Islamic Republic of Pakistan

FY2015 Ex-Post Evaluation of Japanese Grant Aid Project

"Urgent Rehabilitation Project for Sewerage and Drainage System in Lahore"

External Evaluator: Yusuke Hasegawa, International Development Center of Japan Inc.

0. Summary

This project aimed to mitigate the damage in a repeatedly inundated area in Lahore City, Punjab Province, through renovation and installation of drainage pumps and other related equipment, thereby contributing to improving the living and hygiene environments of the local citizens. The project was, consistently, highly relevant to the development policies and development needs of Pakistan, from the planning stage through to the ex-post evaluation; it was also highly relevant to Japan's assistance policy for Pakistan in the planning stage. The project outputs were mostly delivered as planned. The total project cost provided by Japan, which was examined in this ex-post evaluation, was significantly lower than planned due to the competition effect of the bidding process, and the project duration was as planned; therefore, its efficiency is high. Regarding the project's quantitative effects, it produced by and large the expected level of improvement for the total drainage capacity, though the target value was not achieved. The project did achieve its target for mitigating inundation damage. Regarding the project's qualitative effects, the automatic trash rake systems improved the operational efficiency of the pumping stations. In addition, it was observed that the project had positive impacts on the daily lives and the housing and hygiene environments of the people in Lahore; therefore, the effectiveness and impact of the project are high. No major problems have been observed in the institutional, technical, or financial aspects of the operation and maintenance system; therefore, the sustainability of the project effects is high. In light of the above, this project is evaluated to be highly satisfactory.

1. Project Description

Project Location

Operation and Electric Room
(Gulshan-E-Ravi Pumping Station)

1.1 Background

Lahore City is a center of politics, economy, and culture as the capital of Punjab Province; it also plays an important role in Pakistan as one of the country's major cities. However, environmental conditions in the city were deteriorating, since basic infrastructure such as roads, water supply facilities, and sewerage and drainage systems had not been improved to accommodate the expansion of the city and the development of economic activities. Although the urgency of improving sewerage and drainage facilities was recognized, inundation disasters frequently occurred when torrential rains hit the city in the monsoon season, due to slow development of new drains and the lack of equipment to sufficiently maintain the existing facilities. This caused negative impacts on the living environment and economic activities in the city.

To improve the situation, in 2004, the Government of the Islamic Republic of Pakistan (GOP) requested the Government of Japan (GOJ) to render Japan's grant aid for "The Project for the Retrieval of Sewerage and Drainage System in Lahore City," aiming to mitigate inundation damage in the frequently inundated areas in the city, i.e., the central and south-west parts of the areas administered by the Water and Sanitation Agency (WASA). In response to this request, cleaning equipment for drainage pipes and drainage channels was procured, and new drainage pumps and an automatic trash rake system were installed. This contributed to some degree of improvement in the effects of inundation during the monsoon season.

However, massive inundation damage occurred in June and July 2008, causing casualties in the city. This led to recognition that the sewerage and drainage system in Lahore City needed to be further improved and that additional enhancement in drainage capacity, with renovation of the deteriorating drainage pumps, was most urgently required. In these circumstances, the GOP again submitted a request to the GOJ to renovate the existing pumps and install new automatic trash rake systems. This resulted in the realization of this project.

1.2 Project Outline

The objective of this project was to mitigate the damage in a repeatedly inundated area in Lahore City, Punjab Province, through renovation and installation of drainage pumps and other related equipment, thereby contributing to improving the living and hygiene environments of the local citizens.

<Grant Aid Project>

E/N Grant Limit or G/A Grant Amount / Actual Grant Amount	1,223 million yen / 611 million yen
Exchange of Notes Date (/Grant Agreement Date)	August, 2010 / September, 2010
Implementing Agency	Water and Sanitation Agency (WASA), Lahore
Project Completion Date	November, 2012
Main Contractor(s)	EBARA Corporation
Main Consultant(s)	CTI Engineering International Co., Ltd.
Basic Design	March, 2010
Detailed Design	-
Related Projects	➢ JICA Technical Cooperation Project "Project for Improving the Capacity of WASAs in Punjab Province" (2015-2018) ➢ JICA Expert Dispatch "Institutional Reform Advisor for WASA Faisalabad" (2013-2016) ➢ JICA Expert Dispatch "Expert on Implementation Support of System Improvement for Lahore Water Supply and Sanitation Project" (2010-2011) ➢ JICA Grand Aid "The Project for the Retrieval of Sewage and Drainage System in Lahore City" (2005) ➢ The Department for International Development (DFID), UK "Technical training and provision of equipment for removing sludge in the drainage and sewerage"(1996-1998)

2. Outline of the Evaluation Study

2.1 External Evaluator

Yusuke Hasegawa, International Development Center of Japan Inc.

2.2 Duration of Evaluation Study

Duration of the Study: December 2015 – November 2016

Duration of the Field Study: March 21, 2016 – April 6, 2016; June 17, 2016 – June 24, 2016

3. Results of the Evaluation (Overall Rating: A[1])

3.1 Relevance (Rating: ③[2])

3.1.1 Relevance to the Development Plan of Pakistan

The GOP is maintaining its policy to promote the development of sewerage and drainage, as seen in its "National Environmental Policy (2005-2015)" and "National Sanitation Policy" (formulated in 2006), both of which were observed at the time of planning the project. The "Integrated Master Plan for Lahore-2021," prepared by the Lahore Development Authority in 2002, has been maintaining emphasis on developing and improving the sewerage and drainage systems in the city as an urgent issue since the time of the project planning until today. In addition, the "Punjab Water, Sanitation, and Hygiene Sector Development Plan (2014-24)" sets a target of providing sewerage and drainage services to 82% of the population in the provincial cities and towns, intending to improve sanitary conditions and reduce damage from inundation by further introducing sewerage and drainage facilities. Thus, this project has been consistent with the development policies of the national, provincial, and city governments from the time of the planning through to the ex-post evaluation.

3.1.2 Relevance to the Development Needs of Pakistan

Lahore City, with a population of about 7.2 million at the time of planning this project, receives about 700 mm of annual precipitation, 60% of which is concentrated in the monsoon season from July to August. Inundation disasters frequently occurred, due to the city's flat terrain. In addition, retention of sewerage and rainwater occurred in many places due to the insufficient sewerage and drainage system. The three pumping stations targeted by the project were important since they all serve the needs of populated areas in the center of the city and their combined catchment area covers approximately 30% of the entire area administered by WASA and around 50% of the city's population. This project is judged to be consistent with the development needs of the people in Lahore, because, during its planning stage, the project fully considered this concentration of the city's population and the level of necessity to take measures based on the conditions of each of WASA's pumping stations. As described below, inundation disasters can, even now, be caused by torrential rains, although the retention of sewerage and rainwater in the city has greatly improved. Thus, WASA continues to work on facilitating improvement of the sewerage and drainage system, demonstrating the strong need for this project at the time of ex-post evaluation.

3.1.3 Relevance to Japan's ODA Policy

The objective of this project, which was to mitigate inundation damage by improving the capacity of the sewerage and drainage system, was consistent with the priority issues of "improving hygienic conditions" and "improving sewerage and waste management" under the

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

direction of assistance strategy "ensuring water and sanitation and reducing various disparities among people," all stipulated in Japan's "Country Assistance Program for Pakistan" formulated in February 2005. Along these lines, the Japan International Cooperation Agency (JICA) had set "developing urban water supply and sewerage and improving management capacity" as its priority issue at the time of planning the project in 2010, with which the project is considered to have been sufficiently consistent. Thus, this project was highly compatible with Japan's assistance policy.

As demonstrated above, this project has been highly relevant to both Pakistan's development plan and development needs, and Japan's ODA policy. Therefore, its relevance is high.

3.2 Efficiency (Rating: ③)

3.2.1 Project Outputs

The main outputs planned for this project were the installation or renovation of drainage pumps and the installation of automatic trash rake systems for three pumping stations in Lahore City. As shown in Table 1, all of these main outputs were provided as planned.

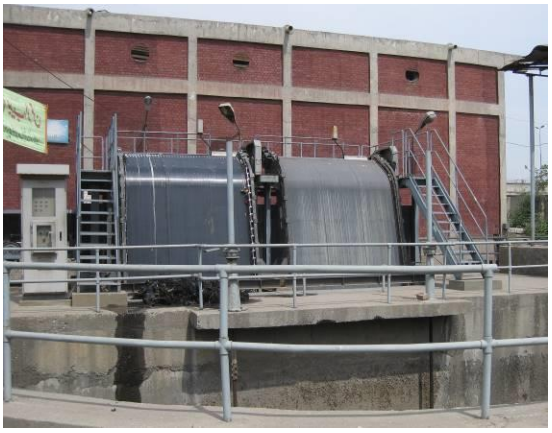
Table 1. Project Outputs: Plan and Actual

Plan	Actual
Shad Bagh Pumping Station: ➢ Renovation of Existing Pumps: 4 units ➢ Installation of New Automatic Trash Rake System: 1 unit Khokhar Road Pumping Station [sharing the same premises as the Shad Bagh Pumping Station]: ➢ Installation of New Pumps: 2 units ➢ Installation of New Automatic Trash Rake System: 1 unit	Shad Bagh Pumping Station: ➢ Renovation of Existing Pumps: 4 units ➢ Installation of New Automatic Trash Rake System: 1 unit Khokhar Road Pumping Station: ➢ Installation of New Pumps: 2 units ➢ Installation of New Automatic Trash Rake System: 1 unit
Gulshan-E-Ravi Pumping Station: ➢ Renovation of Existing Pumps: 6 units	Gulshan-E-Ravi Pumping Station: ➢ Renovation of Existing Pumps: 6 units
Multan Road Pumping Station: ➢ Renovation of Existing Pumps: 4 units	Multan Road Pumping Station: ➢ Renovation of Existing Pumps: 4 units

Source: Documents provided by JICA and the Implementing Agency; interview with the Implementing Agency

There were a few minor alterations to the planned outputs in the implementation stage of the project, comprising: 1) procurement of an additional active ventilation system that was one of

the pump-related systems included in this project, 2) adjustment of the installation positions of two active ventilation systems, and 3) a change in the specifications of the painting materials. The additional active ventilation system was procured because an existing system was found to be defective during the implementation. The other changes were implemented to enable easier operation of the pumping station by the Implementing Agency, and out of environmental considerations. Thus, these changes are considered to have been necessary and relevant to the project objective.



Automatic Trash Rake System
(Shad Bagh Pumping Station)

Drainage Basins
(Multan Road Pumping Station)

3.2.2 Project Inputs

3.2.2.1 Project Cost

The planned total project cost was 1,232 million Japanese yen, of which 1,223 million yen was to be provided by Japan and 9 million yen by Pakistan. Pakistan's funding commitments covered bank commissions for arrangement and disbursement of grant aid funds alone. However, since information on the actual cost incurred by Pakistan was not obtained, the planned and actual costs provided only by Japan will be examined in this ex-post evaluation.

Japan's actual cost amounted to 611 million yen, which was lower than the initially planned amount of 1,223 million yen (50% of the budget). This large difference is attributed to the effect of competitive bidding. According to the documents provided by JICA and an interview with the project consultant, manufacturers of pump products faced severe global price competition at the time of tendering for this project. In addition, many manufacturers had started producing the pumps through their overseas subsidiaries. Consequently, all of the four bidders for this project proposed a price below 60% of the cost estimated by the consultant. Despite this reduction in the anticipated price, all of the proposals were confirmed to meet the required specifications and procurement conditions. Thus, the difference between the planned and actual costs is judged to have been relevant.

3.2.2.2 Project Period

The project period was examined by comparing the planned and the actual periods spent undertaking the works by the Japanese side, as in the case of the project cost. The actual period was 26 months, which exactly matched the planned period: therefore, the actual period was as planned (100% conformance to the plan).

In the course of implementation, a two-month extension was proposed for the delivery dates for some kinds of locally sourced equipment (such as electric cables and steel pipes), and this was approved by JICA. This extension was required as staggered deliveries of the cables and pipes were deemed necessary once it transpired that there was insufficient space to store these products in the Implementing Agency's premises. This arrangement, however, did not influence the work processes of the entire project: the overall project duration was unchanged.

As stated above, this project's outputs were delivered almost as planned. The project cost fell well below the anticipated budget due to the price competition of competitive bidding. The project's duration was exactly as planned. Based on the above, both the project cost and project period were within the plan. Therefore, efficiency of the project is high.

3.3 Effectiveness[3] (Rating: ③)

Effectiveness will be analyzed in terms of both its quantitative effects, based on the operation and effect indicators organized from the indicators and their target values defined at the project's planning stage, and the qualitative effects.

3.3.1 Quantitative Effects (Operation and Effect Indicators)

For the operation indicator "cover rate of pump capacity versus required drainage capacity of the target pumping stations (%)," the actual performance of 62% in the year targeted at the planning stage (i.e. one year after project completion) did not fully reach the target value of 66%, although it greatly exceeded the baseline figure of 47% recorded in 2009, before the project started. One possible reason for this failure to reach the target is that the pump capacity diminished to a certain extent from the time of its installation, after one-year use of the pumps, with the measured value also influenced by the conditions of the pumps, such as blockages, at the particular time of measurement. The required drainage capacity was defined in the Preparatory Survey at the planning stage as the lesser figure of the maximum inflow to the pumping stations, calculated from the scale of the incoming drainage pipes, and the maximum outflow from the pumping stations, calculated from the scale of the outgoing channels and drainage pipes. On the other hand, the targeted pump capacity was decided based on the assumption that the pumps introduced by this project would deliver performance consistent

[3] Sub-rating for Effectiveness is to be put with consideration of Impact.

with the optimal level of their design capacities, indicating that the target value was almost the maximum capacity level expected to be achieved when the pumps became operational upon completion of the project.

Upon completion of the project, the three target pumping stations were equipped with a total of 34 drainage pumps, and there was no change in this number at the time of ex-post evaluation. The measured pump capacity increased by 33% from 25.5 m^3/second in total at the time of planning this project to 33.5 m^3/second in the target year, and the same level of capacity was recorded in 2015. This can be regarded as a substantial improvement to a largely expected level, though the capacity of 35.2 m^3/second (38% increase) expected in the Preparatory Survey Report was not reached.

"Inundation duration and depth at the Chuburgi monitoring station" was selected as the project's effect indicator, and the target figures were set under the condition of approximately 40 mm of rainfall. The actual data in the target year showed that no inundation occurred on the day with rainfall of 40 mm set as a baseline, and that the inundation period was much shorter than the targeted hours, even on the day with rainfall of 67 mm. In addition, even three years after the project's completion, no inundation was recorded on the day with almost the baseline level of rainfall (39 mm). Conversely, an inundation lasting 4.5 hours with a peak depth of 46 cm was recorded on one day with tremendous rainfall (172 mm) during the target year. While the extent of the duration and depth of inundation may be affected by various factors – such as localized rainfall conditions, intensity of rainfall, and installation and cleaning conditions of drains in the area – the target value is judged to have been achieved sufficiently based on the rainfall condition set at the planning stage.[4]

[4] There were around five days recorded with rainfall of 40 mm or more each year, between 2012 and 2015. They mostly fell under the monsoon season from June to September.

Table 2. Operation and Effect Indicators

	Baseline	Target	Actual	
	2009	2013	2013	2015
	Baseline Year	1 Year After Completion	1 Year After Completion	3 Years After Completion
Operation Indicator				
Cover rate of pump capacity versus required drainage capacity (%)	47	66	62	62
Effect Indicator				
Inundation duration and depth at monitoring point (Chuburgi monitoring station) (for rainfall of about 40 mm)*	4.5 hours 15 cm	1.8 hours 2cm	No inundation July 15 (40 mm)	No inundation August 21 (39 mm)
			1.2 hours 13 cm June 15 (67 mm)	2.0 hours 20cm July 6 (67 mm)
			4.5hours 46 cm August 14 (172 mm)	2.0 hours 46 cm July 18 (75 mm)

*Note: Figures in parentheses are rainfall levels recorded at the Jail Road area in the city.
Source: Documents provided by JICA and the Implementing Agency

Table 3 indicates the changes in the inundation situation at some of the monitoring points observed by the Implementing Agency before and after the project. The data on inundation duration and depth before the project were taken from the Implementing Review Study Report, and those recorded after the project were obtained from the Implementing Agency. It is impossible to judge the degree of achievement for these monitoring points because no target levels were determined for them at the planning stage. However, the data reveals that the inundation conditions greatly improved comparing the pre- and post-project figures at many monitoring points. In particular, the reduction of the inundation periods is quite noticeable.

Table 3. Change in Inundation Duration and Depth at Major Monitoring Points
(Before and After the Project)

Monitoring Point	Catchment Area (*1)	July 13, 2008 (Before Project) Rainfall: 61.8 mm/day	June 15, 2013 (After Project) Rainfall: 67.0 mm/day	July 6, 2015 (After Project) Rainfall: 67.0 mm/day
GPO	GR	8.8 hours 13 cm	2.25 hours 38 cm	2.42 hours 25 cm
Nabba Road	GR	6.5 hours 30 cm	3.25 hours 56 cm	3.50 hours 15 cm
Eik Moria Pull	SB	5.3 hours 61 cm	0.50 hours 20 cm	1.00 hours 30 cm

Chowk Nakhuda	SB	7.5 hours 46 cm	0.50 hours 13 cm	No record 15 cm
Sheranwara Gate	SB	3.5 hours 15 cm	2.75 hours 20 cm	No record 25 cm
Outside Bhatti Gate	SB	6.0 hours 76 cm	1.75 hours 20 cm	No record 10 cm

Notes: (*1) GR: Gulshan-E-Ravi; SB: Shad Bagh
(*2) Enclosed figures : Improved after the project
Source: Preparatory Survey Report; Documents provided by the Implementing Agency

From the results of the beneficiary survey[5] and the interviews with residents in the neighborhood of the pumping station, it is evident that the degree of inundation greatly improved after the project. The main results of the beneficiary survey for the residents in the catchment areas of the target pumping stations conducted as part of this ex-post evaluation are as follows:

(1) Among the total respondents (120 households), 83% responded that the frequency of exposure to inundation in their residential area had decreased after the project, given the same levels of rainfall.

(2) Among the total respondents (120 households), 75% responded that the duration of inundation in their residential area had decreased after the project, given the same levels of rainfall.

(3) Twenty-two of the 120 households responded that their houses were not exposed to inundation even before the project. Of the remaining 98 households, 80% responded that the frequency of exposure to inundation in their houses decreased after completion of the project, given the same levels of rainfall.

(4) As stated above, 22 of the 120 households responded that their houses were not exposed to inundation even before the project. Of the remaining 98 households, 82% responded that the duration of inundation in their houses had decreased since completion of the project, given the same levels of rainfall.

(5) According to the interviews with some residents based in the vicinity of one of the target pumping stations, prior to the project, inundation could continue for two to three days, but it now lasts for about 30 minutes after heavy rain. Some of the interviewees commented that clear improvement was recognizable in inundation

[5] The beneficiary survey was conducted to examine the reductions in inundation damage to the properties of residents in the target areas and the impacts on their living and hygiene environments made by this project. The survey was conducted in April 2016 in the targeted catchment areas of three pumping stations, and interviews with the sampled residents (120 households, comprising 40 in each of the three catchment areas) were conducted by surveyors based on the questionnaire at the sample households' residences. The samples were selected as follows. First, fourwards were chosen from each catchment area, to ensure that their locations varied in proximity to the trunk drains. Second, 10 households were randomly selected from WASA's customer list for each ward. A total of 120 respondents, comprising 53 females and 67 males, were selected. Apart from this beneficiary survey, group interviews were conducted directly by the external evaluator with several members of the Union Councils and local shop owners based in the vicinity of the Gulshan-E-Ravi Pumping Station.

conditions immediately after the pumps were replaced in the pumping station through the project. This implies that the project has made a substantial contribution to improving inundation conditions.

Furthermore, as Table 4 indicates, the number of complaints to WASA from 2009 about inundation from the citizens in the target catchment areas has been constantly decreasing from 14,863 cases in the peak year of 2012 to 8,303 cases in 2015. According to the Implementing Agency, the complaints about inundation include not only those directly related to heavy rain but also those caused by other factors, such as blockages in drains, and complaints in both these categories have continued to decrease.

Table 4. Number of Citizen Complaints about Inundation in the Target Catchment Areas

Catchment Area	Number of Complaints about Inundation						
	2009	2010	2011	2012 (Year of Completion)	2013	2014	2015
Shad Bagh Pumping Station	4,897	5,142	5,273	6,096	4,794	4,288	3,347
Gulshan-E-Ravi Pumping Station	4,314	4,890	5,038	5,954	4,827	4,312	3,673
Multan Road Pumping Station	1,566	1,987	2,141	2,813	1,927	1,719	1,283
Total	10,777	12,019	12,452	14,863	11,548	10,319	8,303

Source: Documents provided by the Implementing Agency

As demonstrated above, apart from the actual data concerning the effect indicator, improvement in the degree of inundation is supported by various data and the results of the survey and interviews with the local residents.

3.3.2 Qualitative Effects

Qualitative effects were examined from the perspectives of mitigating the pumps' deterioration and easing the workload of the cleaning staff – referred to as "sanitary workers" – in the pumping station where the automatic trash rake systems were installed. Interviews with the WASA staff in the Implementing Agency's headquarters and on-site in the Shad Bagh Pumping Station revealed that the following pump operation effects were generated by the introduction of the automatic trash rake systems.

(1) The frequency of pump operation shutdowns due to inflows of solid waste decreased by 25-30% after the project, thereby improving the operational efficiency of the pumps.

(2) This has enabled the entire pumping station to operate without interruption (24 hours) during the monsoon season, leading to stable operation of the pumping station.

(3) Fewer operators and fitters are now needed to ensure continuous monitoring of the

pumps.

(4) According to the manager in charge of the pumping station, a more efficient working system for sanitary workers has been realized, with fewer workers required per shift. Furthermore, compared to the previous working conditions, in which sanitary workers manually removed the solid waste flowing into the pumping station, their physical exertions have been mitigated and hygienic environments improved since the automatic trash rake systems were installed.

Therefore, the introduction of the automatic trash rake systems is judged to have mitigated the halt and breakdown of not only the pumps provided by this project, but all of the pumps in the Shad Bagh Pumping Station, and also increased the efficiency of the entire pumping station's operation. Improvement in the workload and hygienic conditions for sanitary workers has also been observed.

3.4 Impacts

3.4.1 Intended Impacts

The overall impact of this project will be determined by verifying the degree to which the expected improvements in the living environment of the residents located within this project's pumping station catchment areas were achieved after the project completion in 2012.

Below are the principal answers to the survey questions, which asked resident beneficiaries about changes in their living environment.

(1) A multiple-choice question was given to the respondents (120 households) in the catchment areas of the project on water-borne diseases affecting anyone in the family before and after the completion of the project, i.e. before 2013 and from 2013. The number who responded that no one in their households was affected by water-borne diseases increased from 41 households (34% of all respondents) to 57 (48% of the same) comparing pre- and post-project data. Furthermore, the number of households affected by relatively common water-borne diseases, such as diarrhea and skin disease, decreased after the project's completion (Table 5).

Table 5. Water-borne Diseases Recognized in 120 Households

Water-borne Disease	Before 2013		From 2013 to Present	
	Number*	Proportion of Total Respondents	Number*	Proportion of Total Respondents
1. Diarrhea	63	53%	42	35%
2. Skin disease	31	26%	24	20%
3. Cholera	3	3%	6	5%
4. Typhoid	8	7%	5	4%
5. Dysentery	3	3%	0	0%
6. Hepatitis A	7	6%	9	8%
7. None	41	34%	57	48%
8. Other	10	8%	9	8%

*Note: Aggregated figures of responses for each disease provided by the 120 respondents
Source: Beneficiary Survey

(2) The same respondents (120 households) were asked to state the total number per year of water-borne diseases that any of their household members had been affected by before the project was initiated and after the project was completed, i.e. before 2013 and from 2013. A decrease in the frequency of disease incidence was observed. For example, households reporting water-borne disease incidence of twice a year or less accounted for 62% before the project's completion and 79% after completion (Table 6).

Table 6. Frequency of Water-borne Diseases Affecting Any Household Member

Disease Frequency	Before 2013	From 2013 to Present
1. None	34%	48%
2. 1 to 2 times a year	28%	31%
3. 3 to 5 times a year	33%	18%
4. 6 to 9 times a year	6%	4%
5. 10 or more times a year	0%	0%

Note: The aggregation of the figures in the columns does not amount to 100% due to rounding error.
Source: Beneficiary Survey

(3) A comparison of the degree to which families' social lives were affected by inundation (the economic aspects of commuting to work or school, and living environmental aspects such as sanitary conditions, mud, dust, stench, etc.) pre- project implementation and post-project completion demonstrated that the effects of inundation had been reduced, and the responses reporting no influence from inundations increased (Table 7).

Table 7. Degree of Influence of Inundation on Daily Life of Household

Degree of influence	Commuting to Work or School		Living Environment (e.g., unsanitary conditions, mud, dust, bad smell, etc.)	
	Before 2013	From 2013 to Present	Before 2013	From 2013 to Present
1. Greatly affected	19%	4%	10%	7%
2. Moderately affected	26%	20%	26%	13%
3. Slightly affected	31%	35%	30%	35%
4. No influence	24%	41%	34%	45%

Source: Beneficiary Survey

(4) In addition to the responses detailed above, open answers were solicited concerning effects on the households' standard of living and environment. Many responses concerned damage to residence walls or to furniture, and 62% reported that such problems had decreased after the project's completion, which was much greater than those who reported no change (23%) and those who reported that the damage was worse (15%).

Thus, while overall improvements were observed through reductions in the incidence and frequency of water-borne diseases, considering that rainfall causing inundation damage occurs on a limited number of days each year, an even greater impact could be achieved through changes to people's habitual use of water, including the water supply system, for daily life activities and drinking. This makes it difficult to assess the degree of this project's contribution. Nonetheless, considering the connection between the reduced inundation damage following this project and the reduction in the latent risks of exposure to water-borne diseases by lessening the chances of direct contact with infection sources, such as contaminated water, it is reasonable to state that this project had a positive, if indirect, effect when considered in connection with other factors of improvement, such as improved water works and a greater awareness of health among the local population. Conversely, since it is recognized that the effects on people's daily life (commuting to work and school) and the living environment were directly generated by the reduced inundation damage, this project is judged to have provided certain positive impacts.

3.4.2 Other Impacts

This project was pursued to add new pumps and renew others at WASA's existing pump stations, in addition to installing related facilities, such as discharge basins; therefore, no damaging effects upon the natural environment have been identified. Furthermore, this project did not involve the acquisition of new land or the relocation of inhabitants.

The machinery and materials removed in the process of implementing this project were disposed of in a proper manner, with no effect on the current operating environment.

Furthermore, the solid waste accumulated within the pumping stations, such as the trash gathered by the automatic trash rake systems installed and that accumulated in the on-site collection ponds, are collected periodically (twice a month) by WASA's drainage division and hauled to the city's waste treatment facility. Thus, the working environment within the pumping stations is properly maintained.

As seen above, in discerning quantitative effects, the cover rate of the total drainage pump capacity to the required drainage capacity shows that the expected levels were largely met. The inundation level at the monitoring point where the target value was set achieved its target. The inundation damage level also shows clear indications of improvement based on the recorded data from other monitoring points, the results of the beneficiary survey, and interviews with representatives of the residents and shop owners in the areas surrounding the pumping stations. The qualitative effects were verified by the increased efficiency of operations and management of the overall pumping stations generated by the introduction of the automatic trash rake systems. The impact of this project can be seen where it has reduced inundation damage, resulting in improving the situations for residents' commute to work or school, in addition to the sanitation environment in their houses. Furthermore, there have been no negative effects on the natural environment, and no resettlement of residents has been required.

In terms of effectiveness and impacts, hence, this project has largely achieved its objectives. Therefore the effectiveness and impacts of the project are high.

3.5 Sustainability (Rating: ③)

3.5.1 Institutional Aspects of Operation and Maintenance

The basic organization of WASA has not changed since the project's planning stage. As of 2015, WASA had 5,655 employees. Under the direction of the Deputy Managing Director of Operation and Maintenance, directors for the towns were assigned, and each town directorate was divided into subdivisions with a Sub Divisional Officer and Sub Engineer assigned to each. Operation and maintenance of each pumping station falls under the jurisdiction of the subdivision concerned.

The operation and maintenance of the three pumping stations targeted by the project is performed 24 hours a day in three shifts, which is unchanged from the time of planning the project. The numbers of operation workers assigned to each pumping station are as follows: 33 at the Shad Bagh Pumping Station, 26 at the Gulshan-E-Ravi Pumping Station, and 15 at the Multan Road Pumping Station. The number of sanitary workers at the Gulshan-E-Ravi Pumping Station, where the automatic trash rake systems were installed by this project, reduced from 21 at the time of planning the project to 14 due to the consequent increased operational efficiency.

For many years, WASA has used newspaper and radio advertising – supplemented from 3-4 years ago with television advertising – to mount campaigns to raise public awareness that waste should not be thrown into the sewerage and drainage systems, thereby attempting to set new norms in their proper use. In addition, from 2012, WASA created a post responsible for social enlightenment, aiming at promoting greater understanding among citizens on water conservation and usage, for which they hired an expert in social awareness activities. This expert is involved in organizing educational activities for children, in collaboration with educational organizations, and other public events.

As explained above, the operation and maintenance system of the machinery and equipment has not changed significantly from the time of planning the project, and WASA is judged to hold an institutional system that can stably handle operation and maintenance. Further, establishing a position of social enlightenment is judged to be a solid foundation for continuous campaigns rooted in the community, though the current scope of the work undertaken by one officer under the Director of Planning and Evaluation is limited.

Motor and Electrical Control Panels
(Multan Road Pumping Station)

WASA's Advertisements to Raise Public Awareness

3.5.2 Technical Aspects of Operation and Maintenance

According to interviews with the Implementing Agency, no problems have been identified with the technical skills of the pump operators and fitters in the pumping stations targeted by the project. The reason is because the installed pumps and the automatic trash rake systems were the same type of equipment and systems as those introduced in 2006 by Japan's Grant Aid "Project for the Retrieval of Sewage and Drainage System in Lahore City," in addition to other equipment used by WASA. The operators and other personnel involved in operating the automatic trash rake systems and other equipment were trained by the equipment's manufacturer when the systems were installed. Additionally, WASA maintains an on-site training center in the Gulshan-E-Ravi Pumping Station to provide technical training to existing workers. In 2015-2016, a total of 138 one-day training sessions were held for drainage pipe

fitters, sanitary workers, pumping well operators, with 3,600 workers participating in total.

None of the machinery and equipment installed in this project require high-level operational skills, and the skills necessary for the existing machinery can be sufficiently applied to the new pumps and systems. In addition, the technical capacity of the staff is maintained by the aforementioned internal training courses. Thus, the operation and maintenance skills of the relevant WASA workers in regard to the machinery and equipment provided by this project are judged to be maintained.

3.5.3 Financial Aspects of Operation and Maintenance

As the organization responsible for providing both water supply and sewerage and drainage services and for collecting the user charges for both services, WASA needs to improve its management system to increase its revenues. Even after completion of the project, WASA's total expenditures have been exceeding its total revenues, making the entity reliant on subsidies to meet the difference. However, some signs of improvement in the organization's financial structure can be observed from the recent trend of its receipts and expenditures (Table 8), which are as follows:

(1) As revenues from water and sewerage charges steadily increase, the proportion of subsidies in WASA's total income has declined from nearly 40% in 2011-12 to a little over 30% in recent years.

(2) Repairs and maintenance have constantly accounted for around 10-13% of WASA's total expenditure and large reductions have not been made. WASA maintains expenditure levels on repairs and maintenance, and no problems or stoppages attributable to lack of repair or inadequate maintenance budgets have occurred with the machinery at the three pumping stations.

One major reason for WASA's expenditures continuing to exceed its revenues is that, for political reasons, water supply and sewerage price increases have not been allowed since 2004. According to an interview with the Government of Punjab, although WASA has been asked to realize more effective management by reducing non-revenue water and by saving costs, the government have continued to provide annual subsidies to pay part of the power and energy charges, which account for nearly half of all WASA's total expenditure. It was explained during the same interview that although the subsidies' provision is decided every year as part of discussions on the province's annual budget, the decisions on the subsidies are based on the balance of WASA's revenue and expenditure. Judging from WASA's current financial situation, there is relatively little prospect of the subsidies being withdrawn in the short term, and it can be assumed that provision of a certain amount of subsidies will continue in the future.

Table 8. Receipts and Expenditures of WASA (Unit: Million PKR)

	2011-12	2012-13	2013-14	2014-15
Receipts				
Water Supply Charges	1,236	1,305	1,583	2,119
Sewerage Charges	878	944	1,141	1,503
Miscellaneous	134	133	415	169
UIP (Urban Immoveable Property) Tax Share	509	926	726	900
World Bank Program			354	425
Sub Total	2,758	3,309	4,218	5,116
Expenditures				
Payroll and Benefits	1,780	1,933	2,044	2,489
Repair and Maintenance	688	785	615	1,803
Petroleum, Oil and Lubricant		517	508	666
Power and Energy	2,491	2,678	2,534	3,846
Other Expenses	98	74	82	288
Monsoon Expenditure	45			
Operating Expenditure	5,102	5,987	5,784	9,090
Amount Payable to Lahore Development Authority				171
Total Expenditure	5,102	5,987	5,784	9,261
Surplus/Deficit for the Year	-2,344	-2,678	-1,566	-4,145
Grant by the Government	1,730	2,179	2,051	2,631
Opening Balance	-897	684	185	670
Total Surplus/Deficit	-1,511	185	670	-843

Note: 2014-15 figures for all items are budget allocation. Figures in the other years are actual amounts.
Source: Documents provided by the Implementing Agency

Furthermore, the number of WASA contracts for water supply and sewerage connections has been increasing every year, and the revenue from each connection has also been constantly increasing. Its collection ratio of water charges based on the number of accounts (physical collection ratio) is also steadily improving. On a financial basis, while the collection rate (financial collection ratio) varies between recent years, it is evident that the overall situation has been improving since even before the project, as the Preparatory Survey Report found that the financial collection ratio largely remained around 70% or over until 2008 (Table 9).

Table 9. Number of WASA's Water Supply and Sewerage Connections and its Collection Ratio

	Unit	2011-12	2012-13	2013-14	2014-15
Number of Connections: Water Supply and Sewerage	Number	620,150	636,490	646,728	657,862
Water Supply and Sewerage Revenue per Connection	Thousand PKR	3.41	3.53	4.21	5.50
Operating Expenditure per Connection	Thousand PKR	8.23	9.41	8.94	13.82
Physical Collection Ratio	%	63.9	64.6	64.0	65.1
Financial Collection Ratio	%	85.0	73.0	85.1	81.9

Note: 2014-15 figures are budget allocation. Figures in the other years are actual amounts.
Source: Documents provided by the Implementing Agency

According to interviews with the Implementing Agency and JICA experts, WASA has been working to implement management and financial reforms set out in its six-year business plan that began in 2010-11. Examples of its financial reform programs that have been evaluated as successful are as follows:

(1) Revenue improvement realized by investigating and tackling illegal connections;
(2) Improved rate of invoice delivery to customers;
(3) Strengthening of timely support for customers, such as tackling leaks;
(4) Promotion of negotiations with the electrical power company concerning over-invoicing of electricity charges caused by flaws in meters;
(5) Renewal of worn-out water pipes and well pumps;
(6) Awareness raising of senior officers, such as assistant directors, to improve profitability by sending them to training courses in financial and customer management at the Al-Jazari WATSAN Academy, which is supported by JICA;[6] and
(7) Computerizing the regular inspection records of machinery and equipment, etc.

Of the approximately 660,000 contracted household connections to water supply and sewerage systems, only 90,000 had been fitted with water meters as of June 2016,. At the time of this ex-post evaluation, however, procedures to procure 50,000 additional meters for installation were ongoing, indicating that the number of meters in use will gradually increase, contributing ultimately to increased revenues from water charges.

According to interviews with JICA experts and to the related documents, the aforementioned WASA initiatives have begun to yield tangible returns. For example, the installation of precise electricity meters and tackling issues of being overcharged by the electrical power company resulted in cost improvements of 3,710 million PKR; moreover, addressing illegal and faulty connections led to a 12 million PKR financial improvement in the first half of FY 2015-16, demonstrating concrete profitability improvements. Since overall cost savings are in progress,

[6] "Project for Improving the Capacity of WASAs in Punjab Province" (2015-2018)

while the necessary costs for operation and maintenance of the machinery and equipment are secured as described above, the financial sustainability of operation and maintenance is judged to be largely guaranteed.

3.5.4 Current Status of Operation and Maintenance

The machinery and equipment procured by this project are all operating without problems. None are observed to be used with a particularly low frequency. For repairs beyond WASA's capability, WASA sub-contracts the repair works to local companies. There are no major problems with the repair works, including the procurement of spare parts.

Other than on-site daily machinery maintenance, a system has been introduced within WASA under which officers at the management level, including sub-divisional officers and sub engineers inspect a certain section of the equipment and facilities in their assigned areas on a daily basis. If a problem is identified, the officer in charge gives instructions to the on-site officers to correct it. Further, manuals of Standard Operation Procedures have been prepared to be followed on-site in case of emergencies or major breakdowns.

Conversely, on-site interviews and observations in this ex-post evaluation revealed that stoppages of the automatic trash rake systems have increased in recent years compared to the initial years of their operation, indicating that more maintenance work on the systems is now required. During the first site visit as part of the ex-post evaluation, the two automatic trash rake systems introduced by the project were being halted for approximately one month for their preventative maintenance in preparation for their full-scale operation in the coming monsoon season. Some on-site staff commented that, during regular operation, the systems have to be stopped about one day each month to allow adjustments to be made. In the interview with a sanitary worker, a comment was also made that the workers had to monitor the automatic trash rake systems at all times as the systems often stopped during daily operations.

Thus, overall, the operational status of the machinery and equipment is satisfactory, and maintenance is judged to be carried out under adequate supervision (both on-site and at the sub-divisional levels) and with various inspection systems (daily inspection, regular inspection, and emergency response). Conversely, the main reasons for the reduced operational efficiency of the automatic trash rake systems can be considered as follows: (1) aging of the systems, and (2) a large amount of solid waste being discharged into the relevant pumping station, which adversely affects the operation of the systems. In fact, a very large amount of solid waste continues to be thrown into the open drainage canals that lead directly to the Shad Bagh and Khokhar Road pumping stations. The WASA personnel in charge of these pumping stations observed that the amount of solid waste flowing into the pumping stations has not declined over the years, but has actually increased. However, judging overall from the interviews with concerned persons, including the consultant on this project, there are no particular problems

with the design or capability of the automatic trash rake systems installed through the project. The systems' current decline in operational efficiency is regarded as being within the normal range, although they do require constant maintenance in an appropriate manner. To ensure continuation of effective use of the systems taking a great deal of strain even more attention needs to be focused on their maintenance in the future. Currently, however, relevant measures are being taken, such as the preventative maintenance in advance of the monsoon season.

Sanitary Workers Removing Solid Waste from Automatic Trash Rake System

Open Drainage Canal Connecting to the Shad Bagh Pumping Station

As seen from the above contents of this report, this project's operation and maintenance system for the machinery and equipment has not changed significantly from the time of planning the project, ensuring that the system continues to stably operate in an organized manner. In terms of technical capacity, a great deal of experience gained by WASA as the organization handling pump operations has enabled it to maintain the machinery and equipment properly, through on-the-job training (OJT) and internal training, in addition to the instructions provided by the manufacturers. Regarding financial aspects, WASA's expenditures still exceed revenues, necessitating subsidies for some time into the future. Nevertheless, the trend of revenues from water supply and sewerage connections is increasing, and stable repair and maintenance expenses are as budgeted. The overall operational status of the machinery and equipment, such as the pumps, is satisfactory. However, the automatic trash rake systems installed through the project are being subjected to extensive strain due to continued in-flows of a large amount of solid waste thrown into drainage canals leading to the pumping stations. Resolving this issue is considered to require greater attention to maintenance of these systems and campaigns to raise awareness among the public to ensure the continued effectiveness of the project in the future. Currently, relevant measures are being implemented, such as the preventative maintenance conducted in advance of the monsoon season. Thus, no major problems have been observed in the institutional, technical, and financial aspects of the operation and maintenance system. Therefore sustainability of the project effects is high.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

This project aimed to mitigate the damage in a repeatedly inundated area in Lahore City, Punjab Province; through renovation and installation of drainage pumps and other related equipment, thereby contributing to improving the living and hygiene environments of the local citizens. The project was, consistently, highly relevant to the development policies and development needs of Pakistan, from the planning stage through to the time of the ex-post evaluation; it was also highly relevant to Japan's assistance policy for Pakistan during the planning stage. The project outputs were mostly delivered as planned. The total project cost provided by Japan, which was examined in this ex-post evaluation, was significantly lower than planned due to the competition effect of the bidding process, and the project duration was as planned; therefore, its efficiency is high. Regarding the project's quantitative effects, it produced by and large the largely expected level of improvement in the total drainage capacity though the target value was not achieved. The project did achieve its target for mitigating inundation damage. Regarding the project's qualitative effects, the automatic trash rake systems improved the operational efficiency of the pumping stations. In addition, it was observed that the project had positive impacts on the daily lives and the housing and hygiene environments of the people in Lahore; therefore, the effectiveness and impact of the project are high. No major problems have been observed in the institutional, technical, or financial aspects of the operation and maintenance system; therefore, the sustainability of the project effects is high. In light of the above, this project is evaluated to be highly satisfactory.

4.2 Recommendations

4.2.1 Recommendations to the Implementing Agency

<u>Strengthen the campaign against unmoral waste dumping by residents in the vicinity of the open drains</u>

A tremendous amount of solid waste still flows into the Shad Bagh and Khokhar Road Pumping Stations directly from the open drain canals stretching in the east side of the stations; moreover, it was revealed during the course of this evaluation that there has been no sign of any decrease of the amount since the project was completed. If the amount of solid waste flowing into the stations exceeds the capacity of the automatic trash rake systems, it may cause severe damage to the pumps, thereby affecting the inundation situation of the people in the entire catchment area of the pumping stations. Therefore, it is recommended that WASA should strengthen its campaigning activities, targeting particular areas to promote people's awareness and behavioral changes in collaboration with relevant authorities and organizations. To prioritize the areas or sections to be addressed, it would be useful to first conduct a survey

on the situation of solid waste flowing into the pumping stations from the concerned open drains and of the locations in the drains where solid waste is dumped. Based on the findings, it would be advisable to then determine the appropriate allocation of human resources necessary for promoting campaigns to the target residents in each area, in parallel with WASA's regular cleaning activities. Furthermore, WASA could consider promoting active communications with the city waste management company and the outsourced company responsible for waste collection, to encourage them to strengthen their activities in the areas concerned. It is further expected, in the longer term, that WASA will consider converting the open drains to closed conduits as the most effective countermeasure to the problem.

4.2.2 Recommendations to JICA

None.

4.3 Lessons Learned

Encourage supporting activities from the beneficiary country to facilitate greater sustainability of the effectiveness of equipment provided through a project

As part of the project, automatic trash rake systems were introduced together with the drainage pumps to mitigate the decrease in operational efficiency of the pumps caused by massive in-flows of solid waste. While the operational efficiency of the pumps has undoubtedly improved because of the automatic trash rake systems, it is observed that these systems themselves have to withstand extensive strain due to constant in-flows of a large amount of solid waste. Although the system's current operation condition is regarded as being within the normal range, it is desirable to start implementing measures to reduce the amount of solid waste flowing into the pumping stations as early as possible, with a view to ensuring their sustained effectiveness in the longer-term. Thus, in planning a cooperation project including the provision of equipment, if certain post-completion supporting activities from the beneficiary country are expected to greatly influence the sustainability of the equipment's effective operation, JICA should encourage the beneficiary country in advance to actively implement the relevant measures. It may be appropriate to first check whether the beneficiary country or the implementing agency's medium term activity plans include such necessary measures.

End