Ex-Post Project Evaluation 2015:
Package IV-6 (Pakistan)

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Islamic Republic of Pakistan

FY2015 Ex-Post Evaluation of Japanese Grant Aid Project

"Project for Improvement of Water Supply System in Faisalabad"

"Project for Expansion of Water Supply System in Faisalabad"

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

0. Summary

This project aimed to improve the water supply in Faisalabad City, Punjab Province, by developing additional water sources and intake facilities and installing water collecting, transmitting, and distribution facilities including a terminal reservoir, and by reinforcing the existing arterial mains, thereby contributing to the improvement of the health and hygiene environment and living conditions of local residents. The project objective was highly relevant to the development policies and needs of Pakistan consistently from the planning stage to the ex-post evaluation, and also to Japan's assistance policy for Pakistan in the planning stage. Although the project plan was revised repeatedly due to a series of unsuccessful bids, the outputs were produced mostly as planned. The main reason for the unsuccessful bids was multiple occurrences of unexpected events, including an extraordinary natural phenomenon, and the revisions of the plan were considered to be adequate. Based on the comparison between the revised plan and the actual inputs, although the project cost was within the scope of the plan, the project period exceeded the plan. Therefore, the efficiency of the project is fair. The augmentation of water supply through the development of a new wellfield, which is the most fundamental indicator for the project's effects, and the increase of the maximum water pressure in the arterial mains in the eastern side of the city were successfully achieved. The project's positive impacts have been observed. On the other hand, water supply hours have not been extended due to inability to cover the operation costs of the distribution pumps sufficiently because of hikes in electric power charges and water supply services in the eastern side of the city have yet to show a sufficient level of improvement. Therefore, the effectiveness and impact of the project are fair. No major problems have been observed in the institutional, technical, and 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 satisfactory.

1. Project Description

Project Location

Terminal Reservoir and Pumping Station

1.1 Background

In recent years, Pakistan's major cities have witnessed a large influx of the rural poor putting added pressure on weak urban infrastructures. Social services, including water supply, have been lagging behind in every large city. In Faisalabad, only 55% of households were connected to the city's water service in 2003, and the rest of the population mostly relied upon groundwater sources from tubewells with motorized pumps or hand pumps and bottled water sold in the city for drinking. While Faisalabad had grown to be one of the major industrial cities in the country along with the development of textile industry, contamination of groundwater was spreading in the city caused by factory wastewater and domestic sewage. Thus, there was a high risk to citizens' health from using contaminated water sources.

In 1976, Faisalabad City developed a master plan for water and sewerage with the support of Asian Development Bank; based on which the Phase 1 system of water supply facilities was completed in 1992. After the revision of the master plan, the government of Pakistan requested the government of Japan, in 1995, to undertake Phase 2 of the plan by a grant aid project to increase water supply amount by 2000. In response to this, JICA dispatched a mission to Pakistan for a basic design study in 1998, but the study was suspended later in the same year due to the suspension of development assistance as part of Japan's economic sanctions on Pakistan in response to its nuclear testing. After the sanctions were removed in 2001, a new basic design study was conducted and the target area for developing water sources was changed.

Against this background, "The Project for Improvement of Water Supply System in Faisalabad" (hereinafter referred to as "The Improvement Project") was initiated in 2004. Phase 2 of the project, which was later divided into two tasks; "The Project for Expansion of Water Supply System in Faisalabad" (hereinafter referred to as "The Expansion Project") was commenced in 2010 to complete the installment of a water source component, separated from "The Improvement Project."

1.2 Project Outline

The objective of this project[1] was to improve water supply in Faisalabad by developing additional water sources and intake facilities and installing water collecting, transmitting, and distribution facilities including a terminal reservoir, and by reinforcing the existing arterial mains, thereby contributing to the improvement of the health and hygiene environment and living conditions of the local residents.

<Grant Aid Project>

E/N Grant Limit or G/A Grant Amount / Actual Grant Amount	(1) "Project for Improvement of Water Supply System in Faisalabad" (i) 708 million yen / 705 million yen (Phase 1) (ii) 3,228 million yen / 3 million yen (Phase 2) (iii) 4,442 million yen / 4,424 million yen (Phase 2)[2] (2) "Project for Expansion of Water Supply System in Faisalabad" 799 million yen / 757 million yen
Exchange of Notes Date (/Grant Agreement Date)	(1) "Project for Improvement of Water Supply System in Faisalabad" (i) November, 2004 (Phase 1) (ii) April, 2005 (Phase 2) (iii) July, 2008 (Phase 2) (2) "Project for Expansion of Water Supply System in Faisalabad" August, 2010 / September, 2010
Implementing Agency	Water and Sanitation Agency (WASA), Faisalabad
Project Completion Date	(1) "Project for Improvement of Water Supply System in Faisalabad" (i) March, 2006 (Phase 1) (ii) Uncompleted (Phase 2) (iii) May, 2012 (Phase 2) (2) "Project for Expansion of Water Supply System in Faisalabad" June, 2012

[1] In this ex-post evaluation, two grand aid projects, namely "Project for Improvement of Water Supply System in Faisalabad" and "Project for Expansion of Water Supply System in Faisalabad," are to be evaluated. The former project faced a series of unsuccessful bids that led to revisions of cost estimates and project scope, and conclusion of a new exchange of notes (E/N). This resulted in the separation of a part of the project components, and the latter project was planned and implemented. For this reason, in this ex-post evaluation report, the word "this project" is used to mean the entire cooperation comprising both of "Project for Improvement of Water Supply System in Faisalabad" and "Project for Expansion of Water Supply System in Faisalabad," based on the recognition that they can be treated as a combined cooperation with a common objective. However, they can be analyzed individually when necessary, in such cases as evaluating efficiency by examining inputs and outputs of each project separately.

[2] E/N was concluded twice for Phase 2 of "the Project for Improvement of Water Supply System in Faisalabad." Since the first one was expired without completion, a new E/N was concluded later.

Main Contractor(s)	(1) “Project for Improvement of Water Supply System in Faisalabad” (i) Taisei Corporation (Phase 1) (ii) Not selected (Phase 2) (iii) Tobishima Corporation (Phase 2) (2) “Project for Expansion of Water Supply System in Faisalabad” Joint Venture of Tobishima Corporation and Dai Nippon Construction
Main Consultant(s)	(1) “Project for Improvement of Water Supply System in Faisalabad” Japan Techno Co., Ltd. (2) “Project for Expansion of Water Supply System in Faisalabad” Japan Techno Co., Ltd.
Basic Design	(1) “Project for Improvement of Water Supply System in Faisalabad” Basic Design Study 1: July, 1998 Basic Design Study 2: June, 2004 Implementing Review Study: December, 2007 (2) “Project for Expansion of Water Supply System in Faisalabad” Implementing Review Study: March, 2010
Detailed Design	Detailed Design Study 1: March, 2006
Related Projects	➢ JICA Grant Aid “Project for Replacement of Pumping Machinery at Inline Booster Pump Station and Terminal Reservoir in Faisalabad” (2015-2019) ➢ 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” (2013-2015) ➢ JICA Grant Aid “Project for Upgrading of Mechanical System for Sewerage and Drainage Service in Faisalabad” (2012-2015) ➢ World Bank “Punjab Cities Governance Improvement Project” (2013-2017) ➢ French Ministry of Economy and Finance “Extension of Water Resources for Faisalabad City” (2010-2015)

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 7, 2016 – March 21, 2016; June 13, 2016 – June 17, 2016

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

3.1 Relevance (Rating: ③[4])

3.1.1 Relevance to the Development Plan of Pakistan

The government of Pakistan has consistently placed an emphasis on increasing the coverage of the water supply for citizens from the time of planning the project[5] to the present. This policy direction is observed in government plans, such as "Poverty Reduction Strategy Paper (PRSP) (2000/1-2005/6)," "Ten-Year Perspective Development Plan (2001-2010)," and "Mid-Term Development Framework (2005-2010)" and "National Drinking Water Policy (NDWP) (approved in 2009)" both of which were confirmed when the project plan was revised by the Implementing Review Studies of 2007 and 2010. NDWP aims to supply safe drinking water to all citizens by 2025. Also, the government of the Punjab targets the supply of safe drinking water to all citizens in the province by 2020 in the "Punjab Drinking Water Policy" that was prepared in 2010 based on NDWP. In addition, "Punjab Water, Sanitation, and Hygiene Sector Development Plan (2014-24)" sets a target of providing 100% coverage of piped water supply in the cities and towns of the province. Thus, this project was in line with the development plans of Pakistan at the national and provincial levels from its planning to its evaluation.

3.1.2 Relevance to the Development Needs of Pakistan

According to an interview with the implementing agency of this project, namely the Water and Sanitation Agency, Faisalabad (hereinafter referred to as "WASA"), Faisalabad's water supply was approximately 65 million gallons (approximately 295,500 m^3) per day and the city's total demand was approximately 130 million gallons (approximately 591,000 m^3) per day at the time of project planning. The current supply is approximately 110 million gallons (approximately 500,000 m^3) per day, with a demand of 160 million gallons (approximately 727,400 m^3) per day. This indicates that although water supply now covers a greater share of the total demand, about one third of the demand has not been met. Likewise, the city's water service coverage rate has improved from approximately 40% at the time of planning the project to approximately 60% in 2012, leaving about 40% of the population still unserved by WASA's services.

Hence, as the water supply services in terms of supply amount and coverage rate have

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

[4] ③: High, ②: Fair, ①: Low

[5] When this evaluation report describes "the time of planning this project," it indicates the time when the Basic Design Study was conducted in 2004, unless otherwise stated.

improved, the tremendous needs that existed during the project planning phase have been gradually satisfied. The improved services, however, have not yet met the demand and development needs remain.

3.1.3 Relevance to Japan's ODA Policy

In its "Country Assistance Policy for Pakistan" formulated in 1997, the government of Japan made the "development of water supply and sewerage" a priority issue under the agenda of "improvement of living environment," as part of social sector development. It was succeeded in the "Country Assistance Program for Pakistan" in 2005, which positioned "ensuring safe drinking water and improving hygienic conditions" as its priority issue. The direction of the "Country Assistance Program for Pakistan" was maintained from the planning stage of "The Improvement Project" to the planning of separating "The Expansion Project" from "The Improvement Project." Since the objective of the project to improve the health and hygiene environment and living conditions of people by improving water supply services was sufficiently in line with this direction, this project was in good accordance with the orientation of Japan's assistance policy.

As described above, this project has been highly relevant to the country's development plan and development needs at the time of planning and this ex-post evaluation, as well as Japan's ODA policy at the time of planning. Therefore its relevance is high.

3.2 Efficiency (Rating: ②)

The efficiency of this project is examined by comparing its inputs and outputs. Regarding the analyzed inputs and outputs, this evaluation covers the facilities and equipment provided with funding from Japan's grant aid, since it was found to be difficult to identify the actual cost data of the undertakings by the Pakistanis in the Basic Design Study and the Implementing Review Study.[6] Accordingly, in this evaluation, the end of the project period is defined as the completion date of the work undertaken by the Japanese.

3.2.1 Project Outputs

Table 1 indicates the planned and actual outputs of this project. The planned outputs shown in the table are based on the original plan made in 2004 for "The Improvement Project." Some of the planned items or specifications were changed in 2007, which are explained in the footnotes of the table. The revision of the plan in 2007 was made by the Implementing Review Study conducted after the expiration of the E/N originally concluded for Phase 2 of "The Improvement Project" due to a series of unsuccessful bids.[7]

[6] The cost items and amounts indicated in the Planning Commission Document-1 (PC-1) for this project are not necessarily comparable to the cost estimates presented in the Basic Design Study and the Implementing Review Study. PC-1 is used as a prime tool in the budget approval system of Pakistan for investing in development projects.

[7] For Phase 2 of "The Improvement Project," the plan made in 2004 based on the Basic Design Study is hereinafter

Booster Pumps

Chlorinator Building at Booster Pumping Station

Table 1 Project Outputs by Phase

Original Plan (2004) (Underlined parts are items/specifications changed later by Implementing Review Study)	Actual: "Project for Improvement of Water Supply System in Faisalabad" Phase 1	Actual: "Project for Improvement of Water Supply System in Faisalabad" Phase 2	Actual: "Project for Expansion of Water Supply System in Faisalabad"
(1) Water source/intake facility 1) Tubewells: 25 units 2) Tubewell pumping stations: 25 units; Tubewell pumps: 25 units 3) Quarters for operators: 1 unit (*1)	-	(This component was originally planned to be undertaken in Phase 2. It was later separated from Phase 2 to be undertaken by "Project for Expansion of Water Supply System in Faisalabad.")	(1) Water source/intake facility 1) Tubewells: 25 units (including restoration of 1 unit) 2) Tubewell pumping stations: 25 units; Tubewell pumps: 25 units
(2) Collecting facility Collector mains (Dia. 400-900 mm x 15.6 km) (*2)	-	(2) Collecting facility Collector mains (Dia. 400-900 mm x 14.6 km)	-
(3) Transmitting facility 1) Booster pumping station: 1 unit; related equipment/facilities 2) Reservoir: 1 unit 3) Operation control building and operators' quarters: 1 unit each (*1) 4) Transmission mains (Dia. 1,000 mm x 13 km) (*2)	-	(3) Transmitting facility 1) Booster pumping station: 1 unit; related equipment/facilities 2) Reservoir: 1 unit 3) Transmission mains (Dia. 1,000 mm x 11.3 km)	-
(4) Distribution facility 1) Terminal reservoir 2) Terminal pumping station (*3)	-	(4) Distribution facility 1) Terminal reservoir 2) Terminal pumping station	-
(5) Reinforcement of existing arterial mains Supplementary sections (Dia. 700-800 mm x 6 km)	(5) Reinforcement of existing arterial mains Supplementary sections (Dia. 700-800 mm x 5.7 km)	-	-

called "the original plan," and the plan made in 2007 based on the Implementing Review Study is called "the revised plan."

(6) Procurement of equipment for operation and maintenance 1) Water level meter: 12 units 2) Water analysis equipment: 1 unit 3) pH/EC gauge: 2 units 4) TDS gauge: 2 units 5) Ultrasonic flow meter: 1 unit 6) Automatic pressure recorder: 2 units 7) Leak sound detector: 2 units 8) Voice communication system: 1 unit	(6) Procurement of equipment for operation and maintenance 1) Water level meter: 12 units 2) Water analysis equipment (spectrophotometer): 1 unit 3) pH/EC gauge: 2 units 4) TDS gauge: 2 units 5) Ultrasonic flow meter: 1 unit 6) Automatic pressure recorder: 2 units 7) Leak sound detector: 2 units 8) Voice communication system: 1 unit	-	-

Note:

(*1) These items were transferred to the undertakings of the Government of Pakistan in the revised plan of "Project for Improvement of Water Supply System in Faisalabad" Phase 2 in 2007.

(*2) The length of collector mains and that of transmission mains were changed to 14.6 km and 11.3 km respectively in the revised plan of "Project for Improvement of Water Supply System in Faisalabad" Phase 2 in 2007.

(*3) The power output and number of pumps were changed from 4 units of 330 kW (3.3 kV) to 2 units of 330 kW (3.3 kV) and 3 units of 620 kW (3.3 kV) in the revised plan of "Project for Improvement of Water Supply System in Faisalabad" Phase 2 in 2007. The actual outputs were the same as the revised plan.

Source: Documents provided by JICA and Implementing Agency; Interview with Implementing Agency

The reasons for revising the original plan and those for changing the planned outputs at the implementation stage are as follows.

The main revision of the original plan was a transfer of provision of operators' quarters and a control building on the premises of the water source and intake facility and the transmitting facility from the undertakings of the Japanese to those of the Pakistanis. This was intended to increase the possibility of a successful bid by reducing necessary work duration and cost, after the bidding for Phase 2 of "The Improvement Project" under the original plan was unsuccessful twice in a row. Since it is understood that there was no particular technical difficulty in the transferred works undertaken by the Pakistanis, and based on the above-mentioned revision process, the revision is judged to have been relevant to the project objective.[8] Other revisions of the original plan included adjustments made to pump specifications and the length of collector and transmission mains based on the agreement of both governments as a result of examination by the Implementing Review Study in 2007. These revisions are considered to have been minor variations from the original plan, judging the entire scope of the project.

At the implementation stage of the project, the length of arterial mains was slightly shortened

[8] According to the revised plan, two units of operators' quarters and one control building were provided by the Pakistanis on the premises of the water source and intake facility and the transmitting facility. In addition, the Pakistanis constructed one unit of operators' quarters on the premises of the distribution facility.

as a result of the Detailed Design Study. Since this changed the routing in order to avoid circumventing buried objects as much as possible, this change is judged to have been relevant to the objective of the project as a whole.

To summarize, though a part of the original plan of the project outputs was revised, the changes were minor and relevant to the project objective. The facilities and equipment were provided mostly as originally planned.

3.2.2 Project Inputs

3.2.2.1 Project Cost

After this project began, it underwent revisions through two Implementing Review Studies (details of the alterations are described later). Based on this fact, this evaluation compares the planned amounts and the actual amounts broken down into the project phases and separated projects (Phase 1 and 2 of "The Improvement Project" and "The Expansion Project"). If the alterations to the plan at each stage was found to be sufficiently appropriate, an evaluation was done based primarily on the comparison between the planned project cost (after revision) and the actual amount. If the alterations to the plan were not sufficiently appropriate, an evaluation was done using the project cost before alteration and the actual amount. Irrespective of the appropriateness, the actual amount is the sum of expenses incurred before and after alteration.

The planned and actual amounts of the project cost in each stage are shown in Table 2.

Table 2 Project Cost: Plan and Actual

	Japanese side (Million Yen)		[For reference] Pakistani side (Million PKR) (*1)	
	Plan	Actual	Plan（PC-1）	Actual
(1) (i) "Project for Improvement of Water Supply System in Faisalabad" Phase 1	708	705	631 (*2)	71.2
(1) (ii) "Project for Improvement of Water Supply System in Faisalabad" Phase 2 (Original Plan)	3,228	3		-
(1)(iii) "Project for Improvement of Water Supply System in Faisalabad" Phase 2 (Revised Plan)	4,442	4,424		441.7
(2) "Project for Expansion of Water Supply System in Faisalabad"	799	757		3.2
Total	-	5,889	631	516.1

Note:

(*1) The planned and actual costs borne by the Pakistanis were based on PC-1. PKR denotes Pakistani Rupees.

(*2) The planned amount in PC-1 was originally PKR 403 million. The PC-1 was revised after the Implementing Review Study on "Project for Expansion of Water Supply System in Faisalabad" was conducted in 2010, and the planned amount shown in the table is the revised one.

Source: Documents provided by JICA and Implementing Agency; Interview with Implementing Agency

Details of the two alterations from the original plan are as follows.

1) "The Improvement Project" Phase 2 (original plan) was not implemented, and Phase 2 was planned anew through a new Implementing Review Study in 2007. The original plan was not implemented because the contractor bidding was unsuccessful on three

consecutive occasions, making it impossible to complete the project by the relevant E/N deadline.

2) A part of the planned project was separated from "The Improvement Project" Phase 2, and this part was planned to be implemented as "The Expansion Project." The reason for this change was another unsuccessful bid for "The Improvement Project" Phase 2 (revised plan). After discussion between the governments of both countries, it was decided to separate components concerning water source and water intake facilities and implement them as "The Expansion Project." An Implementing Review Study was, therefore, conducted in 2010 for the purpose of re-estimation of the project cost of "The Expansion Project."

The causes for the unsuccessful bids, which resulted in two revisions of the plan, were as follows, according to the concerned Implementing Review Study Reports and the documents provided by JICA.

1) While Phase 1 and Phase 2 (original plan) of "The Improvement Project" were planned based on the project cost estimated in 2003, the material and labor costs needed for construction increased significantly due to (i) the subsequent worldwide increase in the price of steel, (ii) the rapid rise and continuing high cost of crude oil, (iii) the increase in prices and labor costs in Pakistan, and (iv) the increase in construction costs as a result of the need for restoration due to the major earthquake[9] that hit northern Pakistan in October 2005.

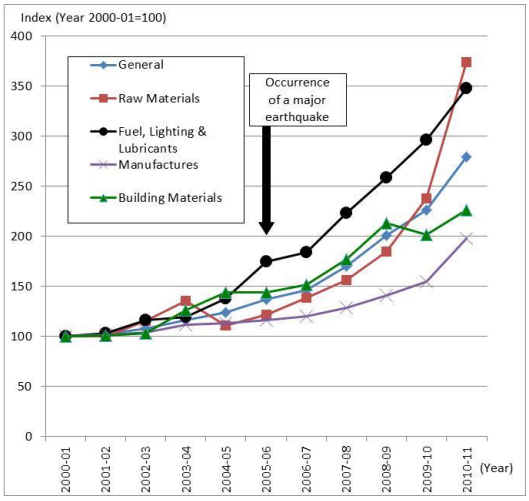
2) A global financial crisis occurred before the bidding concerning "The Improvement Project" Phase 2 (revised plan) in December 2008. This caused violent fluctuations in exchange rates, as well as instability in the costs of materials, such as steel pipes made in Pakistan and other construction costs.

Statistical data on the price indices of Pakistan show that prices, which were relatively stable until the cost estimation for the original project in 2003, subsequently increased continually, and the acceleration of the price rise continued until about 2010. The time when the bid for "The Improvement Project" Phase 2 (original plan) ended in failure in 2006, coincided with the rise in prices that began to manifest itself, as illustrated by the increase in the price of oil-related products by a factor of 1.5 and that of construction materials by a factor of 1.3 from the prices in 2003 (Figure 1). Furthermore, when the bid for "The Improvement Project" Phase 2 (revised) was unsuccessful in 2008, the wholesale price index showed a growth of nearly 20% over the previous year, greatly exceeding the rate of increase from preceding years (Figure 2).

In addition to the confirmation of macroeconomic parameters on the national level, this

[9] The major earthquake that occurred in Kashmir on October 8, 2005, is known as the North Pakistan Earthquake, the Kashmir Earthquake, etc. According to U.S. Geological Survey, it was a magnitude 7.6 earthquake and claimed the lives of at least 70,000 people in Pakistan and India.

evaluation included interviews with two local contractors involved in this project concerning the situation of construction material costs and labor markets in Faisalabad after the major earthquake in the northern region (Table 3). In brief, they explained that after the earthquake, restoration projects in the affected areas caused shortages of construction materials and construction workers in Faisalabad, and construction companies in the area were faced with a significant 1.5 to 2-fold increase in construction material prices and wages during 2006.



Source: Government of Pakistan, Economic Survey 2014-15

Figure 1 Price Indexes of Main Categories

Source: Government of Pakistan, Economic Survey 2014-15

Figure 2 Annual Growth Rate of Price Indexes

Table 3 Market Situation on Construction Materials and Labor in Faisalabad After North Pakistan Earthquake in 2005

Construction Company A

- In 2006, the daily wage for unskilled construction workers increased to PKR 300 from PKR 200 before the great earthquake. Faisalabad faced a labor shortage because many workers went to the earthquake-stricken areas, such as Khyber Pakhtunkhwa Province, for reconstruction projects. After a while, they began to return. However, their wages did not return to the previous level.
- After the earthquake, the prices of construction materials also increased. In 2006, the purchase price of 1,000 blocks of brick roughly doubled from PKR 3,600 to PKR 6,000.

Construction Company B

- This company was engaged in constructing roads as part of the undertakings of the Pakistanis in this JICA grant aid project. After the earthquake, the average daily wage for workers increased from PKR 300 to PKR 400. Huge demand for labor in the areas affected by the earthquake influenced the labor market in other areas in the country.
- At that time, oil prices rose the most among various materials: it increased from PKR 35 to PKR 65 per liter. This created a vicious circle of escalating prices for other materials.
- The purchase price of 1,000 blocks of brick soared from PKR 3,600 to PKR 6,500 during 2006, and the price hike continued. The price of stone increased from PKR 14-15 to PKR 26 per square feet. The price of cement rose from PKR 300 to PKR 500 per 50 kg. A large amount of cement was needed in the earthquake-affected areas to make blocks for civil work and buildings.

Source: Interview with the construction companies

As discussed above, macroeconomic data on the national level and the information

gathered on the situation of construction markets in the Faisalabad region support the view that this project, which was planned in a period of relatively stable prices, was affected by the abrupt price increase triggered by the major earthquake in the northern region and subsequent accelerated price hikes. Under these circumstances, it was extremely difficult to avoid revisions to the original plan, and the alterations, aimed at the eventual completion of the project through stepwise implementation, are considered to have been appropriate.

Based on the finding that the revisions of the plan were sufficiently appropriate, an evaluation of each stage of this project was conducted using the comparison between the project cost after the revision and the actual amount. The results are as follows.

1) "The Improvement Project" Phase 1:
   Actual 705 million yen (actual amount (1)(i) in Table 2) versus planned 708 million yen (planned amount (1)(i) in Table 2) (100% of the plan)
2) "The Improvement Project" Phase 2:
   Actual 4,427 million yen (actual amounts combined under (1)(ii) and (1)(iii) in Table 2) versus planned 4,442 million yen (planned amount (1)(iii) in Table 2) (100% of the plan)
3) "The Expansion Project":
   Actual 757 million yen (actual amount (2) in Table 2) versus planned 799 million yen (planned amount (2) in Table 2) (95% of the plan)

The sums of the planned and actual amounts, respectively, were: actual 5,889 million yen versus planned 5,949 million yen (99% of the plan). According to the numbers above, the project cost as a whole was mostly as planned.

3.2.2.2 Project Period

In the examination of the project period in this evaluation, a comparison between planned and actual figures was made for the project phases and the separate project, with the same logic to the evaluation of the project cost in the preceding section, "3.2.2.1 Project Cost." If the plan was altered in a particular stage and the change was considered sufficiently appropriate, an evaluation was done based on the comparison between the planned project period (after alteration) and the corresponding actual period. If the alteration to the plan was not sufficiently appropriate, evaluation was made by comparing the planned project period before alteration with the actual period calculated as the sum of the actual periods of the original plan and the revised plan.

The planned and actual project periods in each stage are shown in Table 4.

Table 4　Project Period: Plan and Actual

	Period (month)		
	Plan		Actual
(1) (i) "Project for Improvement of Water Supply System in Faisalabad" Phase 1	44	(20)*	16.5
(1) (ii) "Project for Improvement of Water Supply System in Faisalabad" Phase 2 (Original Plan)		(24)*	24 (Expired without completion)
(1) (iii) "Project for Improvement of Water Supply System in Faisalabad" Phase 2 (Revised Plan)	32		46
(2) "Project for Expansion of Water Supply System in Faisalabad"	18		20.7

Note: * Estimated period from the operation schedule of the project in the Basic Design Study Report.
Source: Documents provided by JICA and Implementing Agency; Interview with Implementing Agency

Because the revisions of the plan in this project were considered appropriate, as discussed in the previous section, an evaluation of each stage was conducted using the comparison between the project duration after revisions to the plan and the corresponding actual project duration. The results are as follows.

1) "The Improvement Project" Phase 1:
   Actual 16.5 months (actual period (1)(i) in Table 4) versus planned 20 months (planned period (1)(i) in Table 4) (83% of the plan)
2) "The Improvement Project" Phase 2:
   Actual 46 months (actual period (1)(iii) in Table 4) versus planned 32 months (planned period (1)(iii) in Table 4) (144% of the plan)
3) "The Expansion Project":
   Actual 20.7 months (actual period (2) in Table 4) versus planned 18 months (planned period (2) in Table 4) (115% of the plan)

The sums of the planned and actual periods, respectively, were: actual 82.7 months versus planned 70 months (118% of the plan). Therefore, the project period as a whole was longer than planned.

The major reasons why the actual project period exceeded the planned period in "The Improvement Project" Phase 2 were the amount of time needed for retendering after an unsuccessful contractor bid and the subsequent need for an examination process between the two governments concerning the separation of part of the project. According to the documents provided by JICA, a period of more than a year transpired from the conclusion of the E/N for Phase 2 (revised plan) to the agreement between the both governments on the separation of part of the project. The reason for the delay in "The Expansion Project" can be attributed to the situation at that time when "The Improvement Project" Phase 2 and "The Expansion Project" were implemented in parallel, aiming to simultaneously commission the water intake facility and the collecting, transmitting, and distribution facilities. This implementation needed coordinated work scheduling. Another reason was related to the

electric work conducted by the Pakistanis; there was a delay in the connection work done by the electric power company for commencement of power supply therefore causing a delay of power supply initiation, despite the work from the implementing agency having been completed.

As reviewed above, the outputs of this project were produced mostly according to the plan. With respect to the inputs, while the basic evaluation policy is to compare the actual result against the original plan, the efficiency evaluation for this project was based on the comparison results between the revised plan and the actual result, because the revisions to the project plan were considered appropriate. The main reasons for unsuccessful bids included the abrupt accelerated price increases strongly influenced by the sudden occurrence of the enormous disaster in Pakistan as well as the major external economic disturbances. Because the alteration to the plan was considered appropriate in this situation, a comparison was made between the revised plan and the actual inputs.

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

3.3 Effectiveness[10] (Rating: ②)

With respect to effectiveness, the evaluator first reviewed appropriateness of the indicators and target values defined at the time of planning as the expected effects of this project, and then analyzed the quantitative effects based on operation and effect indicators, as well as other effects (qualitative effects).

3.3.1 Quantitative Effects (Operation and Effect Indicators)

As mentioned above, the plan for this project was revised twice, and the project was implemented in several stages after division into phases and the separation of part of the project. On the other hand, because the overall effects of this project were intended to manifest themselves after the completion of all components, an evaluation was conducted by comparing the actual values and target values of various indicators (after alteration) at the time of the final completion of the project, i.e. at the completion of "The Expansion Project." Table 5 shows the target and actual values of operation and effect indicators.

(1) Operation Indicators

The indicator of "augmented water supply amount through the development of a new wellfield," which can be regarded as the most critical operation indicator in the verification of the effectiveness of this project as a whole, reached the target value of 91,000 m^3/day.

On the other hand, "water supply hours," which is an important element of the water supply service, did not achieve the target of 12 hours/day and remained unchanged from the 2003

[10] Sub-rating for effectiveness is to be put with consideration of impact.

baseline level of 6 hours/day. According to the interview with the implementing agency, the main reason for this was the fact that water distribution pumps had not been operated during peak hours due to the high cost of electricity charges, although it was technically possible to supply water for 12 hours per day. The difference between the peak hour and off-peak hour charges per kWh is about 1.5 to 2-fold at present. In addition, while the electricity rate in 2010 was about PKR 6.50 per kWh, when "The Expansion Project" was planned, it has increased to about PKR 10 during off-peak hours. As suggested by the results of the interview with WASA officers, the decision to restrict the water supply hours was supported by the realization that WASA had to place higher priority on cost reduction and other measures to improve operation efficiency than on service expansion, in a situation where it was being requested to improve financial conditions by the provincial government who was providing subsidies.

"The maximum water pressure in the arterial mains in the eastern area of the city" is the indicator of improvement concerned with the service disparities between the eastern and western areas of the city, which was recognized as a notable problem at the time of planning this project. Although the actual performance in the target year is unknown, subsequent performance record shows general improvement from the baseline value. The recorded actual value ranged from 0.75 to 1.0 kg/cm^2 in 2014, depending on the particular location measured in the arterial mains. Considering that the maximum value in this range was equal to the target value of 1.0 kg/cm^2, the actual performance is judged to have achieved the target. According to the interviews with the relevant persons and the analysis of obtained data, the main reasons that the actual performance at some locations fell below 1.0 kg/cm^2 can be explained as follows: 1) Since the pumped water supply was restricted to 6 hours per day as mentioned above, water use by users was concentrated in this water supply time, and the lack of the expected dispersion of water use time was considered to cause low water pressure. 2) The pump equipment at the terminal distribution reservoir from the Chenab wellfield, which was developed in 1992, had been used beyond its service life, and was unable to provide sufficient pressure for water distribution to the city[11].

(2) Effect Indicators

Among the effect indicators, those for the entire city area served by WASA, including the served water supply population, water service coverage, and average per capita daily water supply, have reached their respective target values. On the other hand, regarding average per capita daily water supply in the eastern area of the city, which was defined as an indicator of improved conditions of water distribution specifically in the eastern side, it is impossible to quantitatively judge the achievement level for the target of 130 liters/person/day, since there are no records of such data. However, while the average per capita water supply is 130

[11] Since 2015, JICA has been implementing a grant aid project to replace pumping machinery at the inline booster pumping station and the terminal reservoir connected to the Chenab wellfield.

liters/person/day for the entire city, the interview with the implementing agency indicates that there still is a disparity in supply volume between the western and eastern areas of the city. This naturally suggests that the target value was not reached for this indicator. While the results of the beneficiary survey suggest that water supply volume has improved in the east area, it presumably has not reached the target level because of the following reasons according to interviews with the relevant people and the analysis of available data. 1) The projected future population of Faisalabad City assumed at the time of the original planning of this project (2.80 million in 2012) was exceeded by approximately 13% by the actual population of 3.15 million. 2) According to the interviews with the implementing agency, the basic policy of WASA intended to supplement the increase in water supply volume with the introduction of water meters, which would accelerate the improvement of water distribution conditions in the eastern area by promoting appropriate water use by users and elongating service hours. However, the installation of water meters had made little progress since the completion of this project until 2015 mainly due to a lack of funding.

Table 5 Operation and Effect Indicators

	Baseline	Target	Actual	
	2003	2012	2012	2014
	Baseline Year	Completion Year	Completion Year	2 Years after Completion
[Operation Indicator]				
Augmented water supply through the development of a new wellfield (m^3/day)	0	91,000	91,000	91,000
Water supply hours (hours/day)	6	12*	6	6
The maximum water pressure in the arterial mains in the eastern area of the city (kg/cm^2)	0.5	1.0*	N/A	0.75-1.0
[Effect Indicator]				
Served population of water supply (10 thousand)	127	189*	189	208
Water service coverage in Faisalabad (%)	55	60	60	62
Average per capita daily water supply (liters/day)	100	130	130	130
Improved conditions of water distribution in the city	Unequal distribution (insufficient supply in the eastern side)	An average of 130 liters/day/person supplied in the eastern side	No data available	No data available

Note: * These figures are the revised target values from the original plan. 24 hours of water supply per day was targeted in the original plan. The target value was changed to 12 hours per day in the planning period of "Project for Expansion of Water Supply System in Faisalabad," considering a future water demand of the city projected at the time. The target value of the maximum water pressure in the arterial mains in the eastern side of the city was 1.0-1.5kg/cm^2 in the original plan, and it was changed to 1.0kg/cm^2 in the Implementing Review Study Report in 2007 to revise the plan of "Project for Improvement of Water Supply System in Faisalabad," Also, water supplied population of 1,564 thousand was targeted in the original plan. The target value was changed to 1,890 thousand in the timing of planning "Project for Expansion of Water Supply System in Faisalabad." The target year delayed four years from 2008 in the original plan to 2012 set in the plan of "Project for Expansion of Water Supply System in Faisalabad." These changes in target values were judged to be relevant reflecting on the city's demographic changes over time.
Source: Documents provided by JICA and Implementing Agency

3.3.2 Qualitative Effects

Qualitative effects were examined in terms of the number of complaints from customers to WASA and the changes in the number of non-payment cases before and after the completion of the project, and customer recognition and satisfaction concerning water services as assessed by the beneficiary survey.

As shown in Table 6, the number of complaints from customers concerning WASA's water supply services decreased from 1,839 in 2010 to 1,530 in 2015, although the number of users increased in this period. The number of complaints per connection to a domestic customer also decreased from 0.017 cases to 0.014 cases. Similarly, non-payment cases tended to decrease both in terms of the total number and the number of cases per connection.

Table 6 Number of Complaints about Water Supply Services from Customers and Non-payment

	2010	2011	2012	2013	2014	2015
Number of complaints about water supply services	1,839	1,710	1,580	1,504	1,434	1,530
Number of refusal to pay for water charges	54,414	55,060	54,259	48,677	49,885	47,150
Number of connections to domestic customers	107,405	109,085	108,279	109,022	109,758	110,330
Number of complaints per connection	0.017	0.016	0.015	0.014	0.013	0.014
Number of refusal to pay per connection	0.507	0.505	0.501	0.446	0.454	0.427

Source: Compiled based on documents provided by Implementing Agency

The main results of the beneficiary survey[12] among the residents of WASA's service area, conducted as part of this ex-post evaluation, are as follows.

Table 7 Main Results of Beneficiary Survey to WASA Service Areas

(1)	Among the respondents who currently use WASA's water supply service (72 households), 82% answered that the water supply hours (available hours) increased after this project. Looking at the results by area, 74% in the western area of the city and 96% in the eastern area of the city answered as above.
(2)	Among the respondents who currently use WASA's water supply service (72 households), 83% answered that the water supply amount increased after this project. Looking at the results by area, 77% in the western area of the city and 96% in the eastern area of the city answered as above.
(3)	Among the respondents who currently use WASA's water supply service (72 households), 63% answered that the water quality supplied improved after this project. Looking at the results by area, 62% in the western area of the city and 64% in the eastern area of the city answered as above.
(4)	On the other hand, 48 households, or 40% of all the respondents to the survey, answered that they currently

[12] The beneficiary survey was conducted to examine the changes in water supply conditions before and after the project and the users' satisfaction level to the water supply service. It was implemented from March to April 2016 in the target area of the project, i.e. in two service areas of WASA (western and eastern parts of Faisalabad City), and interviews with the sampled residents (120 households: 60 in each of the western and eastern parts) were made by surveyors based on the questionnaire at the sample households' residences. The selection of the samples was made as follows: first, six colonies were chosen from each part of the city so as to ensure that their locations have variations in distance to the arterial mains reinforced by this project. Then, 10 households were randomly selected from each colony. A total of 120 valid respondents were composed of 52 women and 68 men. Apart from the beneficiary survey to the household users, interviews were conducted directly by the external evaluator with four business users of WASA's service. They consisted of two industrial users and two commercial users.

do not use WASA's water supply service. Particularly, more of the respondents in the eastern area of the city answered as above. For their main reasons, they recognized problems in water quality, such as dirtiness and smell. It was also revealed that all the respondents in the survey obtain water from water sources other than WASA's service, including private or shared wells (used by 100% of the respondents) and sold water (used by 96% of the respondents).

(5) In interviews with a total four commercial and industrial users of WASA's water supply service, they showed a common recognition that the water supply hours and amounts increased after this project. One industrial user located in the western area of the city answered that WASA's efforts to tackle the problem with illegal connections had been improving. On the other hand, one industrial user in the eastern area of the city pointed that there had been problems in water quality, such as contamination with dirty water. In addition, an industrial user and a commercial user in the eastern area both commented that water pressure was not sufficient, although it had shown improvement.

(6) The beneficiary survey to the residents also asked their satisfaction level with WASA's service. More than 90% of WASA's household users responded that they were satisfied with daily supply hours and amount of water from the tap. On the other hand, 32% of users were not satisfied with water quality, while the rest were satisfied.

Source: Beneficiary Survey

As shown above, the beneficiary survey indicated that a majority of users recognized improvement in all the aspects of supply hours, supply amount, and water quality. In particular, more residents in the eastern area recognized improvement in supply hours and supply amount than those in the western area, indicating a substantial contribution made by this project. On the other hand, lower percentages of respondents recognized improvement in water quality as compared with supply hours and supply amount, and a certain portion of people, mainly in the eastern area, do not use tap water, but mainly depend on purchased water and groundwater from the well. It should be noted that the results related to water quality found in this beneficiary survey are based on the respondents' subjective views, not on the comparison of water quality measured scientifically before and after the project or on the comparison with any water quality standard. The result is considered to be showing; however, the status of recognitions or reliability to the quality of tap water among WASA's existing and potential customers, which suggests that there is still room for further improvement in its water supply service.

3.4 Impacts

3.4.1 Intended Impacts

The impacts of the project expected at the time of planning included the improvement of the health and hygiene environment for citizens through the reduction of hepatitis, diarrhea, typhoid fever, and other water-borne diseases, as well as the improvement of their living conditions, as a result of the increase in stable supplies of safe water.

According to the Health Department of the province, the occurrence of major water-borne diseases recorded at the public health and medical facilities in Faisalabad City after 2010 peaked in 2013 and decreased thereafter. For example, the number of the acknowledged cases of typhoid fever increased from 6,499 in 2010 to 10,965 in 2013, but then decreased to 6,128 in 2015. In this evaluation, the evaluator visited three medical institutions in the city, and

interviewed physicians treating water-borne diseases. According to a physician at a district-level hospital in Faisalabad, the number of patients presenting water-borne diseases had been decreasing for the past 10 years along with the number of severe cases. They believed that these changes reflected, in addition to the improvement of water quality, the improvement of people's awareness leading to a better hygiene environment in daily living. The answers to the questions concerning water-borne diseases in the beneficiary survey also showed that the number of types of water-borne diseases occurring in the households served by WASA and the frequency of the diseases among them decreased markedly after the completion of the project. However, while these decreasing tendencies were clearly seen in both the eastern and western areas, no evident difference was found between the two areas. In addition, similar tendencies were observed among the households who were not served by WASA.

Judging from the observations above, while the frequency and severity of water-borne diseases have been clearly decreasing and improving in and around Faisalabad City, the prime reason behind this change is thought to be an increase in citizen awareness of the hygiene environment. People were using safer water selectively, irrespective of where they resided, or whether or not they had contracts with WASA. Although it is considered that the expansion of the water supply and the improvement of the quality of water supplied by this project have been factors contributing to the decrease in water-borne diseases, it was not possible to clearly confirm the degree of its impact.

3.4.2 Other Impacts

(1) Impacts on the Natural Environment

According to the interview with the implementing agency during this evaluation, the intake of water from the tubewells constructed in this project did not cause notable negative impacts on groundwater levels of agricultural wells in the vicinity of the water source. The villagers interviewed in the areas around the water source also reported no impact on the water levels of their agricultural wells. The farmers usually use the irrigation water from the Jhang Branch Canal for farming, and they use the wells mainly for farming during the period when irrigation water stops once a year and for daily living activities other than farming.

(2) Land Acquisition and Resettlement

According to the interview with the implementing agency, there was a case of land acquisition from a farmer involving a very small part of the water source area, but this did not cause a problem. Specifically, compensation was paid to a farming household who owned the land (site No. 5, about 505 m^2) where one of the 25 tubewells was constructed. There was no resettlement of inhabitants.

(3) Improvement of Living Environment in Surrounding Villages of Wellfield

This project was implemented based on the agreement with the farmers in the water source

area, and "compensation programs," including infrastructure improvement, were carried out by the Pakistanis as measures targeting residents in the area in parallel with this project. A total of 55 programs covering 14 villages were implemented.[13] These programs consisted mostly of construction and paving of roads and construction and improvement of drainage canals in the villages. They also included construction of elementary school facilities (classrooms, restrooms, etc.), construction of a deep well, etc.

During a group interview on the impact of the compensation programs, many villagers in the area expressed their satisfaction, stating that the improvement of roads in the village provided better access to market and schools, the improvement of the drainage canal improved overall hygiene, and that children no longer needed to commute a long distance to school after additional classrooms were constructed in a nearby school. These programs are thought to have contributed greatly to the improvement of the living conditions of the villages.

On the other hand, the interviews with the implementing agency and the villagers in the area indicated that a deep well constructed by WASA as part of these programs had not been operational after completion due to a disagreement over who would operate it (mainly who would pay for the electric power). This problem seems to have resulted from a lack of sufficient consultations to clarify, in advance, the responsibilities upon completion. However, as only one of the 55 programs involved well construction and generated issues, the compensation programs as a whole are considered to have had a large, positive impact.

As reviewed above, among the operation indicators of quantitative effects in the assessment of effectiveness, "augmented water supply through the development of a new wellfield," which was the most important operation indicator, reached 91,000 m^3/day as planned, and the maximum water supply pressure in the arterial mains in the eastern area of the city is judged to have achieved the target value. However, water supply hours remained as low as one-half of the target of 12 hours/day with no change from before the project. Effect indicators also reached target values in terms of the water supply service throughout the entire city, such as the served water supply population and water service coverage, but the water distribution conditions in the eastern area are considered to be falling short of the target. With respect to qualitative effects, more than 80% of users among beneficiary survey respondents acknowledged improvement in water supply amount and water supply hours, while a lower percentage of users, or about 60% of those, claimed improvement in water quality. With respect to project impact, although water-borne diseases among citizens decreased in general and this project is considered to have been one of the factors contributing to the decrease, the extent of its contribution could not be clearly confirmed. No negative impact was seen on the groundwater levels in the villages

[13] They include both the programs implemented based on the PC-1 concerning this project and the programs implemented separately by the provincial government.

around the water source facility. The compensation programs implemented in relation to this project facilitated infrastructure development, leading to the improvement of living conditions for villagers.

Consequently, this project has to some extent achieved its objectives with some issues to be improved. Therefore, the effectiveness and impact of the project are fair.

Tubewell Pumping Station (No.11)


Tubewell Pump Equipment and Operator

3.5 Sustainability (Rating: ③)

3.5.1 Institutional Aspects of Operation and Maintenance

The basic organizational system of WASA has not changed since the time of planning. According to the document provided by the implementing agency (March 2016), WASA has 2,347 employees. Under the command of the Deputy Managing Director (Service), the Water Resources Division takes responsibility for maintenance after the completion of this project. The division is staffed with Director, Deputy Director, and 14 managerial officers at the WASA headquarters and other locations. Operating personnel in the fields related to this project include 80 persons at the water source tubewells along the Jhang Branch Canal, 25 at the booster pump station, and 43 at the terminal distribution reservoir (including the personnel in charge of the facilities and equipment constructed in this project). This system for operation and maintenance is considered to have no problems, and it is believed to be a sustainable system for conducting organizational actions in a stable manner.

3.5.2 Technical Aspects of Operation and Maintenance

According to the interview with the implementing agency, the water supply facilities provided in this project are similar to the existing facilities in terms of equipment configuration and composition, and the terminal water distribution facilities are located in the same premises as the existing reservoir. The operation and maintenance of these facilities can be performed sufficiently with the present level of technical capabilities.

In addition, most of the management officers from the Water Resources Division are qualified engineers or holders of other qualifications in electric and mechanical fields. Although about 90% of the operators at the water source facilities, the booster pumping station,

and the terminal distribution reservoir have been recruited from villagers in the area around the water source, they were trained for operation methods by the contractor at the time of the completion of the pump and other facilities. With the exception of several workers, most of these operators are still working at present and are continuing the operational tasks without problems. It is believed that there are no particular problems with operational and maintenance techniques.

3.5.3 Financial Aspects of Operation and Maintenance

(1) Receipts and Expenditure of WASA

As shown in Table 8, WASA remains in a state where current expenditure exceeds revenue from water service even after the completion of this project, and more than 60% of expenditure is occupied by personnel costs and electricity costs. On the other hand, the following tendencies were also observed; 1) As compared with before the completion of this project, the revenue from water supply and sewerage services tends to be increasing. According to the implementing agency, this revenue for 2014-15 fell below that of the previous fiscal year because of the influence of the temporary delay in the billing services caused by the switch to outsourcing its service. The monthly data for the next fiscal year show that revenue began to increase again. 2) The percentage of subsidies tends to decrease, as the revenue from water supply service increases. 3) The percentage of repair and maintenance costs in expenditure also tends to decrease.

A major reason why WASA's current expenditure still exceeds the revenue from water supply services is attributed to the fact that the rise in water rates has not been approved since 2007 due to political reasons. According to the interview with the provincial government, while it demands that WASA pursue further improvement of management efficiency through cost reduction and other measures, it provides subsidies every year for the purpose of contributing to the electricity costs. The provision of subsidies is expected to continue, provided that WASA makes earnest managerial efforts. While WASA is also reducing the percentage of operation and maintenance costs as cost-cutting efforts, this mainly consists of a reduction of maintenance costs through the renewal of old equipment, according to the implementing agency. Since most of the facilities and equipment constructed and provided in this project have not been used for long since the beginning of operations, the cost for their maintenance is not likely to increase at present. On the other hand, revenue from service charges is expected to grow, as discussed above. For this reason, the cost of maintenance for these facilities and equipment is expected to be covered as in the past.

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

	2010-11	2011-12	2012-13	2013-14	2014-15
Receipts					
Water Supply Charges	171	172	234	271	218
Sewerage Charges	274	274	374	433	348
Urban Immoveable Property (UIP) Tax Share	156	140	224	197	285
Subsidy	0	176	325	262	262
World Bank Program	0	0	0	293	331
Other Income	260	174	200	172	270
Sub Total	860	936	1,358	1,628	1,713
Expenditures					
Payroll and Allowance	374	420	560	619	634
Electricity	331	319	457	363	442
Operation and Maintenance	84	80	140	116	102
World Bank Project	0	0	0	286	338
Other Expenditures	66	90	134	132	140
Sub Total	855	909	1,291	1,515	1,656
Surplus/Deficit for the Year	5	27	67	113	57

Source: Documents provided by Implementing Agency

(2) Management Reform of WASA

WASA, with support from JICA and other donors, is actively promoting management improvement and organizational reform that include various measures to increase revenue under the lead of the top executives. In particular, the actions aimed at financial improvement include 1) promotion of the instllation of water meters, 2) reduction of water leakage through the replacement of old water pipes, 3) actions for more efficient use of electric power and negotiation with the electric power company to cut back electrical power costs, 4) actions against illegal connections, 5) staff capacity building in the field of customer services at the training center (Al-Jazari WATSAN Academy) supported by JICA,[14] and 6) development and marketing of bottled drinking water business.

With respect to water meters, 12,000 meters for households and 538 for commercial and industrial establishments were installed by December 2015 as part of the cooperation project of the government of France, resulting in meter use of about 10% of the users with WASA contracts. Payment based on a measured rate system has begun. In addition, WASA plans to install a total of approximately 105,000 meters in a phased manner over the next 5 years. It has filed a budget request with the provincial government for the installation of 25,000 meters for households and 2,120 for industrial and commercial users for fiscal year 2016-17.

Some of the actions listed above for financial improvement have begun to show effects in cost reduction. In particular, while little progress had been made in the introduction of meters due to the lack of funding and other reasons, it has been promoted in earnest after the completion of this project. It is therefore considered highly probable that progress will be

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

made in medium-term financial improvement in combination with the improvement of water supply services through the appropriate use of water supplies.

3.5.4 Current Status of Operation and Maintenance

The facilities and equipment constructed and provided in this project are operating without any problems at their respective sites. Except for some units, the equipment provided in 2005 during "The Improvement Project" Phase 1 is still in use at present. The implementing agency stated that the pH/EC meter and the TDS meter are not used currently, because there were no agents supplying spare parts in the country when these units broke down after several years of use. At present, WASA is using meters manufactured in different countries as substitutes. Although these meters are inferior to those made in Japan and provided by the project in terms of the quality of measurement, there are no major problems in daily operation. The pump for each tubewell in the water source facility is drawing water with an upper limit of 200 m^3/hour and is normally operated for 16-18 hours per day. These conditions are the same as the operating conditions defined during the Basic Design Study and Implementing Review Study for this project, aimed to ensure the recovery of the water level to its optimal level. In fact, the monitoring data obtained by the implementing agency from the 25 wells constructed in this project show an average decrease of water level of 0.74 m a year from the wells' operation commencement, indicating a possibility of operation for about 35 years, as compared with the design operation period of 25 years.

The water source facility, the boosting pump facility, and the terminal distribution reservoir are operated on a 24-hour, 3-shift basis. Maintenance of pumps and other equipment is conducted regularly on the sites, and emergency responses are performed according to the Standard Operation Procedures. The conditions of operation and maintenance are considered to be generally satisfactory.

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

4. Conclusion, Lessons Learned, and Recommendations

4.1 Conclusion

This project aimed to improve the water supply in Faisalabad City, Punjab Province, by developing additional water sources and intake facilities and installing water collecting, transmitting, and distribution facilities including a terminal reservoir, and by reinforcing the existing arterial mains, thereby contributing to the improvement of the health and hygiene environment and living conditions of local residents. The project objective was highly relevant to the development policies and needs of Pakistan consistently from the planning stage to the

ex-post evaluation, and also to Japan's assistance policy for Pakistan in the planning stage. Although the project plan was revised repeatedly due to a series of unsuccessful bids, the outputs were produced mostly as planned. The main reason for the unsuccessful bids was multiple occurrences of unexpected events, including an extraordinary natural phenomenon, and the revisions of the plan were considered to be adequate. Based on the comparison between the revised plan and the actual inputs, although the project cost was within the scope of the plan, the project period exceeded the plan. Therefore, the efficiency of the project is fair. The augmentation of water supply through the development of a new wellfield, which is the most fundamental indicator for the project's effects, and the increase of the maximum water pressure in the arterial mains in the eastern side of the city were successfully achieved. The project's positive impacts have been observed. On the other hand, water supply hours have not been extended due to inability to cover the operation costs of the distribution pumps sufficiently because of hikes in electric power charges and water supply services in the eastern side of the city have yet to show a sufficient level of improvement. Therefore, the effectiveness and impact of the project are fair. No major problems have been observed in the institutional, technical, and 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 satisfactory.

4.2 Recommendations

4.2.1 Recommendations to the Implementing Agency

No problems were observed with the groundwater level of farmers' private wells in the surrounding villages of the wellfield developed by this project. The villagers were highly satisfied with the preventive compensation programs conducted in their villages. On the other hand, this evaluation study found that there has been no system to monitor the changes of the groundwater level in the surrounding villages after the pumping operation began in the wellfield. Although the Basic Design Study for the project confirmed that much of the groundwater source was recharged by infiltration of water from the Jhang Branch Canal, it recommended that the groundwater level in the surrounding area be carefully monitored after the operation started and that WASA be prepared to take additional compensative measures in case an adverse effect on the groundwater level was identified. There remained uncertainties about actual changes in the groundwater level in the surroundings after the project tubewells began to withdraw water source. Since the completion of the compensation programs, there has been no system of regular communication or dialogue between WASA and the villages. It is recommended that WASA undertake monitoring activities for the water level of the agricultural wells in the surrounding area with an appropriate frequency and coverage, in addition to the 25 tubewells completed by the project. This would enable WASA to identify the changes of groundwater level in the surrounding villages promptly and take necessary

measures appropriately[15].

4.2.2 Recommendations to JICA

None

4.3 Lessons Learned

Sufficient risk consideration should be made when implementing a cooperation project requiring capital investment that needs some time until contributing to revenue generation of the implementing agency:

This project was planned and implemented in a situation where developing a new water source was not directly linked to a revenue increase of the implementing agency in the short term under the current fixed tariff system, while the implementing agency was requested to realize its financial self-sustainability in the future by the provincial government. The project was thus expected to act as "trigger" to improve the implementing agency's revenues by enhancing customers' satisfaction through the advance services of increasing water supply and expanding supply hours, which would promote transition from fixed rate to pay-as-you-go charges and customers' appropriate use of water, and then increase the number of users. In such cases, there may be a time gap between the project completion and the start of its financial contribution. This means that the implementing agency has to bear additional costs of operating and maintaining new equipment in the meantime. In this project, a part of the planned advance services (extension of water supply hours) was not realized due to heavy cost burden by electricity price hike beyond the allowable level to the implementing agency. Therefore, for such a project that contains advance services, which are expected to generate revenue later, formulation of the entire plan is needed taking into account the risk of the services unrealized due to financial pressure on the implementing agency in the short term. The following points can be considered: (i) Potential factors of cost increases in the short term should be identified as extensively as possible; (ii) It is important to examine the significance of the advance service component in the entire project plan and the influence on the project effects when the component is not realized; and (iii) It is also important to carefully examine a feasible coverage of the service and the target.

Clear setting of the party responsible for financing operation of the service provided as part of compensative measures:

In this project, a series of development programs were planned and implemented to the affected villages in the surrounding area of the wellfield as compensative measures, based on the consultation between the villages and the government including the implementing agency.

[15] WASA began monitoring the water level of three agricultural tubewells along the Jhang Branch Canal in May 2016, in response to the discussion with the field mission of this evaluation study. WASA plans to continue the monitoring activity once a month, simultaneously checking the water level of the tubewells installed by the project.

Although a tubewell was constructed in one of the neighboring villages as part of the programs, it has never been in operation because of a disagreement between the implementing agency and the village as to who should bear the operation cost (such as electricity charge) of the water source facility. Since this type of program is provided to people who will unilaterally be disadvantaged without such measures due to the implementation of cooperation projects, they would potentially take it for granted that all the related costs, including operating cost incurred after the provision of the compensated machinery or facilities, will be covered by the compensating party. Therefore, when a cooperation project plans to include compensative measures to the possibly affected areas or groups of people, and if the measures are expected to require constant expenses for their operation, it is important to clearly define in advance the party responsible for providing finance for the operation of the service realized as part of the measures. In some cases, it would be effective for the implementing agency to plan and select particular measures on condition that the beneficiaries agree to undertake the operation cost.

End

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.

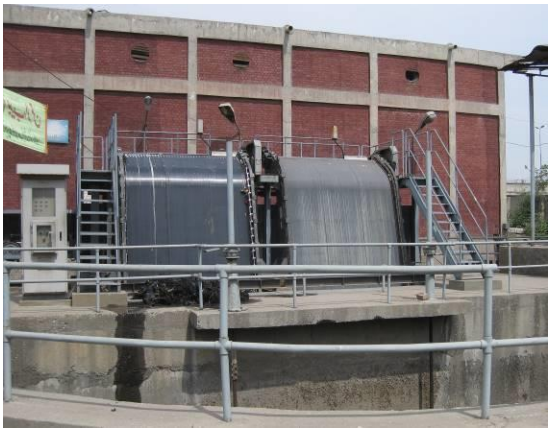
Table 1. Project Outputs: Plan and Actual

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