of this. While, similar trial calculation cannot be made concerning the repair of distribution reservoirs and increase in the number of sectors, since the final adjusted planned amount would be greater than 14.3 billion yen, the planned vs. actual cost ratio taking changes in outputs into account is deemed to be lower than 103%.

quantity of works due to design modifications based on the materials and positions of pipelines in the water supply and sewer network, existence of new connections and other buried objects which were discovered following the start of works; increase in the volume and period of consulting services in line with extension of the project period.[13]

3.2.2.2 Project Period

Following the signing of the loan agreement in September 2009, the Project was scheduled for completion in September 2013. In reality, however, the Project was completed two years behind schedule in September 2015 (see Figure 2 and Table 3). The actual project period was 73 months, equivalent to149% of the originally intended 49 months.



Source: Materials provided by JICA and SEDAPAL

Figure 2 Planned and Actual Project Periods (Excluding the World Bank portion)

Table 3 Works Contract for the Project for Optimization of Water Supply and Sewerage in North Lima Metropolitan Area (I) (Excluding the World Bank portion)

Contract Lot	Scope of Works	Date of Contract	Date of Completion
Lot 1	Water transmission line from the North Branch, repair of distribution reservoirs	November 2011	December 2014
Lot 2	Repair of the water supply and sewer networks	February 2013	September 2015
Lot 3	Repair of the water supply and sewer networks	September 2012	September 2015

Source: Materials provided by SEDAPAL

[13] At the time of the ex-post evaluation, SEDAPAL and the contractor are in dispute over settlement of the cost of main works, so it is possible that the amount paid could increase by up to 3%. Moreover, according to responses to the questionnaire that was sent out to officials of SEDAPAL, the reason why so many changes arose following the start of works was partly due to the insufficient quality of the detailed design implemented by the consultant. Moreover, because the same consultant implemented the detailed design and construction supervision under a single contract, the consultant was unwilling to recognize the deficiencies in the detailed design that were pointed out by the contractor, and this led to an increase in the number of issues under dispute.

The main reasons for the increase in the Project period were as follows.

- According to responses of SEDAPAL officials to the questionnaire, more time than planned was required for procurement of some of the civil works (Lots 2, 3) which were implemented under three contracts since the SEDAPAL personnel assigned were not well accustomed to the procurement process and other reasons. As a result, the start of some of the works was delayed by around one year.

- It was scheduled for the North Branch, which was to supply water to the Project, to be completed in May 2011. However, in reality, there was a large delay and it was completed in July 2014[14]. Accordingly, in Lot 1, which included the water transmission main connecting to the North Branch, even though the actual works were not greatly delayed, the work completed in December 2014 because the hydraulic testing couldn't be implemented (delays arising from the North Branch amounted to approximately 19 months). Similarly, the delayed completion of the North Branch caused delays in other works (Lot 3; delay of three and a half months).

- Various design changes arising following the start of works resulted in the works period of each contract extended by 3 to 7 months.

3.2.3 Results of Calculations for Internal Rate of Return

At the time of appraisal, the economic internal rate of return (EIRR) of the water supply component of the Project was calculated as 8.9% assuming the Project cost to be the cost, and the reduction in water leakage, reduction in operation and maintenance cost, and the residents' willingness to pay for longer water supply time to be the benefits. On the other hand, the financial internal rate of return (FIRR) has not been calculated considering that the Project has high public nature and water supply and sewerage tariffs are collected at relatively low level.

Since specific information concerning the preconditions and procedures used for calculating the EIRR at the time of appraisal couldn't be obtained, and no necessary information was available concerning operation and maintenance cost for the Project facilities and the amount that residents are willing to pay for longer water supply time, recalculation of the EIRR was not conducted in the ex-post evaluation.

Summing up, although the project cost was kept within the planned amount, the project

[14] Following the signing of the contract, works on some sections were delayed due to revision of the number of distribution reservoirs attached to the North Branch (distribution tanks) from 5 to 4, discovery of more rocky soil than expected along the tunnel route of the North Branch. In addition, it took longer than 1 year to repair damage caused by an accident in the North Branch over a section that was handed over in February 2012, resulting in the entire completion and handover being postponed until July 2014.

period exceeded the plan. Therefore, the efficiency of the Project is deemed to be fair.

3.3 Effectiveness and Impacts[15] (Rating: ③)

3.3.1 Effectiveness

3.3.1.1 Quantitative Effects (Operation and Effect Indicators)

The purpose of the Project was "to improve the quality of water supply and sewerage services through optimizing water supply and sewer systems". "Optimization of water supply and sewer systems" refers to reducing leakages of water and sewage through rehabilitating the water supply and sewer networks, while at the same time sectorizing the water supply system and thereby making it possible to implement efficient water supply management and operation and maintenance. In view of this, the degree to which targets have been achieved in the Project is analyzed based on the following indicators: sectorization, water meter coverage (reference indicator), non-revenue water rate, water supply time and water pressure, number of breakages and leakages in water supply pipelines, and number of sewerage accidents (see Table 4).

Table 4 Operation and Effectiveness Indicators – Standard, Planned and Actual Values

Indicator	Standard Value (before Project implementation)	Planned Value	Actual Value
Number of sectors	0 sectors	9 sectors	14 sectors
Non-revenue water rate	50%	25%	21% (2017 trial calculation value)
Water supply time	Approx. 12 hours	No planned value	24-hour (September 2016-)
Water pressure	Unknown	10-50mca (Government standard value)	Dry season (June) Min. 11-14mca, Max.14-35mca Rainy season (January) Min.14-20mca, Max. 25-40mca
Number of breakages and leakages in water supply pipelines	(2008) Breakages: 209 Leakages: 993 Total: 1,202	Approx. 86% reduction	(2016) Breakages: 120 (43% reduction) Leakages: 212 (79% reduction) Total: 332 (72% reduction)
Number of sewerage accidents	661 (2008)	No planned value	439 (2016)
Water meter coverage (reference indicator)	25% (2008)	100% (2012)	96% (2016)

Source: Prepared from materials provided by JICA and SEDAPAL
Note: The unit of water pressure (mca) is "meter of water column", which is the unit of pressure that can support a 1-meter column of water. The standard value in Peru is 15-50 meters of water column.

(1) Sectorization

The planned number of sectors was nine, but 14 were established in reality. Each sector has

[15] Sub-rating for Effectiveness is to be put with consideration of Impacts.

a distribution reservoir that makes it possible to conduct 24-hour water supply. Water transmission to the distribution tanks has been automated (with standard values for automatic operation able to be changed by SCADA) and the volume of inflow to and water level in distribution tanks are constantly monitored by SCADA. The valves for transmitting water from the distribution tanks to the water supply network are left open at all times, and water pressure is not controlled according to time of day[16]. According to SEDAPAL, the 14 sectors of the Project are being operated appropriately without any problems.


(Left) Valves at a distribution tank connected to SCADA
(Right) SCADA control room (SEDAPAL headquarters)


(Left) Street where water supply and sewerage rehabilitation were made
(Right) Newly installed water meter (outside of the Project scope)

[16] In sectors in the central part of Lima, valves for controlling the inflow volume are installed and are automatically tightened for lower pressure at night to reduce water leakage. In sectors in the Project target area, only valves installed at inlets to distribution reservoirs are connected to SCADA. Manually operated valves are installed at sections for transmitting water from the distribution reservoirs to the water supply network, however, no flow meters are installed, and no continuous records of the amounts of water flow and distribution are kept.

(2) Water meter coverage (reference indicator)

While the water meter coverage at the time of appraisal was 25% (June 2008), it was agreed that SEDAPAL would advance the installation of water meters in tandem with the Project and that the water meter coverage in the target area would be 100% by 2012. Due to delays in the procurement of meters and implementation of works in the Project, as the timing deviated, the installation of water meters by SEDAPAL was not completed in time for the completion of the civil works in 2015. In 2016, a large batch of water meters for installation in the target area were procured, and the coverage ratio had risen to 96% by December that year.

Introduction of metered billing with installation of water meters is considered to suppress water consumption by helping users save water. Therefore, in those areas where there is much waste of water, increased coverage of water mater can lead to an improvement of supply hours and water pressure even though supply volume of water is same. According to hearings with SEDAPAL and residents[17], in the sectors where water meter coverage before the Project was low, it was only after the installation of water meters that noticeable improvements in water supply services such as increase in supply hours were observed. The Project constructed water distribution facilities with supply capacity corresponding to the water demand with 100% coverage of water meter, that is to the suppressed water demand[18]. It was originally planned for the rehabilitation of facilities and installation of water meters to be advanced simultaneously. However, in reality, there was a time lag of one to two years from the rehabilitation of facilities to the installation of meter, and actual water demand was temporarily larger than the supply capacity during this period[19].

In the hilly areas, there are still some blocs where residents will not consent to installing water meters because they are afraid of higher water tariffs[20]. According to SEDAPAL, when newly installing meters, residents tend to demand that services be improved first. However, in the Project, because the water meter installation was made some years after the rehabilitation of facilities (without any noticeable improvement in services), some residents were doubtful over

[17] In the ex-post evaluation, qualitative survey was implemented through conducting group interviews with ordinary residents in the target area and individual interviews with owners of local shops, restaurants, etc. Interviews with general residents were conducted with a total of 78 householders or their spouses (36 males, 42 females) comprising one group in each of the 14 target sectors, while 14 shops or restaurant owners (one in each sector) were individually interviewed. In both cases, persons who have lived in the target area for six or more years were targeted. In the interviews at the area where water meter was newly installed, specific examples of the water saving effect was seen by such reports as; "I stopped watering the garden after installing the meter", "Now I always close the faucet securely so that there should be no water leak", "I closed all the faucets and checked if the water meter turns in order to verify any leakage in the house."

[18] At the time of planning, it was assumed that installation of water mater would reduce water consumption by some 20%.

[19] According to the consultant's completion report, there were sectors where the peak water consumption volume was more than three times the planned volume by the time the Project was completed.

[20] According to SEDAPAL, among the fixed rate users, there are households that use water paid for by other households (use of single household contracts for multiple households), and households that sell water, and such households are averse to installing water meters.

the service improvement and were averse to installing water meters[21].

According to the interviews with residents, many residents understand that water meter installation will promote saving water and lead to improvements in water supply time and water pressure. They are making efforts to save on water with a view to holding tariffs down, however, they also have their doubts about the accuracy of meters.

(3) Non-revenue water rate

Before the Project, the non-revenue water rate in the Project target area reached as high as 50%. The Project was intended to bring this down to 25% or lower.

In the 14 sectors in the Project target area, except for one sector, official monitoring of the non-revenue water rate has not yet been started. In the ex-post evaluation, as a result of conducting trial calculation of the non-revenue water rate over the entire target area (14 sectors) based on the volume of water supplied to distribution reservoirs and volume of water consumption targeted for charges in each sector, the non-revenue water rate was approximately 22% in 2016 and 21% in 2017. Accordingly, it is highly likely that the Project goal of reducing the non-revenue water rate to no higher than 25% has been achieved[22]. According to the non-revenue water control team of SEDAPAL, experience to date in the LMA shows that the most effective measures for reducing non-revenue water have been to reduce commercial losses through installing water meters, followed by reducing water leakages through appropriately maintaining the water supply network and rationalizing water pressure. The reduction in non-revenue water rate described above has been achieved through synergy of the Project combined with water meter installations which was implemented separately from the Project. Hence, the Project is deemed to have contributed to the reduction of non-revenue water.

The non-revenue water control team of SEDAPAL nominates sectors that meet certain conditions as "Controlled Sectors" and monitors their non-revenue water rate every month, and in sequence, it implements sector-wise projects to control non-revenue water utilizing the results of JICA's technical cooperation[23]. As of November 2017, only one out of 14 sectors in the Project

[21] On the other hand, in other projects where rehabilitation of facilities was implemented at the same time as installation of water meters, there have been relatively few problems. In consideration of such experiences, SEDAPAL is simultaneously conducting the rehabilitation of facilities and installation of water meters under the same contract in the subsequent "Project for Optimization of Water Supply and Sewerage in North Lima Metropolitan Area (II)" (2013-).

[22] The non-revenue water rate over the entire service area of Comas Service Center in 2016 was 32%, representing a major improvement compared to 50% in 2009. The figure over LMA overall was 28% in 2016.

[23] Under the JICA technical cooperation "Project for Capacity Strengthening for Non-revenue Water of SEDAPAL" (2012-2015), interventions to control non-revenue water were implemented in two sectors in the central part of Lima. SEDAPAL has continued these activities and implemented similar interventions in 36 out of LMA's 300-350 sectors as of 2017. In each sector, over the course of one year, the following activities are implemented: assessment of non-revenue water and water leakages, detection and repair of water leakages, setting of appropriate water pressure, establishing of sub-sectors, installation and replacement of water meters, removal of unlawful connections. For sectors to qualify for the interventions, they must be i) properly hydraulically isolated, ii) connected to SCADA to enable accurate measurement of flow rates, iii) have a water meter coverage rate of at least 80%, and iv) have uniform meter reading days for all the contract holders. In the sectors targeted in the Project, failure to comply with condition iv) has

has satisfied the condition, however, a further two to nine sectors are expected to meet the required conditions during 2018[24]. Targeting the entire metropolitan area, SEDAPAL intervenes to control non-revenue water in roughly 15 sectors every year, while, no such projects have yet been implemented in the Project target area. If such projects are implemented in the Project target area in future, further improvement to the non-revenue water rate is anticipated.

(4) Water supply time and water pressure

Before the Project (2008), water supply was conducted for roughly 12 hours per day in the Project target area. Following completion of the Project, 24-hour water supply has been conducted in the whole target area of the Project since September 2016 when progress was made in the installation of water meters. This is the synergistic result of the Project, water meter installations, and construction of Huachipa WTP and the North Branch. However, due to delays in the installation of water meters, there was a gap of one year between completion of the Project in August - September 2015 and the realization of 24-hour water supply in the whole area. As for the water supply time, no target value was set at the time of appraisal. On the other hand, water supply time over the entire LMA in 2016 was 21.7 hours/day.

The minimum / maximum water pressure in each sector in 2016 was 11-14 mca / 14-35 mca during the dry season (June) when water consumption goes up, and 14-20 mca / 25-40 mca during the rainy season (January), indicating that it was within the standard range of 10-50 mca[25].

According to interviews with residents, almost all residents are satisfied about the improvements that have been made to water supply time and water pressure. However, there were also some complaints that the water pressure falls and water supply is sometimes interrupted during the dry season (summer) when the demand for water increases.

(5) Number of breakages and leakages in water supply pipelines

At the time of appraisal, it was planned for the number of incidents involving pipeline breakages and leakages in the water supply network to decrease by approximately 86% compared to 2008[26]. In the water supply network in the Project target area, the number of incidents involving

been the main drawback, however, SEDAPAL is working to remedy the situation. Moreover, since flow meters are only installed at inlets to distribution tanks, it has been pointed out that water used for washing the distribution tanks and so on is included in the water consumption flow. Moreover, there is said to be a higher risk of errors due to the poor positioning of flow meters at some distribution reservoirs. SEDAPAL intends to take necessary measures for them upon investigating the situation.

[24] According to a staff member in charge of non-revenue water countermeasures at Comas Service Center, which is responsible for operation and maintenance in the Project, although the necessary knowledge and know-how have been acquired thanks to JICA's technical cooperation, the shortage of personnel to implement actual work is a constraint.

[25] The unit of water pressure (mca) is "meter of water column". A "meter of water column" is the unit of pressure that can support a 1-meter column of water.

[26] At the time of appraisal, it was intended to reduce frequency from 36 per month in 2008 to 5 per month in 2015. However, since the scope of measuring indicators was unclear, making it difficult to compare with actual figures, it was decided to make comparison based on the rate of decrease in the number of breakage and leakages in the project area.

pipeline breakages and leakages declined from 1,202 in 2008 (209 pipeline breakages and 993 leakages) to 332 in 2016 (120 pipeline breakages and 212 leakages). The rate of reduction over the period between 2008-2016 was 72% overall, breaking down as 43% for pipeline breakages and 79% for leakages, more than 80% of the planned level of 86%.

According to SEDAPAL, almost all pipeline breakages occur in asbestos concrete pipes that have not been rehabilitated. Therefore, one of the reasons why the rate of decrease in pipeline breakages was lower than planned was because rehabilitation in the water supply network were limited to 65% of the planned figure. On the other hand, almost all leakages occur in connections, while, repairs were implemented as planned on all connections. Accordingly, reduction rate of leakages is higher than that of pipeline breakages.

(6) Number of sewerage accidents

It was envisaged that the Project would result in development of the sewer network and reduction of sewage blockages[27]. According to SEDAPAL, the number of sewage blockages occurring in the Project target area fell from 661 in 2008 to 439 in 2016 (34% rate of decrease) [28]. Sewage blockages are mainly caused by disposal of wastes by residents into sewers and manholes and occurs more in hilly areas, where the frequency of waste collections is lower and the residents treat sewers and manholes as alternative waste receptacles.

According to interviews with residents, many of them are satisfied that the frequency of sewage blockages, sewage spills and bad odor has declined to some extent. On the other hand, some owners of stores, restaurants, etc. said that there has been no noticeable decline in sewage blockages along main roads. Reasons for this, according to SEDAPAL, are as follows: i) sewer pipelines along trunk roads in flat areas have small inclination; ii) sloppy sediment caused by roadworks and gasworks often infiltrates into sewers as its management by construction companies is insufficient; and iii) restrictions on water supply during the dry season of 2016 caused the sewage flow to decline. Over the scope of the interviews, residents are increasingly aware that disposal of wastes into the sewer system is a cause of sewage blockages, while some homemakers make efforts not to dispose of kitchen wastes in the sewage. However, among the residents interviewed, there was no one who received education or information in relation to the Project concerning how to use the sewer system form the consultant, construction companies nor SEDAPAL[29].

Incidentally, pipeline breakages refer to incidents where water leakage is confirmed aboveground, while water leakages refer to cases that cannot be confirmed aboveground.

[27] At the time of appraisal, standard values and indicators were not set. In addition, data on sewerage accidents in the target area of the Project could not be obtained except for the number of sewage blockages.

[28] The number of sewage blockages in the entire Comas area including the target area of the Project has not changed significantly in the past 10 years (7,723 cases in 2005, 7,542 cases in 2015).

[29] According to the report of the consultant, an explanatory meeting for the residents on the scope and effects of the Project was carried out when implementing the project's civil works. However, it was not possible to confirm whether

Summing up, the degree of achievement regarding the Project objective of "improving water supply and sewerage services" has been high when measured using the indicators of non-revenue water rate, water supply time and water pressure, number of water supply pipeline breakages and leakages, number of sewerage accidents, etc.

3.3.2 Impacts

3.3.2.1 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.

Many residents reported in the interviews that thanks to the realization of 24-hour water supply with appropriate water pressure, they had become able to conduct cleaning, bathing and washing whenever necessary, making it possible for them to increase frequency of cleaning / bathing / laundry and keep their homes clean and maintain personal hygiene at all times. In the past, when the water supply time was limited, residents needed to store water in buckets and tanks and could only conduct cleaning, bathing and washing at limited times. In addition, since some residents didn't conduct regular cleaning of tanks, the sanitary management of stored water left much to be desired. Accordingly, it is thought that the Project has contributed to improving the sanitary condition of residents. Moreover, some residents believe that removing the need to store water has helped prevent the spread of Dengue fever and other infections transmitted by mosquitoes, while there is no clear basis for this. When the decrease in sewerage issues is also taken into account, many residents believe that the improvements to water supply and sewerage services resulting from the Project have contributed to the improvement of household sanitation. In restaurants, hotels, barbershops that require even greater care regarding hygiene, the sanitation improvement arising from 24-hour water supply is recognized as a particularly important benefit.

3.3.2.2 Other Positive and Negative Impacts

(1) Environmental Impacts

An environmental impact assessment (EIA) for the Project was implemented under the consulting services, and the findings were approved by the Ministry of Housing, Construction and Sanitation in May 2010 (before the tender for the civil works). According to SEDAPAL, during the civil works, measures to address air pollution, soil pollution, waste treatment, etc. were implemented according to the environmental management plan included in the environmental impact assessment. During the rehabilitation works of asbestos cement pipes, which may cause health risk from asbestos dust during construction, water sprinkling and other measures to protect workers from dust were adopted. Removed asbestos pipes were stored, transported and disposed

the enlightenment or education on proper use of sewerage has been carried out.

(safe landfill) according to the waste management law and relevant guidelines in Peru[30]. No other negative impacts were recognized in the natural environment as a result of the civil works in the Project.

On the other hand, in the interviews with residents, some people said that the installation of water meters has led to less greenery and more dust in hilly neighborhoods because residents are sprinkling less water in their gardens and on streets in an effort to conserve water.

(2) Land acquisition and resettlement of residents

In the Project, land was acquired to enable distribution reservoirs to be repaired (construction of fences, etc.) and valve chambers, etc. to be installed, while, in each case public land or land owned by SEDAPAL was used at no cost. There was no resettlement of residents and no major problems were observed regarding land acquisition.

(3) Other Impacts

In the hearings with residents, the realization of 24-hour water supply had a major impact in raising the quality of life. Residents are happy about having greater convenience and freedom because they no longer need to store or carry water and they can conduct cooking, cleaning, bathing and so on whenever they need. In restaurants, hotels, etc. too, owners have reported that work efficiency has been improved due to reduction in water-related labor and greater freedom of business operating hours and so on.

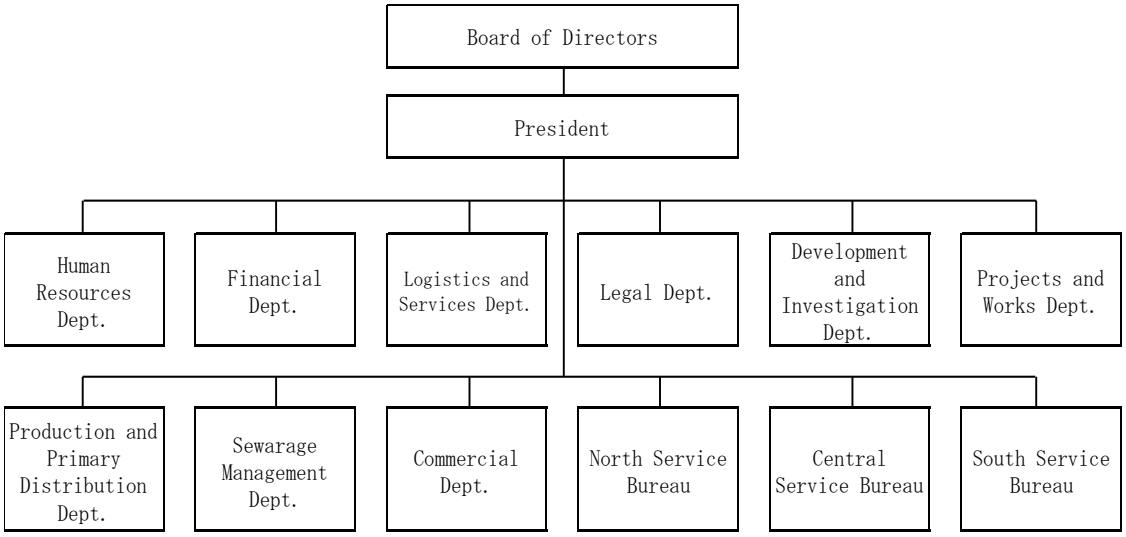
Summing up, the Project has realized the planned effects and its effectiveness and impact are high.

3.4 Sustainability (Rating: ③)

3.4.1 Institutional/Organizational Aspect of Operation and Maintenance

SEDAPAL has a staff strength of roughly 2,500 employees and enjoys the highest organizational capability among the sanitation service companies in Peru. Figure 3 shows the organizational structure of SEDAPAL. In respect to the Project, the Production and Primary Distribution Department is responsible for the SCADA and water supply transmission trunk line, while the Comas Service Center belonging to the North Service Bureau handles operation and maintenance of the distribution tanks and water supply and sewer networks.

[30] Procedures concerning the handling of asbestos cement pipes are given in the construction waste management guidelines established by the Ministry of Housing, Construction and Sanitation in 2013 and the water distribution network rehabilitation manual prescribed by SEDAPAL in 2014.



Source: Prepared based on materials provided by SEDAPAL

Figure 3 Organizational Structure of SEDAPAL

The Production and Primary Distribution Department of SEDAPAL operates the SCADA system for the general water supply networks. It also has two operation and maintenance teams for valve-replacement, two operation and maintenance teams for SCADA, and two operation and maintenance teams for pipeline-repairs, with each team comprising 5-6 members ready to respond to emergencies. These teams possess heavy equipment. Once damage to a pipeline or leakage is discovered, the distribution sector 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 may assist the repair works. According to a staff member of this department, the number of teams is not sufficient to fully cover the entire LMA.

In the LMA, seven service centers are in charge of the operation and maintenance of water supply and sewer networks. Comas Service Center, which is in charge of the Project area, has emergency response teams for repairing leakages, sewage blockages, etc. In fact, emergency response is provided 24 hours a day with three shifts for the water supply service (2-4 teams depending on the time of day) and during daytime with two shifts (4-7 teams depending on the time of day) for the sewerage service. The emergency response teams for water supply not only respond to leakages but also conduct preventive maintenance on valves, fire hydrants and so on. The emergency response teams for sewerage service use high-pressure cleaning vehicles procured in the Project (outside of the scope of the yen loan). In addition, workers of external contractors are deployed at this 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 repairs. When a leakage or blockage of sewage is reported, an emergency response team is dispatched. If repair work is found to be necessary, such works are conducted by the

external contractor. While the Comas Service Center 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. Also, it is desirable to increase the number of teams to ensure that sufficient time is spent on preventive maintenance of valves and fire hydrants. According to the interviews with residents, one of the dissatisfactions with SEDAPAL are the lack of speed in responding to leakages, sewage blockages, etc. coupled with a lack of trust concerning meter readings[31].

Summing up, although there appears to be some shortage in staffing and the number of emergency response teams[32], the operation and maintenance system for the Project is clearly established, posing no major problems.

3.4.2 Technical Aspect of Operation and Maintenance

SEDAPAL employs many engineers, possesses a human resource strengthening program and implements various training for its employees[33]. It has been a pioneer in introducing advanced technologies in Peru's water supply and sewerage sector such as sectorization, SCADA, and sewage treatment using the activated sludge process. SEDAPAL has been certified for international standards relating to quality control, environmental management, occupational health and safety, information security and 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. SEDAPAL has built up its SCADA operating experience over 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 from outsourced contractors. No new technologies are required for the operation and maintenance of the water supply and sewer network and water transmission lines, and there do not appear to be any technical issues. The manuals are provided for the distribution tanks and the daily operation and maintenance management results are recorded. A communication setup is established for emergencies and other events. The geographical information system on which additional work is being advanced in the Project target area makes it easier to search facilities and users, and it is utilized in reducing non-revenue water, managing assets, conducting operation and maintenance.

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[31] Some residents reported receiving tariff invoices that were exorbitant in relation to the household composition. Although many such cases occur in the first invoices after installation of water meters, they also occur at other times, and some residents believe that they arise from inaccurate meter readings. According to SEDAPAL, all the water meters installed in the Project target area are appropriately calibrated and the said situations arise out of air infiltrating connections or water leakages that are unnoticed by the residents. Residents can inquire to SEDAPAL about exorbitant invoices and request amendment at any time. Also, SEDAPAL dispatches technicians to check for water leakages as the need arises.

[32] According to SEDAPAL, staffing level is gradually strengthened, but concrete improvement plan could not be confirmed.

[33] Every year, at least 1 staff member from SEDAPAL takes part in JICA's task-based training on operation of the water supply and sewerage.

Summing up, there are no particular technical problems concerning operation and maintenance of the Project.

Table 5 Financial Status of SEDAPAL

(Unit: 1,000,000 soles)

	2012	2013	2014	2015	2016
Operating revenue (i)	1,385	1,472	1,513	1,624	1,737
Water supply and sewerage service charge	1,331	1,419	1,409	1,508	1,608
Other revenue	54	52	104	115	129
Operating cost (ii)	1,318	1,224	1,385	1,301	1,523
Cost of operation (a)	1028	904	941	949	1,058
Retail expenses	155	180	194	181	199
Administration cost, etc.	135	140	250	171	267
Operating profit (iii) = (i) – (ii)	67	248	128	3232	214
Non-operating revenue (iv)	301	154	288	177	153
Non-operating cost (v)	118	85	115	346	293
Taxes (vi)	67	90	42	90	50
Ordinary profit (vii) = (iii) + (iv) – (v) – (vi)	182	227	259	63	24
Operating profit ratio	5%	17%	8%	20%	12%
Current ratio (b)	212%	272%	355%	418%	367%
Debt ratio (c)	77%	80%	82%	135%	131%

Source: Materials provided by SEDAPAL

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

3.4.3 Financial Aspect of Operation and Maintenance

The operating profit of SEDAPAL for 2012 through 2016 was in the black with a high operating profit ratio of 12% in 2016 (see Table 5). 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 has increased to more than 100% since 2015. This is not indicative of a decline in corporate financial stability, rather it was caused by a decrease in equity capital on book following changes in accounting standards to match international accounting standards. On the other hand, non-revenue water rate and coverage rate of water meter installation of SEDAPL were 28.0% and 92.2% respectively in 2016. Both of these have been improved[34]. Accordingly, 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 couldn't be obtained. Nevertheless, no serious problems caused by financial constraints were found regarding their operation and maintenance.

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

3.4.4 Status of Operation and Maintenance

Judging from the findings of site visits and interviews with SEDAPAL, no major problems have been observed regarding the operation and maintenance of facilities constructed in the Project. The distribution tanks, pressure reducing valves and others undergo regular cleaning and have required no major repairs so far. Concerning the water supply and sewer networks and connections, emergency response teams perform repairs in response to calls from users.

Based on the above, no major problems have been observed in regard to the institutional, technical and financial aspects and current status of the operation and maintenance of the Project. Therefore, sustainability of the Project effects is high.

4. Conclusions, Recommendations and Lessons Learned

4.1 Conclusions

The Project was implemented with the objective of optimizing water supply and sewer systems to improve the quality of water supply and sewerage services and thereby contribute to improving the sanitation environment for residents of Comas-Chillon area within the service area of Huachipa WTP in the LMA. The water supply and sewage sector has consistently been a priority issue 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 in the LMA, and the facilities under the Project play an important role at the time of ex-post evaluation. In addition, 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. Although the scope of water supply network rehabilitation was reduced and other revisions including an increase in the number of sectors were made at the time of the detailed design, the Project cost was roughly as planned. Meanwhile, due to delay in completion of the North Branch as the water source, the Project was completed two years behind schedule. Therefore, the efficiency of the Project is fair. The intended effects of the Project, including 24-hour water supply based on appropriate water pressure, major improvement in the non-revenue water rate, and reduction of sewerage blockages, have generally materialized as planned. In addition, the sanitation environment has been improved for residents, while the 24-hour water supply has resulted in greater convenience and flexibility in the lives of residents. Therefore, the effectiveness and impacts of the Project are high. As no 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.

To sum up, the Project is evaluated to be highly satisfactory.

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency (SEDAPAL)

- In addition to promptly preparing the conditions for treating the Project sectors as "managed sectors" and commencing the monitoring of non-revenue water, it is necessary to utilize the results of JICA's technical cooperation to successively implement interventions for controlling non-revenue water with a view to further improving the non-revenue water rate.

- It is necessary to work on raising awareness and educating residents concerning appropriate use of sewerage. This should entail preparing educational materials that demonstrate the problems caused by disposing waste into sewers and their impacts on the lifestyle and health of residents, and proper methods for handling waste. Such materials should be used in the social component (explanations to residents, raising of awareness, and education) of public investment projects for rehabilitation / construction of water supply and sewerage. In addition, it is necessary for service centers to investigate the conditions and causes of sewage blockages, identify the areas where sewage blockages caused by discharge of wastes occur frequently, and prioritize such areas in implementing programs aimed at raising awareness. Possibilities should also be examined regarding cooperation with public health and waste management campaigns conducted by the Ministry of Health.

- Concerning dissatisfaction among residents regarding the lack of trust in the accuracy of meter and slow speed of responses to leakages and sewage blockages, it is necessary to examine countermeasures through disseminating appropriate information and improving the emergency response setup.

4.2.2 Recommendations to JICA

It is necessary to monitor the implementation of interventions to address non-revenue water of the sectors created by the Project and take steps to expedite their smooth implementation.

4.3 Lessons Learned

<u>Water meter installation when conducting water supply network repairs</u>

In projects that are intended to improve water supply services by rehabilitating water supply networks and increasing the water meter installation rate, rather than installing water meters after some time has passed following rehabilitation works, it is easier to obtain public understanding by installing water meters at the same time as the rehabilitation works. There is a possibility that an increase in the coverage of water meter leads to an improvement of water supply hours and

pressure by suppressing water consumption through saving water, even though supply volume of water is unchanged. Moreover, residents tend to be more receptive to water meter installation on condition that they receive satisfactory water supply services in return. In the Project, water supply network rehabilitation was implemented on the assumption of a 100% water meter installation rate. However, due to delays in the water meter installations which were outside the scope of the Project, improvement in water supply services did not immediately materialize following the completion of rehabilitation works. As a result, some residents started to doubt whether water supply services would be improved and resisted the installation of water meters, leading to the further delay of water meter installation in some blocks.

Comparison of the Original and Actual Scope of the Project

Item	Plan	Actual
① Outputs*	Construction of new water transmission pipe from the North Branch 22.5km Rehabilitation of distribution tanks 19 sites Rehabilitation of water supply network 325.5km Rehabilitation of sewer network Unknown* Rehabilitation of water supply** connections Rehabilitation of sewerage connections Unknown* Sectorization 9 sectors Consulting services: Preparation of detailed design, preparation of tender documents and tender assistance, environmental impact assessment, advice on activities for raising awareness of local residents, construction supervision, establishment of a water supply and sewerage inventory, preparation of an asbestos cement pipe handling manual Others (no plans) Approx. 37,000 sites	22.5km 19 sites 325.5km unknown approx. 37,000 unknown 9 sectors	21.0km 23 sites 211.3km 163.5km 36,650 22,938 14sectors Generally, as planned 3 high-pressure cleaning vehicles
② Project Period*	September 2009-September 2013 (49 months)	September 2009 - September 2015 (73 months)
③ Project Cost* ODA loan portion Fund from Peru side** Total Exchange rate	 15,309 million yen 9,759 million yen 5,550 million yen 1 US$ = 111 yen = 3.16 nuevo sol	 14,779 million yen 9,381 million yen 5,398 million yen 1 US$=100 yen=2.77 nuevo sol

Notes: * Excluding the World Bank portion
** Funding on the Peru side (actual) includes loan from KfW.