Ex-Post Project Evaluation 2017: Package I-3 (Indonesia)

August 2018

JAPAN INTERNATIONAL COOPERATION AGENCY

Octavia Japan, CO., LTD.

EV
JR
18-08

Disclaimer

This report compiles the result of the ex-post evaluations. These are conducted by external evaluators to ensure objectivity, and the views and recommendations herein do not necessarily reflect the official views and opinions of JICA. JICA is not responsible for the accuracy of the English translation, and the Japanese version shall prevail in the event of any inconsistency with the English version.

Minor amendments may be made when the contents of this report is posted on JICA's website.

Comments by JICA and/or the Counterpart Agencies may be added at the end of the evaluation report when the views held by them differ from those of the external evaluator.

Republic of Indonesia

FY2017 Ex-Post Evaluation of Japanese ODA Loan

"Lower Solo River Improvement Project (Phase I)"

External Evaluator: Kenichi Inazawa, Octavia Japan Co., Ltd.

0. Summary

This project implemented river improvement work in the lower Solo River Basin on the island of Java, which is subject to frequent flooding, in order to contribute to the reduction of flood damages, improve productivity of agriculture in the surrounding area, and stimulate the economy. Relevance of this project is high because it conforms to the development plan for infrastructure needed to reduce flood damage and disaster risks through the *National Medium-term Development Plan* and the *Strategy Plan,* identifies development needs related to the development and improvement of flood control and levees through the construction of barrages and dams in the lower Solo River Basin, and maintains consistency with the assistance policy of the Japanese Government. As for efficiency, project outputs were implemented mostly as planned, but project costs exceeded the initial plan due to rising consulting service and management costs and land acquisition costs and construction costs incurred after the completion of the loan (since 2004). With regard to the project period, land acquisitions had yet to be completed by the executing agency even at the time of ex-post evaluation. Thus, efficiency of this project is low. As for quantitative effects, discharge capacity at the time of ex-post evaluation exceeded the target value, the water level observed at the Babat Barrage was below the levee height at the same place, and no flooding from the levee of the main Solo River or flood damage has occurred. Additionally, interviews with local residents and farmers as well as economic and agricultural production data indicate the project is supporting the stimulation of the local economy. Thus, the effectiveness and impacts of this project are high. There are no particular concerns regarding the structural aspects, technical aspects and financial aspects of the organizations and departments in charge of the project's operation and maintenance. Thus, sustainability of the effects realized through this project is high.

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

1. Project Description

Project Location

Solo River and Babat Barrage

1.1 Background

The Solo River is the largest river on the island of Java. It has a drainage basin of around 16,000 km^2 and is about 600km of river flow path. Prior to the start of this project, development was progressing in the lower Solo River Basin following an increase in the local population, but flooding occurred on almost an annual basis. Flood damage grew worse with the concentration of economic assets resulting from urbanization and the extent of human and economic damages could no longer be ignored. Therefore, carrying out river improvement work in the lower Solo River Basin to reduce flood damages in the surrounding area was an urgent task.

1.2 Project Outline

The objective of this project is to mitigate flood damages due to habitual inundation in the lower Solo River Basin, on the island of Java, by implementing river improvement works (levee construction between the mouth of the Solo River and Babat Barrage) corresponding to a flood of 10 year probability of flood control; thereby contributing to improve agricultural productivity and economic activities in the surrounding area.

Loan Approved Amount/ Disbursed Amount	10,796 million yen / 10,781million yen
Exchange of Notes Date/ Loan Agreement Signing Date	December 1995 / December 1995
Terms and Conditions	Interest Rate: 2.1-2.3% Repayment Period: 30 years (Grace Period: 10 years) Conditions for Procurement: Bilateral Tied
Borrower / Executing Agency	Republic of Indonesia / Directorate General of Water Resources, Ministry of Public Works and Housing; (hereafter referred to as “DGWR”)

Project Completion	February 2018 (Not completed yet)
Main Contractors (Over 1 billion yen)	PT. Adhi Karya (Indonesia), PT.Teguh Raksa Jaya (Indonesia)
Main Consultants (Over 100 million yen)	PT. Indah Karya (Indonesia) / PT. Wiratman & Associates (Indonesia) / PT. Bina Karya (Indonesia) / PT. Barunadri Engineering Consultant (Indonesia) / Nippon Koei (Japan) (JV)
Related Studies (Feasibility Studies, etc.)	Master Plan: Overseas Technical Cooperation Agency (OTCA), (Solo River Water Resources Development Plan, April 1974)
Related Projects	(Japanese Technical Cooperation) - Project on Capacity Development for RBOs in Practical Water Resources Management and Technology in the Republic of Indonesia (Phase 1: 2008-2011), (Phase II: 2014-2018) (ODA Loan Project) -Wonogiri Multi-purpose Dam Construction Project (Loan agreement was made in August 1977.) -Madiun River Urgent Flood Control Project (Loan agreement was made in February 1985.) -Upper Solo River Flood Control Project (Loan agreement was made in December 1985.) -Lower Solo River Flood Control Project Phase 2 (Loan agreement was made in March 2005.) -Countermeasure for Sediment in Wonogiri Multipurpose Project (Loan agreement was made in March 2009 for Phase I, in February 2014 for Phase 2.)

2. Outline of the Evaluation Study

2.1 External Evaluator

Kenichi Inazawa, Octavia Japan Co., Ltd.

2.2 Duration of Evaluation Study

This ex-post evaluation study was conducted with the following schedule.

Duration of the Study: July 2017 - August 2018

Duration of the Field Study: 16-27 October 2017 and 16-25 February 2018

2.3 Constraints during the Evaluation Study

This ex-post evaluation was unable to obtain sufficient data because of unsatisfactory monitoring by the executing agencies with regard to the quantitative effects (river flow rate and flood probability) since project completion (2004). Many aspects of the evaluation were forced to rely on interviews with related parties.

In addition, the executing agency has constructed barrages and levees in other areas up to the time of the ex-post evaluation, in order to improve the reliability of flood control for the entire

Solo River, and "Lower Solo River Flood Control Project (Phase 2)" is in process. Taking this into account, the evaluation has judged the quantitative effects in the lower Solo River Basin (target area of this project) and it has been difficult to determine the effects and impacts attributed directly to this project.

Moreover, land acquisition has yet to be completed for certain areas of this project; thus, for all intents and purposes the project is incomplete. However, because a certain degree of effects are seen, the evaluation decision has been carried out based on an analysis of the outlook and trends of the realization of effects.

3. Result of the Evaluation (Overall Rating: B[1]).

3.1 Relevance (Rating:③[2])

3.1.1 Consistency with the Development Plan of Indonesia

At the time of appraisal, the Government of Indonesia prepared the *Sixth Five Year Plan* (REPELITA VI, 1994 to 1999) as a national medium-term development plan. This plan placed particular emphasis on flood control projects in urban areas with large concentrations of people and assets and in agricultural areas with developed irrigation facilities. This project, which aimed to reduce flood damages in the vicinity around the Solo River, aligned with the country's development plan.

At the time of ex-post evaluation, the Government of Indonesia formulated the *National Medium-term Development Plan* (RJPMN, 2015 to 2019 fiscal year), which sets forth seven priority areas for realizing an independent domestic economy (1. Improve food self-sufficiency, 2. Secure and improve water resources, 3. Improve energy self-sufficiency, 4. Protect natural resources and manage the environment and disasters, 5. Develop sea routes and the maritime economy, 6. Strengthen the financial sector, and 7. Strengthen national fiscal capacity). Among these, "4. Protect natural resources and manage the environment and disasters," calls for reducing areas prone to flood damages through flood control and coastal protection from volcanic sediment and lava. In addition, DGWR prepared the *Strategy Plan* (RENSTRA, 2015 to 2019) that includes plans to develop necessary infrastructure facilities to improve and protect coastal and river dikes for disaster risk reduction, including climate change, through the management of flood prone areas, as one measure for managing the country's water resources.

Based on the above, the Government of Indonesia has continued to place importance on flood

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

control and disaster countermeasures from the time of appraisal to the time of ex-post evaluation. Also, this project continues to maintain consistency with the importance placed on flood control projects in the *Sixth Five Year Plan* (REPELITA VI) at the time of the appraisal. Thus, the project is acknowledged as consistent with the policies and measures laid out in the national plan and sector plan at both before the start of the project and at the time of ex-post evaluation.

3.1.2 Consistency with the Development Needs of Indonesia

At the time of appraisal, flooding occurred in the Solo River vicinity on almost an annual basis. In particular, large-scale flooding occurred during the monsoon season, resulting in many deaths and injuries, victims, and damaged homes. The flood that occurred in March 1993 inundated an area of 64,000 hectares, causing 24 deaths and injuries, affecting some 300,000 people, and damaging about 60,000 homes. This flood also caused major damages to the area's agriculture and economy. Protecting areas prone to flooding from damages and reducing human loss and impacts on economic activities, mainly agriculture, was an urgent task.

At the time of ex-post evaluation, no flooding from the levees developed by this project or flood damages in surrounding areas had occurred. However, the Jabung Reservoir[3] located north of the Babat Barrage developed in this project had yet to be completed, which has resulted in flooding of nearby farmland during the monsoon season and flood damages in the surrounding area of the ponds and tributary rivers connecting to the main Solo River. Therefore, Balai Besar Wilayah Sungai, Bengawan Solo (hereafter referred to as "BBWS"), the Solo River office under DGWR, which is charged with the operation and maintenance of this project's facilities, continues to work on river improvements and flood control to implement flood control facility development in all areas of the river (constructing barrages and dams, developing and improving levees, and others).

In light of the above, the lower Solo River Basin has had strong needs for flood control facility development from the time of appraisal to the time of ex-post evaluation. Thus, the project is consistent with the development needs of the area both at the time of appraisal and at the time of ex-post evaluation.

3.1.3 Consistency with Japan's ODA Policy

In February 1994, the Ministry of Foreign Affairs of Japan formulated the *Country Assistance*

[3] Phase 2 is currently under development as a continuation of this project.

Program for the Republic of Indonesia. Within this program there were five areas of focus: namely, (1) equal development country wide ensuring fairness; (2) raise educational levels and develop human resources for wide ranging areas from the perspective of securing competitiveness; (3) response to environmental issues caused by rapid development; (4) industrial restructuring for sound macroeconomic management and broader economic development; and (5) development of industrial base for the continued inflow of investment.

This project involved infrastructure assistance for reducing flood damages through river improvement work in the vicinity of the lower Solo River Basin and stimulating the economy in the process, and it maintains consistency with the five areas of focus in the *Country Assistance Program for the Republic of Indonesia* above. Therefore, it can be said that this project is consistent with the assistance policy of the Japanese government.

In light of the above, this project has been highly relevant to Indonesia's development plan and development needs, as well as Japan's ODA policy. Therefore its relevance is high.

3.2 Efficiency (Rating: ①)

3.2.1 Project Outputs

This project carried out river improvement work from the mouth of the Solo River to Babat to address 10-year probability of flood control. Figure 1 shows the specific developed places. Table 1 contains the details of the output plan (at the time of appraisal: 1995), changes after detailed design (1998), and actuals at the time of ex-post evaluation (2017).

Table 1: Planned and Actual Outputs of this Project

Outputs		Appraisal (1995)	After detailed design (1998)	Actuals at the time of ex-post evaluation (2017)
1) River improvement (Packages I-1 to I-5)	Levee	Approx. 126km	Approx. 138km	Approx. 131km *Note
	Low water dike construction	Approx. 4km	Approx. 2.6km	Approx. 2.6km
	High water dike construction	Approx. 3km	Approx. 2.7km	Approx. 2.7km
2) Discharge channel (Package F)	Small discharge channel at Sedayulawas	Length: 12.4km, Bottom width: 25m	As planned	As planned
3) Land acquisition	Land acquisition ([1] Levee)	Land acquisition and resettlement (approx. 3,000 homes)		Generally assumed to be as planned

			(There is no data on the number of homes for resettlement. Also, some households did not relocate even after compensation negotiations, so negotiations faced difficulties.)
	Land acquisition ([2] New river channel)	Land acquisition in the vicinity of the Karanggenen Shortcut	Almost as planned (There is no data on the number of homes for resettlement.) *However, it was determined that the total land area acquired for (1) levees and (2) new river channel amounted to 41,300m^2
4) Consulting services		Bid assistance, construction project management, and detailed design of Jabung Reservoir and Small discharge channel width expansion at Sedayulawas, etc.	As planned
[Additional outputs] 1) Development of Babat Barrage as well as dikes in the vicinity and access road (Packages B-1 and B-2) 2) Development of bridge at the inlet of Jabung Reservoir and water gate at the outlet (Packages J-1 and J-3) 3) Consulting services for (1) Development of Babat Barrage as well as dikes in the vicinity and access road			

Source: JICA documents, interviews with BBWS, answer on questionnaire, field visits

*Note: This 131km section includes work paid for by the Indonesia side after the end of the loan disbursement (2004).

1) As for river improvement work, the output plan was modified slightly based on the detailed design after the start of the project (1998). The plan after the detailed design consisted of levees of approximately 138km, low water levee construction of approximately 2.6km and high water levee construction of approximately 2.7km. As for actuals at the time of ex-post evaluation, low water levee construction and high water levee construction proceeded according to plan, but the levee was approximately 131km at the ex-post evaluation, indicating a difference (approximately 7km) with the extension at the time of the detailed design. The reason is because

land acquisition has not been completed at the time of ex-post evaluation. The application location is shown in Figure 1.

2) The small discharge channel at Sedayulawas was developed as planned.

3) At the time of the project appraisal, land acquisition and resettlement were deemed necessary for the levee and the vicinity of the Karanggenen Shortcut. It was assumed that affected households would be relocated to nearby land or inside the levee to avoid flood damage.

Table 2 contains changes in land acquisition results for the levee (based on length of levee) and remaining sections. The background and factors as to why land acquisition was not completed are described in detail in 3.4.2.2 Impacts – Resettlement and Land Acquisition.

Table 2: Changes and Remaining Section Regarding Land Acquisition's Record Based on the Extension of Levee

(Unit: km)

At the Time of Appraisal ⇨	After Detailed Design ⇨	At the Time of Loan Completion (2004)		At the Time of Ex-post Evaluation (2017)	
		Already acquired	Not acquired yet ⇨	Already acquired	Not acquired yet
Approx.126	Approx.138	Aprrox.112	Aprrox.26 *Note	Aprrox.131	Aprrox.7 *Note

Source: JICA documents, interview with BBWS

*Note: Indicates the remaining sections that need to be acquired. At the end of the loan disbursement for this project (2004), Japan and Indonesia agreed that the approximately 26km of remaining sections yet to be completed would be borne by the Indonesia side.

4) Consulting Services

Consulting services including bid assistance, construction project management, and detailed design of Jabung Reservoir and small discharge channel width expansion at Sedayulawas, were implemented as planned.

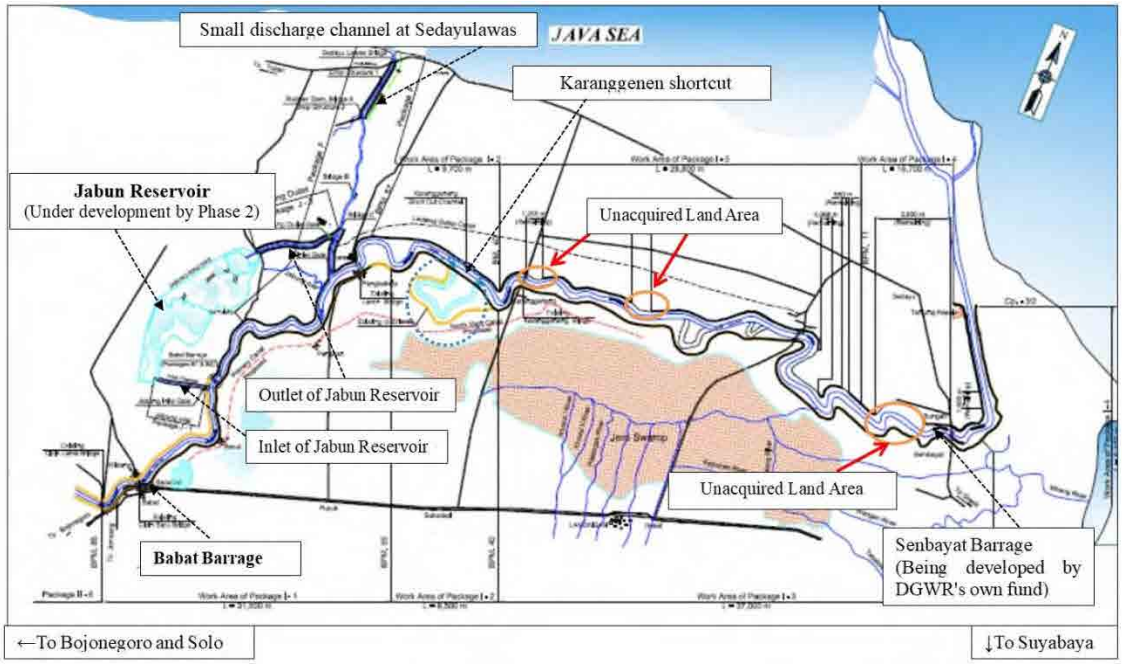
[Additional outputs]

Additional outputs were planned from 1998 to 1999 and implemented from 2000 to 2002. For Babat Barrage, it was determined that developing a barrage across the Solo River would be preferable for directing flood water to Jabung Reservoir. In addition, this barrage was developed to more efficiently manage flow rate control along the entire lower Solo River Basin. A dike and access road were also developed in the vicinity of Babat Barrage. The development of a bridge at the inlet of Jabung Reservoir and development of a water gate at the outlet was initially expected to take place through Phase 2 as the continuation of the project, but following the collapse in the value of the rupiah during the Asian Currency Crisis in the second half of the

1990s, at the time Indonesia was able to convert most of its yen loans (yen capital account) to rupiah, making it possible to carry out more civil works projects than initially planned[4]; thus, this work was carried out before commencement of the Phase 2 project.

Photo 1: Dyke around Babat Barrage

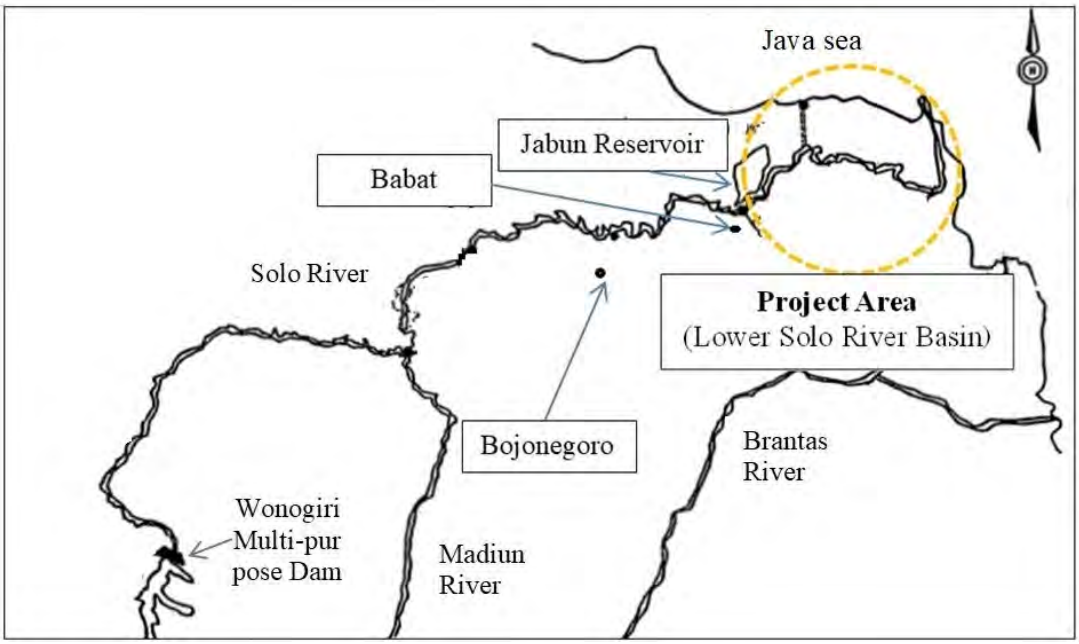
Photo 2: Water Gate Control Room of Babat Barrage



Source: BBWS

Figure 1: Location Map of Lower Solo River Basin and Project Site

[4] Most of the payments made to domestic vendors were denominated in rupiah. Therefore, it was possible to increase the amount of work.



Source: JICA document

Figure 2: The Entire Solo River (Upstream to Downstream)

3.2.2 Project Inputs

3.2.2.1 Project Cost

The total project cost planned at the time of appraisal was 13,563 million yen (of which 10,796 million yen was covered by yen loans). The actual costs totaled 15,132 million (of which 10,781 million yen was covered by yen loans) at the time of ex-post evaluation, which marked a slight overrun from the initial plan (112% compared to the plan). The main reasons for this overrun were the additional civil works projects beyond the initial plan implemented due to additional outputs as well as an increase in consulting services and administrative costs borne by the Indonesia side due to the extension of the project period, and land acquisition costs and construction costs required[5] after the completion of the loan (since 2004), among others.

3.2.2.2 Project Period

At the time of the appraisal, the project period was planned for the six year and one month period from December 1995 to December 2001 (73 months). The project period currently stands at December 1995 to February 2018 (267 months) because it is yet to be completed. This indicates the plan was exceeded by a large margin (366% versus the plan, and still not complete).

[5] Project costs could potentially increase in the future (portion borne by Indonesia) as the project is still not completed at the time of ex-post evaluation.

Table 3 shows the initial plan and actual periods of each project component. As noted above, the levee has not been completed due to land acquisitions not being completed, which was the main reason for this delay[6]. Therefore, the time of the ex-post evaluation is considered the nodal point in terms of the timing for judging the project period. In addition, civil works construction and consulting services were delayed slightly less than about three years compared to the initial plan. The reason for this is because of the budget allocations within the Government of Indonesia affected by the Asian Currency Crisis of the late 1990s and delays in procedures inside of DGWR.

Table 3: Planned and Actual Periods of This Project

	Planned (1995)	Actual
(The Whole Project)	December 1995 – December 2001 (73 months)	December 1995 – February 2018 (267 months)
Each Project Component		
1) Selection of Consultants	December 1995 – June 1996	December 1995 – February 1996
2) Selection of Contractors	July 1996 – December 1998	April 1996 – June 1997[7] April 1996 – September 1996[8]
3) Detailed Design	July 1996 – July 1997	April 1996 – June 1997
4) Civil Works	December 1997 – December 2001	July 1997 – April 2004[9] October 1996 – August 2001[10]
5) Land Acquisition	December 1995 – November 2000	December 1995 – February 2018 (Not yet completed at the time of ex-post evaluation)
6) Consulting Services	July 1996 – December 2001	March 1996 – August 2004
Additional Works		
1) Selection of Contractors	-	January 2000 – September 2000[11] February 2001 – September 2001[12]

[6] The completion of most civil works projects including additional outputs was April 2004. Afterwards, dike construction made progress along with progress in land acquisition, but information was not obtained from BBWS about the specific implementation period. In either case, parts of the levee were not completed at the time of ex-post evaluation due to incomplete land acquisitions; thus, it is difficult to say that the project has reached the project completion's timing assumed initially.

[7] Package I-1～I-5

[8] Package F

[9] Package I-1 to I-5. Part of the construction work was carried out up to 2015 following progress with land acquisition, but information could not be obtained on the implementation period.

[10] Package F

[11] Package B-1 and B-2

[12] Package J-1 and J-2

2) Detailed Design	-	January 1999 – September 2002
3) Civil Works	-	October 2000 – April 2004[13] August 2001 – December 2002[14]

Source: Documents provided by JICA, answers on questionnaire

3.2.3 Results of Calculations for Internal Rates of Return (Reference only)

Economic Internal Rate of Return (EIRR)

At the time of the project's appraisal, the economic internal rate of return (EIRR) was calculated to be 15.9%, based on the expected amount from reduction of flood damages (assets such as homes, businesses, and public facilities, and products such as rice, soy beans, maize and farmed fish) and expected amount of increased income (reduction of flood frequency, increased yield from increased planting, and increased yield from new development of non-arable land) as the benefits, construction costs, operation and maintenance costs, reserve funds, and consulting service costs as the costs, and 50 years as the project life. Attempts were made to collect data related to the benefits, but the executing agency and local governments in the vicinity did not accumulate this data from the time of the appraisal to the time of the ex-post evaluation. Basic data for analogical reasoning was also missing and could not be collected; thus, a re-calculation of EIRR was not possible.

Financial Internal Rate of Return (FIRR)

The FIRR was not calculated for this project at the time of the appraisal. Therefore, a re-calculation was not performed at the time of ex-post evaluation.

Based on above, the project cost exceeded the plan, and the project period significantly exceeded the plan. Therefore, efficiency of the project is low.

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

3.3.1 Effectiveness

3.3.1.1 Quantitative Effects (Operation and Effect Indicators)

1) Operation Indicator

For this project, the discharge capacity and highest water level were assumed to be operation

[13] Package B-1 and B-2
[14] Package J-1 and J-2
[15] Sub-rating for Effectiveness is to be put with consideration of Impacts.

indicators. The discharge capacity can be found in Table 4. The values for both river channel and discharge channel exceed the target values. Since completing the main construction (since 2004), BBWS has not regularly calculated data on discharge capacity and amount of river flow, but this data was confirmed only at the time of ex-post evaluation (most recent several years). BBWS and Jasa Tirta I (East Java) Public Corporation (hereafter referred to as "Jasa Tirta 1")[16], a nation owned corporation affiliated with the Ministry of Public Works and Housing responsible for operating and maintaining the Babat Barrage, discharge channel, and the outlet for Jabung Reservoir, confirmed, through interviews of local residents and farmers appearing below, that at the time of heavy rains there has been no flooding from the developed levee or flood damage up to the ex-post evaluation. It can be surmised that the outcome of this project's river improvement work has secured the integrity of the river (width of river and height of levee) and discharge capacity[17] in general.

Table 4: Actual Results Related to Discharge Capacity and Highest Water Mark

Indicator	Target (At the time of project completion: 2001)	Actual Results (At the time of ex-post evaluation: most recent several years)
Discharge capacity *Note 1 (Unit: m^3/second)	River channel: 2,500 to 2,530 Discharge channel: 125 to 365	River channel: 2,960 to 3,500 *Note 3 (response to 10 to 50 year flood scale) Discharge channel: 400 to 640 *Note 4 (response to 10 to 50 year flood scale)
Highest water level *Note 2 (Unit: m)	7 to 8	6.36 to 8.20m (*See Table 5 for details)

Source: Interviews with BBWS and Jasa Tirta I, BBWS documents
Note 1: Discharge capacity indicates the designed flow rate without flooding. The actual river flow rate has not been observed.
Note 2: Observed at Babat Barrage at the time of ex-post evaluation.
Note 3: Discharge capacity between the mouth of the Solo River and Babat Barrage. Depending on the location, readings vary between 2,960 to 3,500m^3/second.
Note 4: Discharge capacity of the small discharge channel section at Sedayulawas. Depending on the location, readings vary between 400 to 640m^3/second.

The actual results of the highest water level were observed around the vicinity of the Babat Barrage developed as part of the project. Table 5 shows the highest water level and date which

[16] The relationship with BBWS in terms of operation and maintenance is explained in 3.5.1 Institutional Aspects of Sustainability, Operation and Maintenance.
[17] However, at the time of ex-post evaluation about 17 years after the completion of the project's main work and about 13 years after the completion of work on additional outputs, BBWS developed barrages and levees along the Solo River upstream and mid-stream (including the Phase 2 intended as a continuation of the project [river improvement project in the vicinity of Bojonegoro]) and Sembayat Barrage downstream (see Figure 1), furthermore developed using its own funds flood control facilities throughout the entire Solo River Basin. Since the discharge capacity and the reliability of flood control have improved for the entire Solo River, this is one factor behind why the actuals in Table 4 exceed the targets. In other words, there is room for discussion about identifying discharge capacity quantitatively focused on the project's outputs or limited to the project.

was recorded for each year. According to BBWS and Jasa Tirta 1, the highest water level recorded since the year of completion of this project (2004) was 8.2 meters on February 28, 2009. Table 6 shows the warning levels for Babat Barrage. Although the above record of 8.2 meters exceeds the "red" level (8.0 meters) (and although 8.0 meters was recorded on December 1 and 2, 2016, December 30 and 31, 2007, and January 1, 2008), this level is below the levee height (9.20 – 9.5 meters), and there was no flooding from the developed levee in either case. Also, through interviews with residents at 3.3.1.2 Qualitative Effects, it was confirmed that flood damage has not occurred around the levee of the target area, so it is judged that flood damage has been alleviated. Therefore, it can be said that the initially envisioned purpose of the project (reduce flood damage) has been achieved[18].

Table 5: (Actual) Highest Water Level and Date Which Was Recorded for Each Year

Year	Highest water level	Recorded Date
2005	6.70m	April 7
2006	6.70m	January 6, 7, and May 4
2007	8.00m	December 30, 31
2008	8.00m	January 1
2009	8.20m	February 28
2010	6.99m	May 18
2011	7.04m	May 4
2012	7.00m	January 18
2013	7.85m	December 20
2014	6.36m	December 22
2015	6.99m	February 13
2016	8.00m	December 1, 2
2017	7.35m	February 5

Source: Jasa Tirata I, BBWS

[18] As stated in 3.2.1 Project Effectiveness and Outputs, it cannot be denied that parts of the river may be flooded at the time of high water levels, as for the area around the undeveloped levee (approximately 7km) due to lack of land acquisition.. In interviews with BBWS and Jasa Tirta I, representatives commented that "We don't know the detailed extent of damages at high water levels in the areas where the levee hasn't been developed. To date, we have not received complaints, reports or requests for countermeasures from residents or community leaders. It is believed that damages to commercial or residential land are nearly non-existent. If there were damages, they would likely be limited." Although the reliability of flood control hasn't improved only in the areas in question, there was no mention of flood damaged areas in interviews with local residents as explained in "(Reference) Flood Damage in the Lower Solo River Basin" and "3.3.2 Qualitative Effects" below. In either case, it is desirable that BBWS should strive to resolve the land acquisition issues in the areas in question to every extent possible, but flood damage in areas where the levee has yet to be developed is presumed to be limited.

(Reference) Table 6: Warning Levels for Babat Barrage

Classification		Height
Level of highest levee		9.20-9.50m[19]
Water level	Red	8.00m
	Yellow	7.50m
	Green	7.00m

Source: Jasa Tirata I, BBWS

(Reference) [Warning Levels for the Solo River Basin (Types)]

Red: Monitoring of weather, water level and structures such as dikes is performed continuously and reported every 15 minutes to one hour to related institutions (BBWS, surrounding local governments, National Board of Disaster Management (BPBD)). BBWS will discuss flood warning alerts with the governments of East Java and Central Java.

Yellow: Monitoring of weather, water level and structures such as dikes is performed every hour and reported every three hours to related institutions (same as above). BBWS commences discussions about flood warning alerts and evacuation orders with the regional branches of the National Board of Disaster Management (BPBD) and surrounding local governments (Tuban, Gresik, Lamongan).

Green: Monitoring of weather, water level and structures such as dikes is performed every two hours and reported every six hours to related institutions (same as above). Materials are prepared for flood countermeasures.

2) Effect Indicator

This project set reliability of flood controls (decline in flood probability) for the lower Solo River Basin as the effect indicator. According to BBWS, prior to the start of this project floods occurred frequently whenever heavy rains struck in the monsoon season and there were extensive damages incurred in the river's lower basin vicinity. In other words, it is presumed that overflowing occurred every year or once every several years resulting in flooding of the surrounding area. Table 7 shows the target and actual figures of the reliability of flood controls (decline in flood probability) for the lower Solo River Basin. BBWS' opinion is that it has now more able to control the flow rate for the entire Solo River Basin because of the combination of completing development of Sembayat Barrage as well as barrages and levels in the upstream and mid-stream areas of the Solo River using its own funds. In addition, BBWS has shown the opinion, "It is impossible to determine the flood probability specialized in this project which has been over 16 years since most of the levees have already been completed. However, concerning only the lower Solo River Basin, the situation close to the 1/10 to 1/50 (corresponding to the flood scale once every 10 to 50 years) has already been achieved in places other than the

[19] This range is used because of differences in depth in the surrounding area.

unresolved land acquisition site[20].” Although it cannot deny that the quantitative basis required for accurate judgment is somewhat lacking, once the Jabung Reservoir in Phase 2 of the project and levee are completed in areas where land acquisition has yet to be resolved in Phase 1, it is presumed that response to 1/10 flood scale will be guaranteed and it will be closer to realizing responses to 1/50.

Table 7: Ensuring Reliability of Flood Control Surrounding the Lower Solo River Basin

	Target (At the time of project completion)	Actual (2017)
Ensuring reliability of flood control (decline in flood probability)	1/10 (Response to flood scale of once every 10 years)	1/10－1/50 (Response to flood scale of once every 10－50 years)

Source: Interview with BBWS

(Reference) Flood Damage in the Lower Solo River Basin

For reference, Table 8 explains flood damages that occurred in the lower Solo River Basin (since 2011, only for the Lamongan area[21]). As for flood damage, data since 2011 only was obtained from the National Board of Disaster Management (BPBD). However, with regard to the content of Table 8, it was confirmed by interviews with BBWS that, instead of flood damages caused by the flooding of the main Solo River, damages from flooding from the nearby irrigation canal, streams, lakes, wetlands, and undeveloped Jabung Reservoir (Phase 2) did occur during heavy rains, farmers in the lower Solo River Basin vicinity, and employees of surrounding local governments[22]. Backing these views, Table 5 and 6 above as well as their explanations serve as evidence. In other words, the content of Table 8 is handled as reference only because it is not related to the levees developed by this project. Meanwhile, in interviews farmers commented, “there is continuing risk that our fields will flood during heavy rain as long as work is not completed on the Jabung Reservoir (Phase 2) and connecting channels (inlet and outlet).” That is to say, in the surrounding areas damages continue to occur due to factors beyond this project, although these are not flood damages due to the flooding from the levees developed by this project[23].

[20] It was confirmed through this evaluation survey that BBWS has not carried out estimates of the flood probability on a regular basis. Information about the situation of flood damages in areas around sections of the levee not yet developed due to the lack of resolution of land acquisition is as already discussed.
[21] The Lamongan area occupies a majority of the lower Solo River Basin.
[22] BBWS has a plan for a project to connect wetlands and small rivers to the channel and then control water volume and flows as well as draw and discharge accumulated water using pump facilities.
[23] See Footnote 18 for an explanation of flood damages concerning parts where land acquisition has yet to be completed (approximately 7km).

(Reference) Table 8: Flood Damages that Occurred in the Lower Solo River Basin

Year	Flooded Households	Damage to Farmland (rice field) (ha)	Amount of Total Damage (1 million Rp.)
2011	2,106	0	9,657
2012	1,361	146	8,138
2013	2,462	305	1,250
2015	1,361	146	7,384
2016	246	91	955.5
2017	3,346	0	6,343.58

Source: Lamongan Branch Office, National Board of Disaster Management (BPBD)
Note: Lamongan Branch, the National Board of Disaster Management (BPBD) was established in 2011. As a result, no data exists prior to 2010. The Indonesian National Board of Disaster Management was established in 2008. Furthermore, enough flood damage data has not been retained by BBWS.

Photo 3: Constructed Levee (Tuban District)

Photo 4: Jabung Reservoir Inlet (Developed as additional output)

3.3.1.2 Qualitative Effect (Other Effects)

Reduction of Flood Damages through Project Implementation

Interviews[24] of residents and farmers in the vicinity of the lower Solo River Basin were interviewed for this ex-post evaluation. Comments included, “Floods occurred frequently before the start of the project. In particular, in the flood of March 1994 the water level reached about two meters above ground level, causing extensive damages. Many needed to rebuild homes or make major renovations due to the damages, but now there is no need. I don’t really feel that transportation has been affected by floods or access has improved with the development of the levee, but I do feel safe knowing I can go out with two wheel drive motorcycle or bicycle when the Solo River rises. I can go about my life with more peace of mind because there are no longer any floods like the one in March 1994.” Also, comments were received from local governments

[24] In this evaluation survey, group interviews were held involving residents and farmers living in the village communities under the Tuban and Lamongan local governments in the lower Solo River Basin (Banjar, Tegalrejo, and Shimojo under Tuban’s administration and Kedung under Lamongan’s administration: all four villages close to the main Solo River). Key informant interviews were separately held for community leaders. There were 18 total participants in the interviews, consisting of 16 men and 2 women.

(Tuban and Lamongan) that included, “Although we cannot explain quantitative date for flood probability, we do not believe there has been any flood damages in the vicinity thanks to the project. If this project wasn’t implemented, there would still be a lot of human and property damages caused by heavy rain.” Furthermore, BBWS executives commented, “Without the discharge channel at Sedayulawas, residential and agricultural land would have been flooded after prolonged rains or heavy rains. During floods 20 years ago (before the start of the project), flood water levels remained the same for at least more than five hours. This discharge channel plays a vital role in discharging water appropriately.”

In light of the above, it is believed that this project has been contributing to the reduction of flood damages in the vicinity of the lower Solo River Basin.

Photo 5: Interview of Project Beneficiaries

Photo 6: A tributary River Located Away from the Solo River (Flooding occurs sometimes during heavy rains)

3.3.2 Impacts

3.3.2.1 Intended Impacts

Contributions to Improving Productivity of Agriculture in the Lower Solo River Basin Area and Stimulating the Economy

1) Quantitative Effects

Table 9 shows changes in the Gross Regional Domestic Product (hereafter referred to as “GRDP”) of the local governments in the lower Solo River Basin and production value of the agricultural sector. Data for this table is from before the start of this project (1991), the years after completion of the project from 2005 to 2010, and the most recent six months of data from 2015. Although a simple comparison is not possible[25] between the time prior to the start of the

[25] As one example, readers must keep in mind the massive change of the rupiah in Indonesia caused by the Asian Currency Crisis in the second half of the 1990s.

project (1995), the time of completion of the project (2004) and the time of ex-post evaluation many years later (2017), in the three local government around the Solo River Basin (Gresik, Lamongan, and Tuban), GRDP and production value of the agricultural sector tend to increasing since 2005. As explained above, with major reductions in flood damages in most of the area along the main Solo River, as noted below in 2) Qualitative Effects based on comments from farmers, farmers can now plant rice and corn during the monsoon season with peace of mind, securing stable income throughout the year. Taking this into consideration, it is believed that this project is underpinning the economic stimulation of the surrounding area.

Table 9: GRDP of Local Governments in the Lower Solo River Basin and the Production Value of Agriculture Sector

(Unit: 1 billion rupiah)

	1991	2005	2006	2007	2008	2009	2010	2015
【Gross Regional Domestic Production (Nominal GRDP)】								
a) Kab. Gresik	1,189.9	19,746	20,990	24,337	28,353	33,247	59,069	100,724
b) Kab. Lamongan	333.7	5,306	6,016	6,807	10,358	11,774	17,360	28,831
c) Kab. Tuban	279.1	7,689	8,995	10,325	12,160	16,978	28,018	47,691
【Production Value of Agriculture Sector】								
a) Kab. Gresik	121.1	1,925	2,183	2,409	2,688	3,173	3,581	8,274
b) Kab. Lamongan	157.7	2,179	2,368	2,643	2,980	4,749	5,293	11,520
c) Kab. Tuban	173.6	1,873	2,092	2,240	2,513	4,321	5,346	10,277

Source: Statistics Indonesia (BPS)

2) Qualitative Effects

Interviews[26] of residents and farmers were conducted about the environment surrounding farming in the lower Solo River Basin area. Comments including the following, “After completion of Babat Barrage, I have been able to secure a stable supply of irrigation water throughout the monsoon season and dry season (supplemental explanation: water intake barrages have been developed along the levee on the banks of the main Solo River and water is supplied to nearby farmland). In particular, prior to the development of the levee, water intake

[26] Implementation method and eligible persons are explained in 3.3.1.2 Project Effectiveness and Qualitative Effects (Reduction of Flood Damages through Project Implementation). 80 to 90% of the residents in villages under local governments in the vicinity of the project facilities work in agriculture.

during the dry season was inconsistent, resulting in inconsistent rice yields, but now my income has increased in dry season thanks to the rice crop. In the past, I only had one growing season, but now it's mainly two to three. I believe that the price of agricultural land is increasing[27]. Compared to 20 years ago, before the start of the project, there is little concern of flooding, so during the monsoon season I can plant rice and corn without worry. I now have stable and rising income. This means I have been able to afford to spend money and renovate my house to make it stronger (the house was made of bamboo, but now it is made of concrete blocks and bricks). I was also able to buy a two wheel drive motorcycle. My house flooded during the flood 20 years ago and it cost me a great deal to repair it, making it impossible to save money. Today, such flooding no longer happens. Children of the village were only able to attend the local junior high school in the past, but now some are able to attend vocational school or four-year university."

In light of the interviews results above, this project has increased the production volume of crops in the lower Solo River Basin area, increased residents and farmers' incomes as well as their purchasing power, and in the process contributes to the stimulation of the local economy.

3.3.2.2 Other Positive and Negative Impacts

1) Impact on the Natural Environment

This project is applied to "OECF Guidelines for Environmental Consideration" (October 1989). The environmental impact assessment (EIA) for this project involved the environmental impact study carried out from 1992 to 1994, and the project was officially approved after receiving approval of the Minister of Public Works.

During the project implementation, interviews with BBWS confirmed that there were no negative impacts on the ecosystem, issues related to air or water pollution and waste. As for loud noise, according to BBWS, some noises in a short time were made during the river improvement work, and there were no complaints from residents in the surrounding area. It was confirmed through interviews with BBWS and field visits that no negative environmental impacts (air pollution, water quality issues, loud noises/vibrations, and negative impacts on ecosystem, etc.) have occurred since project completion (2004).

According to BBWS and Operation and Maintenance Area 4 Bojonegoro Office (Area 4 Kantor Bojonegoro; hereafter referred to as "Bojonegoro Office"), under BBWS and in charge

[27] According to the leader of Tegalrejo Village, under Tuban and situated in the middle of the lower Solo River Basin, comparing the time of project completion (2004) and the time of the ex-post evaluation (2017), land prices of residential, agricultural and commercial lands have risen at least between approximately 150 and 200%.

of operation and maintenance of the levees developed by this project, if negative environmental impacts were confirmed, there is a system in place for dealing with such impacts. BBWS and Bojonegoro Office will discuss and have the local government with jurisdiction in the lower Solo River Basin check the detail, and then a request letter will be sent to the DGWR head office in the name of the local government to request for instructions and decision. Later, the DGWR head office will then issue instructions to BBWS and Bojonegoro Office (appropriating a budget if necessary). In either case, this system has not functioned because there have been no negative environmental impacts up to the ex-post evaluation.

2) Resettlement and Land Acquisition

As noted in 3.2.1 Project Effectiveness and Outputs, land acquisition and resettlement was carried out according to plan for the new river channel (Karanggenen Shortcut vicinity). There were 201 landowners that negotiated and concluded agreements with BBWS and local governments, and the total area of land acquired was approximately 41,300m^2, with total compensation paid of 97,815 million rupiah. According to BBWS, land acquisition procedures were carried out appropriately according to Indonesian law (land law). However, data is not available on the number of homes resettled and the number of people resettled through land acquisitions[28].

As noted above, the land acquisitions and resettlement has generally been completed in most of the areas around the levee, but in some areas (areas along approximately 7km) land acquisitions have yet to be settled. The reason why settlements have yet to be reached is because some residents living along the Solo River since ancient times have continually lived there while braving the dangers of rising water levels during heavy rains. Figure 3 shows an archetypical example. These people will not resettle no matter how much compensation or land is offered for resettlement. Among them, some have built their own simple levees and have continued to live where they are with an overinflated sense of security in the effects of these homemade levees. BBWS and local governments have continually negotiated for land acquisitions during project implementation but have yet to acquire surrounding land for the remaining approximately 7km section[29]. According to BBWS, “BBWS and local governments

[28] The reason why the number of resettled homes and resettlement residents is unknown is because BBWS and local governments negotiated only with landowners. In many cases, there were multiple homes and residents on land in the possession of landowners, and BBWS and local governments were unable to negotiate directly with them. For this reason, there are no records and monitoring has not been carried out after acquisition. Compensation for affected residents and measures to restore livelihoods were included in the compensation amount paid.

[29] As of the ex-post evaluation, BBWS is working on identifying the landowners of land for the remaining

worked diligently to seek the understanding of local residents about the project, through seminars and briefing sessions. BBWS feels like the coordination and negotiating capabilities of local governments and community leaders was not as expected. At the time, BBWS was not able to directly engage in coordination and negotiations with local residents. Our assumption was that local governments and community leaders would cooperate and coordinate. Yet, in many cases their high coordination capabilities and willingness was not as it seemed. Part of the reasons why land acquisitions were not completed by 2004 was somewhat because of this situation." As indicated above, since there are residents who stubbornly refuse relocation, it is thought that the executing agency should have prepared for consultation with the residents widely ahead of time prior to the start of the project, identified the coordinating capabilities and influence of the local governments and community leaders at earlier stage, and taken the measures.

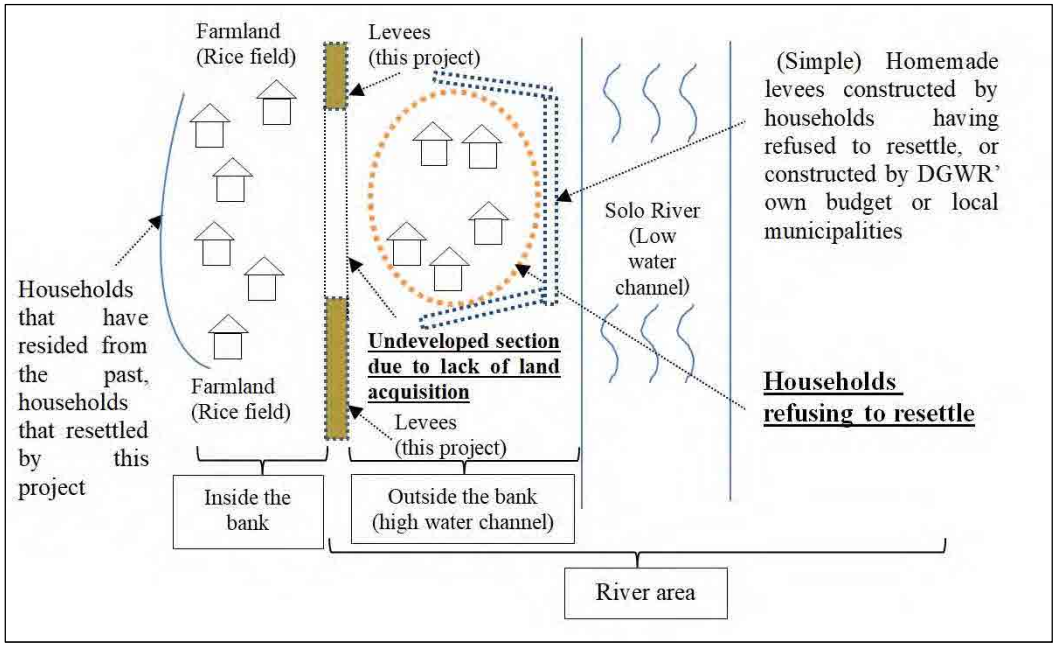


Figure 3: Explanation of Sections Where Land Acquisition Has Not been Completed (Example)
(Low water channel indicates where everyday water flows and the high water channel indicates where floods occur at times of rising water levels.)

approximately 7km section and BBWS will be in a position to secure a budget with the necessary funds.

Photo 7: Lower Solo River Basin and Households Living Along the River that Refuse to Resettle (pictured at left)

Photo 8: Levee Developed Using BBWS' Own Budget and Undeveloped Area Due to Absence of Land Acquisition

[Summary of Effectiveness and Impact]

With regard to quantitative effects, discharge capacity at the time of ex-post evaluation (designed flow rate) had attained and exceeded the target for both the river channel and discharge channel. No flood damages caused by the flooding of the main Solo River have occurred during heavy rains from the levees developed. Water levels recorded at Babat Barrage are below the levee height at the same place, thus, it can be determined that the project purpose initially assumed (reduce flood damages) has been attained. In addition, according to interviews with residents and farmers and economic and agricultural production statistical data, it is presumed that farmers have seen an increase in crop yield and incomes of both residents and farmers have increased, which is believed to be stimulating the local economy as well. Thus, effectiveness and impacts of this project are high.

3.4 Sustainability (Rating: ③)

3.4.1 Institutional / Organizational Aspects of Operation and Maintenance

At the time of ex-post evaluation, the executing agency of this project is DGWR, which is responsible for flood control, water resource development, planning of irrigation projects, as well as project implementation, operation and maintenance in Indonesia. In the Solo River Basin, BBWS, an organization under DGWR, is responsible for new water resource development, as well as flood control project planning, execution, management and maintenance.

Bojonegoro Office[30], a department of BBWS, is responsible for the operation and maintenance of levees developed by this project. The operation and maintenance work mainly involves inspections, patrols and repairs related to the levees and river channel, digging of river channel when necessary, and water resource management. Jasa Tirta 1[31], a nation owned corporation affiliated with the Ministry of Public Works and Housing is responsible for the operation and maintenance of Babat Barrage, discharge channel, and the outlet for Jabung Reservoir developed by this project. Jasa Tirta 1 carries out daily maintenance mainly in the form of cleaning around the barrage, weed removal along the access road, inspecting, replacing, greasing of cables/wires and barrages for opening/closing water gates, and painting of structures and guardrails, etc. It also observes water levels of the Solo River at Babat Barrage and reports to BBWS[32].

At the time of ex-post evaluation, BBWS has employed a workforce of approximately 1,300 (of these, around 330 are responsible for flood control projects), while the number of employees at Bojonegoro Office under BBWS is 30, and at Jasa Tirta I is 12. At the time of field visits, through interviews with frontline workers of the Bojonegoro Office and Jasa Tirta I, it was observed that the workforce of each organization is sufficient. It was confirmed that the staff are allocated to each department without shortage or overage and right person is assigned for the right job[33].

Figure 4 contains a diagram (outline) of the organizations in charge of the operation and maintenance for this project. Supervision and work reports are carried out among the DGWR head office, BBWS and Bojonegoro Office.

[30] Bojonegoro City is located in the upper basin of the project's target area; therefore, Bojonegoro Office established a project office in Babat City (hereafter referred to as "Babat Office"), closer to the project's target area, and carries out work from there.

[31] Jasa Tirta I is a nation owned organization specializing in operation and maintenance. DGWR has concluded an agreement on facility operation and maintenance (MOU) with Jasa Tirta 1 in order to achieve more efficient operation and maintenance after the project output's warranty period.

[32] It was confirmed through field visits that Jasa Tirta I has the necessary equipment for maintenance (water level observation room, equipment, heavy machinery, and vehicles, etc.).

[33] As for the working conditions of employees, Bojonegoro Office has a daytime shift on weekdays (Monday to Friday). However, Jasa Tirta I uses a three-shift system 24 hours a day, 365 days a year because it monitors daily flow rate and water levels at the Babat Barrage.

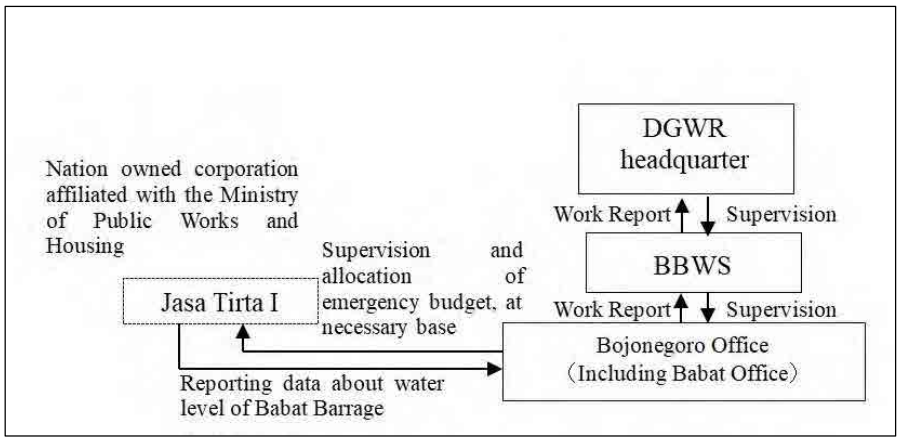


Figure 4: Organization Relationship Diagram
for the Operation and Maintenance of this Project (Schematic)

In light of the above, it is judged that no particular institutional issues were observed with regard to the project's operation and maintenance.

3.4.2 Technical Aspects of Operation and Maintenance

At the Bojonegoro Office, employees are required to undergo training two times per year. This training is carried out at facilities such as research or university institutes in Indonesia and covers inspections of river barrages and levees, opening and closing of water gates, water level observation methodology, barrage's maintenance, and how to use discharge pumps. Employees who receive training share what they learned with colleagues and this knowledge is put to good use in daily maintenance work. On-the-job-training is also carried out for new employees in a timely manner. One of the requirements for new employees is that they must have graduated from a specialty school (vocational college or four-year university). After being hired, new employees undergo performance valuations on a regular basis within the organization and their capabilities and experience has been confirmed. Jasa Tirta I also provides training to employees on a regular basis. This training covers operation of machinery and electrical work, fire fighting, and accident prevention, etc. As with the Bojonegoro Office, training is conducted at facilities of research and university institutions in Indonesia. The hiring requirement and on-the-job-training is the same, too. Through field visits and interviews at both organizations, it was confirmed that highly experienced employees are assigned based on the right person for the right job. In addition, it was confirmed that a manual on maintenance for project facilities has been created by both organizations and this manual is being used in a timely manner.

Based on the above, no technical issues were observed with regard to the project's operation

and maintenance.

3.4.3 Financial Aspects of Operation and Maintenance

Table 10 shows the operation and maintenance budget of Bojonegoro Office for the most current four years.

Table 10: Operation and Maintenance Budget of Bojonegoro Office

(Unit: million Rp.)

2014	2015	2016	2017
Approx. 8,000	Approx. 8,000	Approx. 12,000	Approx. 14,000

Source: BBWS

Bojonegoro Office and BBWS commented that, "Every year sufficient budget funds are appropriated for maintenance work. There has never been a budget shortfall that has affected maintenance work." The budget has increased since 2016. One reason cited for this increase is that the central government is more strongly aware of the importance and need for DGWR's operations in terms of water supply, irrigation and flood control. When looking only at this project's facilities, the budget for maintenance has been allocated in just the right amount, with attention given to increasing frontline workers and appropriate flow rate management (including water level observation and management of various data). Interviews at the office also confirmed that there are no funding issues[34].

Based on the above, taking into account that no insufficient maintenance has occurred due to a shortfall in the budget, no particular financial issues were observed with regard to the project's operation and maintenance.

3.4.4 Status of Operation and Maintenance

At the time of ex-post evaluation, there were no particular problems with the levees and discharge channel developed by this project, the facilities including Babat Barrage, and maintenance situation. Both the Bojonegoro Office and Jasa Tirta I prepare a maintenance plan every year, and inspections and maintenance of each facility are carried out after identifying necessary areas of emphasis. This was confirmed through interviews at both organizations and

[34] Although specific monetary data could not be obtained on the budget for operation and maintenance of the project's facilities handled by Jasa Tirta I, interviews with senior management revealed that although monetary amounts are not large, every year the budget is appropriated in the right amount needed. Also, according to Jasa Tirta I, separate from this project, it carries out a water supply project at a water treatment plant fed by the Solo River, which provides ample fee income.

field visits.

There are no problems with the purchase or storage of spare parts at the Bojonegoro Office and Jasa Tirta I. Every year the necessary budget is appropriated. However, Jasa Tirta I keeps purchases and storage of spare parts to a minimum because relatively major maintenance work has not been required. If major repairs or replacement is needed, Jasa Tirta I can address the situation internally or request assistance from the Bojonegoro Office.

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

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

This project implemented river improvement work in the lower Solo River Basin on the island of Java, which is subject to frequent flooding, in order to contribute to the reduction of flood damages, improve productivity of agriculture in the surrounding area, and stimulate the economy. Relevance of this project is high because it provides a development plan for infrastructure needed to reduce flood damage and disaster risks through the *National Medium-term Development Plan* and the *Strategy Plan*, identifies development needs related to the development and improvement of flood control and levees through the construction of barrages and dams in the lower Solo River Basin, and maintains consistency with the assistance policy of the Japanese Government. As for efficiency, project outputs were implemented mostly as planned, but project costs exceeded the initial plan due to rising consulting service and management costs and land acquisition costs and construction costs incurred after the completion of the loan (since 2004). The project period had a low efficiency because land acquisitions had yet to be completed by the executing agency even at the time of ex-post evaluation. As for quantitative effects, discharge capacity at the time of ex-post evaluation exceeded the target value, the water level observed at the Babat Barrage was below the levee height at the same place, and no flooding from the levee of the main Solo River or flood damage has occurred. Additionally, interviews with local residents and farmers as well as economic and agricultural production data indicate the project is supporting the stimulation of the local economy. Thus, the effectiveness and impacts of this project are high. There are no particular concerns regarding the structural aspects, technical aspects and financial aspects of the

organizations and departments in charge of the project's operation and maintenance. Thus, sustainability of the effects realized through this project is high.

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

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

・At the time of ex-post evaluation, BBWS observes the water level of the Solo River on a daily basis, but it was observed that BBWS does not fully share data on river water level and flood damages with Jasa Tirta I. This data is useful for the analysis of effects of flood control projects; thus, it is desirable that a system be developed for sharing this data among related parties to every extent possible. Also, it is desirable to properly store and manage the past data.

・At the time of ex-post evaluation, land acquisitions had yet to be completed in some areas (approximately 7km) of the lower Solo River Basin. It is desirable that BBWS cooperate with DGWR and address this situation in a prompt manner.

4.2.2 Recommendations to JICA

・None.

4.3 Lessons Learned

<u>Importance of coordination related to land acquisition and resettlement at an early stage</u>

・Although the task of land acquisition and resettlement is not an easy in the lower Solo River Basin as some residents obstinately refuse resettlement and land provision, the possibility cannot be refuted that progress could have been made that BBWS should have prepared for consultation with the residents widely ahead of time prior to the start of the project, identified the coordinating capabilities and influence of the local governments and community leaders at earlier stage, closely tied up and taken all measures (example: BBWS continues to make proposals or lobby, so as to have local governments and community leaders repeatedly engage residents in discussions patiently). In addition, as a possible measure to be taken during the project implementation, there may have been room for BBWS and local governments to carry out awareness raising activities to encourage residents continually living along the Solo River outside the levee (high water channel) or provide some form of useful incentive outside of money, or review such measures proactively. Therefore, if difficulty in land acquisition could be foreseen at an early stage after the start of the project, a persistent stance is needed in which

negotiations should be carried out after coordination to every extent possible with relevant institutions, and based on predictions of outcomes, and in which difficult situations are addressed to every extent possible.

Comparison of the Original and Actual Scope of the Project

Item	Plan	Actual
1. Project Outputs	1. River improvement ・Levee (approx.126km) ・Low water dike construction (approx. 4km) ・High water dike construction (approx. 3km) 2. Discharge Channel ・Small discharge channel at Sedayulawas (length: 12.4 km, bottom width: 25 m) 3. Land Acquisition ・Levee (land acquisition and resettlement: approx.3,000 homes) ・ Part of new river channel (land acquisition in the vicinity of the Karanggenen Shortcut) 4. Consulting Services ・Bid assistance, construction project management, and detailed design of Jabung Reservoir and Small discharge channel width expansion at Sedayulawas, etc.	1. River improvement ・Approx. 131km (Note: this 131 km includes construction by the Indonesian side to be borne after the end of loan disbursement (2004)) ・Approx. 2.6km ・Approx. 2.7km 2. Discharge Channel ・As planned 3. Land Acquisition ・Estimated almost as planned ・Estimated almost as planned 4. Consulting Services ・As planned [Additional Output] 1) Development of Babat Barrage as well as dikes in the vicinity and access road 2) Development of bridge at the inlet of Jabung Reservoir and water gate at the outlet 3) Consulting services for 1) Development of Babat Barrage as well as dikes in the vicinity and access road
2. Project Period	December 1995 – December 2001 (73 months)	December 1995 – February 2018 (267 months, not completed yet)
3. Project Cost Amount Paid in Foreign Currency	7,238million yen	2,032million yen
Amount Paid in Local Currency	6,325million yen （140,541million Rp.）	13,100million yen (871,726million Rp.)
Total	13,563million yen	15,132million yen
ODA Loan Portion	10,796million yen	10,781million yen

Exchange Rate	1 Rp.=0.045 yen 1USD=98.3 yen （As of April, 1995）	1Rp.=0.015349 yen 1USD=117.04 yen （Average between 1995 and 2004） 1Rp.=0.008713 yen 1USD=104.18 yen （Average between 2012 and 2017） based on rates issued by the IMF's International Financial Statistics Data
4. Final Disbursement	August 30, 2004	

Republic of Indonesia

FY2017 Ex-Post Evaluation of Japanese ODA Loan

"Keramasan Power Plant Extension Project"

External Evaluator: Kenichi Inazawa, Octavia Japan Co., Ltd.

0. Summary

This project aimed to increase the electricity supply capacity, to improve the stability of supply, and to mitigate tight supply-demand conditions for grid electricity at Keramasan Power Plant connected to the South Sumatra Grid on the island of Sumatra, by expanding the plant's combined cycle power generating facilities; thereby, contributing to improve the investment environment and economic development in the South Sumatra area. Relevance of this project is high because of its confirmed consistency with the policies on the development of new power generation facilities and electricity supply presented in the *General Plan for National Electricity*[1] established by the Government of Indonesia and the *Electricity Supply Business Plan* prepared by the State Electricity Company (Perusahaan Listrik Negara; hereinafter; "PLN"), the executing agency, and with the country's development needs for addressing growing electricity demand as well as the assistance policy of the Japanese government. As for efficiency, project outputs were implemented mostly as planned, and project costs were within the initial plan thanks to the effects of foreign exchange rates and the tax exemption placed on gas turbine generating facilities. In contrast, the project period exceeded the plan by a large margin because more time was required than anticipated for selection procedures for the consultant and contractor. Thus, the efficiency is fair. In terms of the project's quantitative effect indicators, maximum output, plant capacity factor, plant availability, gross thermal efficiency, and net electric energy production have generally achieved target values since 2015, and because it is believed that this is underpinning the avoidance of risk of tight supply-demand for electricity and the stable supply of electricity within this grid, the effectiveness and impact of this project are high. There are no particular concerns in terms of institutional, technical or financial aspects of the PLN Keramasan District Office (Hereinafter; "PLTGU Keramasan"), which is responsible for the operation and maintenance of this project. Although a fuel nozzle for the Unit 1 generating facility burned out in February 2017, requiring repairs, and operations were stopped until the end of October 2017, at the time of the ex-post evaluation, repair work had been completed and operations restarted. There have not been other problems in terms of the operation and maintenance of other equipment and facilities. Thus, the sustainability of the

[1] Indonesian is Rencana Umum Ketenagalistrikan Nasional (RUKN).

effects realized through this project is high.

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

1. Project Description

Project Location

Power Plants Developed by this Project

1.1 Background

Indonesia faced tightening supply-demand conditions for electricity following the country's population growth and economic development. Prior to the start of this project (2004), electricity demand was expected to grow at a rate of about 6.4% per year on average, with the total capacity of power generation facilities required by 2013 estimated to be approximately 7,400MW for Java and Bali, approximately 1,300MW for South Sumatra, approximately 1,200MW for North Sumatra, approximately 600MW for Batam, and approximately 400MW for South Sulawesi. As a result, the country was faced with the pressing need to address this growing demand for electricity. In particular, in the South Sumatra area, where this project is located, robust economic growth was forecast for the future given the active investment taking place, while at the same time the supply-demand balance of electricity was expected to tighten in the near future. In addition, since the Asian Currency Crisis of 1997, PLN faced difficulties in developing new power plants using its own funds; therefore, development funded by other sources, including those outside the country, was considered an urgent task.

1.2 Project Outline

The objective of this project is to increase the capacity of electricity supply, alleviate tight power demand and supply situation, and improve the stability of supply, by expanding combined cycle power generation facility in Keramasan Power Plant connected to the South Sumatra Grid on the island of Sumatra, thereby contributing to improve the investment

environment and economic development in the South Sumatra area.

Loan Approved Amount/ Disbursed Amount	9,736 million yen / 9,677million yen
Exchange of Notes Date/ Loan Agreement Signing Date	March 29, 2005 / March 31, 2005
Terms and Conditions	Interest Rate: 1.3% Repayment Period: 30 years (Grace Period: 10 years) Conditions for Procurement: General Untied
Borrower / Executing Agency	Republic of Indonesia / State Electricity Company (PT. PLN)
Project Completion	December 2014
Main Contractors (Over 1 billion yen)	Marubeni Corporation (Japan)
Main Consultants (Over 100 million yen)	-PT. Connusa Energindo (Indonesia) / CHUBU Electric Power Co.,Inc. (Japan) / Electric Power Development Co.,Ltd. (Japan) /PB Power（NZ）Ltd （New Zealand）（JV）- NEW JEC Inc. (Japan)
Related Studies (Feasibility Studies, etc.)	F/S: March, 2003
Related Projects	None

2. Outline of the Evaluation Study

2.1 External Evaluator

Kenichi Inazawa, Octavia Japan Co., Ltd.

2.2 Duration of Evaluation Study

This ex-post evaluation study was conducted with the following schedule.

Duration of the Study: July 2017 - August 2018

Duration of the Field Study: October 2-15, 2017 and February 11-15, 2018

3. Results of the Evaluation (Overall Rating: A[2]).

3.1 Relevance (Rating:③[3])

3.1.1 Consistency with the Development Plan of Indonesia

According to the *General Plan for National Electricity* prepared by Indonesia's Ministry of Energy and Mineral Resources in April 2004, the installed generating capacity of the entire

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

[3] ③: High, ②: Fair, ①: Low

country was declining due to aging facilities, among other factors. Also, this same plan forecasted that the South and North Sumatra Grid would see tightening supply-demand following future population growth and economic development. The plan cited the importance of hydroelectricity for North Sumatra, gas for South Sumatra, and geothermal resources for Lampung as future energy sources. In other words, it can be said that this project, which expanded combined cycle power generation facilities in South Sumatra fueled by gas as an energy source, was consistent with the development policies of the Indonesia government.

At the time of the ex-post evaluation, the Government of Indonesia prepared the *National Energy Policy*[4] in January 2014. This policy has stated a target of increasing the entire country's generating capacity from 51GW in 2014 to 115GW by 2025 and 430GW by 2050. In the *General Plan for National Electricity* (2012 to 2031) at the time of the ex-post evaluation, an electricity supply plan has been stated focusing on the avoidance of electricity supply shortages and the development of gas and pumped storage power plants for peak demand load to minimize the use of fossil fuels. Furthermore, PLN, the executing agency for this project, has established an *Electricity Supply Business Plan*[5] in 2012 (running from 2012 to 2021). This plan advocates the alleviation of electricity supply shortages, further improvements in electricity reliability and quality, and reduction in basic production costs by optimizing the power mix, etc., as goals to be achieved. At the same time, PLN has indicated it will work to lower emissions of greenhouse gases under its philosophy of "activities with an eye on the environment." As part of this, PLN is aiming to transition from the use of fossil fuels to the use of gas at gas-fired thermal power plants in order to lessen its use of fossil fuels[6].

In light of the above, through the time of appraisal and ex-post evaluation, the Government of Indonesia continues to place importance on the development policy of the electric power sector including the improvement of electricity supply capacity. Thus, the project is acknowledged as consistent with the policies and measures laid out in the national plan and sector plan both at the time of appraisal and at the time of the ex-post evaluation.

3.1.2 Consistency with the Development Needs of Indonesia

Prior to the start of this project, peak demand on the South Sumatra Grid was expected to nearly double from 1,132MW in 2003 to 2,429MW in 2013. The installed generating capacity

[4] Indonesian is *Kebijakan Energi Nasional (KEN)*
[5] Indonesian is *Rencana Usaha Penyediaan Tenaga Listrik (RUPTL)*
[6] According to *Electricity Supply Business Plan* and PLN, the reason for this shift is directly linked to the reduction of greenhouse gas emissions.

of this same grid in 2003 was 1,607MW, but in 2007 a diesel-fired power plant in operation was expected to be decommissioned due to aging, and as a result, the supply capacity was expected to drop by about 273MW, the capacity of this power plant. Given this, PLN faced difficulty in delivering a stable supply of electricity since 2008 and it predicted that it would face similar difficulties in addressing peak demand of the future. In other words, increasing new installed generating capacity on the grid was an urgent task.

At the time of the ex-post evaluation, Indonesia continues to be at high risk of tightening supply-demand conditions for electricity. According to PLN, it is recognized that when the supply reserve ratio of electricity in Indonesia drops below 30%, the risk of tightening supply and demand becomes high. Table 1 shows the supply-demand results for electricity for the South Sumatra Grid. Electricity demand is rising, and the reserve ratio continues to fall when looking at the results up to 2016. The reserve ratio stood at 16.2% in 2016, indicating the need for improvement as yet. Additionally, Table 2 shows the electricity supply-demand and future forecast (2018 to 2021) for the South Sumatra Grid. The table indicates that the supply-demand condition has been tight up to 2018. Taking into account the above, the Government of Indonesia is striving to secure generating capacity by promoting nationwide, including the South Sumatra area, the program called "35,000MW for Indonesia[7]" to expand power generation facilities with an additional output of approximately 35,000MW. Moreover, PLN is striving to achieve a stable supply of electricity by implementing *a transformer expansion project in Gunawan*, South Sumatra, and *the Sumatra program for reinforcing the electricity grid*, which aims to improve the electricity supply system of the South Sumatra Grid.

Table 1: (Actual) Electricity Demand and Supply for the Southern Sumatra Grid (2010-2016)

	Unit	2010	2011	2012	2013	2014	2015	2016
Peak demand	MW	2,140.7	2,321	2,520.5	2,749.2	2,955.4	3,143.4	3,513.4
Installed capacity	MW	2,569.3	2,858	3,164	3,227.9	3,836.1	3,904.7	4,083.3
Reserve ratio *Note	%	20	23.1	25.5	17.4	29.8	24.2	16.2

Source: PLN
Note: The reserve ratio by PLN is calculated as "(Installed capacity ÷ peak demand) - 1)".

[7] Indonesian is *35.000 MT Untuk Indonesia*.

(Reference) Table 2: Future Prediction of Electricity Demand and Supply for the Southern Sumatra Grid (2018-2021)

	Unit	2018	2019	2020	2021
Peak demand	MW	3,889	4,279	4,958	5,679
Installed capacity	MW	4,634	6,204	7,480	8,756
Reserve ratio	%	19	45	51	54

Source: PLN

In light of the above, securing power generation capacity and achieving stable supply of electricity at the time of appraisal and ex-post evaluation are major issues for the South Sumatra Grid. Thus, it can be said that the project is consistent with the development needs of the area both at the time of the appraisal and at the time of the ex-post evaluation.

3.1.3 Consistency with Japan's ODA Policy

The Government of Japan's *Country Assistance Program for the Republic of Indonesia* (November 2004) cited "sustainable growth led by the private sector" as one of the important areas of focus. The same document cited economic infrastructure development for the improvement of the investment environment as one way of supporting the fulfillment of this important area of focus. Meanwhile, JICA prepared the *Medium-Term Strategy for Overseas Economic Cooperation Operations* (April 2002), which cited "infrastructure development aimed at economic growth" and "support for regional development" as important areas of focus. It clearly stated that support will be provided to encourage economic development through the development of economic and social infrastructure, including electricity, as a specific way of fulfilling this policy. Moreover, JICA established the *Country Assistance Strategy for Indonesia* (September 2004), which cited the development of an environment for growth led by private sector investment as one of the important areas of focus. Within the assistance policy for major sectors, it specified the four points of stable supply of electricity, greater efficiency of the electric power sector, increased electrification rate, and environmental measures as issues facing the electric power sector. In addition, the policy stated, "Actively support the new construction and expansion of generating facilities in the region and projects for expansion of the coordinated transmission grid, aimed at a stable supply of electricity in the major economic centers of Sumatra and Sulawesi."

In light of the above, this project is considered to have strong consistency with Japan's assistance policy because the electricity supply created by the generation facilities developed by this project can be expected to underpin the economic growth of the island of Sumatra.

This project has been highly relevant to the Indonesia's development plan and development needs, as well as Japan's ODA policy. Therefore its relevance is high.

3.2 Efficiency (Rating: ②)

3.2.1 Project Outputs

This project expanded combined cycle power generation facility in Keramasan Power Plant connected to the South Sumatra Grid on the island of Sumatra. Table 3 contains planned and actual outputs of this project. The outputs were largely in line with the original plan.

Table 3: Planned and Actual Outputs of this Project

Planned at the Time of Appraisal (2004)	Actual at the Time of Ex-post Evaluation (2017)
1) Construction Works, Procurement of Equipment, etc	
(a) Combined Cycle Power Generation Facility (80 MW class) ① Installation of gas turbine and generating facilities (two units) ② Installation of steam turbine and generating facility (two units) ③ Installation of heat recovery steam generator (two units) ④ Extension of accessory equipment (gas supply equipment, 150 kV switchyard, etc.) necessary for the above equipment (b) Related Civil Engineering and Construction Work (c) Cooling Water System (d) Desalination, Pure Water Equipment (e) Spare Parts (quantity necessary for operation / repair for 2 years after start of operation)	Mostly implemented as planned. (The capacity of the gas combined cycle power generation facility changed to 75 MW.)
2) Consulting Services	
(a) TOR related to the construction and operation of power station: ①Detailed design, ②bidding assistance, ③ construction supervision, ④ performance evaluation, ⑤assistance for operation and maintenance, ⑥assistance for environmental management, ⑦ technology transfer and human resource development, etc.	Implemented as planned.

(b) Assistance for strengthening planning functions of PLN and South Sumatra local government officials: ①Assistance for electric power supply and demand anticipation, ② establishment of anticipation system, ③ assistance for optimum power supply development plan capacity, ④assistance for transmission and distribution cable construction plan, ⑤ assistance for making investment plan	

Source: Documents provided by JICA, answers on questionnaire and on-site visits (actual results at the time of ex-post evaluation)

1) In regard to the capacity of the gas combined cycle generating facilities under the category of construction work and procurement of equipment, changes were made at the time of the detailed plan after the start of the project, with the rating from 80MW in the initial plan to 75MW. The reason for this change is cited as the daytime temperature near the Keramasan Power Plant is high causing the generating efficiency to fall[8]; therefore, it was determined through a field investigation at the time of the detailed plan that it would be difficult to increase the output to 80MW[9].

3.2.2 Project Inputs

3.2.2.1 Project Cost

The plan at the time of the project's appraisal called for a total project cost of 11,455 million yen (of this, 9,736 million yen was to be covered by yen loans). In contrast, the actual total project cost was 10,414 million (of this, 9,677 million yen was covered by yen loans), indicating the cost was within the plan (91% versus the plan). The reason for this is because the budget included taxes on imported items such as gas turbine generating facilities since the possibility that the Government of Indonesia would not exempt these taxes could not be eliminated, but in actuality, these taxes were exempted after the start of the project[10]. In addition, fluctuations in

[8] In typical gas combined cycle power generation, when there is a large difference between the exhaust temperature of the gas turbine and the outside air temperature, the amount of power generated by the gas turbine will increase, but conversely, when there is a small difference between the exhaust temperature and outside air temperature, the amount of power generated by the gas turbine will decrease.

[9] Installed generating capacity of "planned value of 80MW" at the time of the appraisal was set based on the possibility of changes due to the bid results of the contractors.

[10] According to PLN, in most cases imported items for state-affiliated projects in Indonesia are non-taxable, but sometimes these items are not tax exempted. Policy wise, procedures to apply for a tax exemption are required, which

foreign exchange rates (strong yen, weak dollar, and weak rupiah) during the project period are also cited as a factor.

3.2.2.2 Project Period

At the time of the project's appraisal, the project period was planned for the six years (72 months) from March 2005 to February 2011. In actuality, the project period was nine years ten months (118 months), from March 2005 to December 2014, greatly exceeding the plan (164% versus the plan). The major causes of this delay are cited as: 1) more time than expected was required within PLN for procedures concerning the selection of the consultant, and the timing of selection start was delayed, 2) more time than expected was required for contractor selection procedures and negotiations with regard to the detailed design and procurement, and 3) trial operation was delayed. More specifically, at the timing of initial firing, supplied gas pressure was lower than required pressure specified by the turbine manufacture. Table 4 shows the initial plan and actual periods of each of the project's components.

Table 4: Initial Plan and Actual Periods of This Project

	Original Plan (At the time of Appraisal: 2004)	Actual (At the time of Ex-post Evaluation: 2017)
(The Whole Project)	March 2005 – February 2011 (72 months)	March 2005 – December 2014 (118 months)
1) Selection of Consultant	April 2005 – September 2006	May 2006 – November 2007
2) Consulting Services	April 2006 – February 2011	November 2007 – December 2014
3) Detailed Design and Procurements	April 2006 – March 2008	August 2008 – March 2011
4) Construction Works	April 2008 – February 2010	April 2011 – November 2012
5) Trial Run	October 2009 – February 2010	May 2013 – December 2013
6) Defect Liability Period	March 2010 – February 2011	December 2013 – December 2014

Source: JICA documents, answers on questionnaire

means waiting for the decision handed down by the Central Government. Therefore, these taxes were included in the project cost prior to the start of the project.

3.2.3 Results of Calculations for Internal Rates of Return (Reference only)

Financial Internal Rate of Return (FIRR)

At the time of the project's appraisal, the financial internal rate of return (FIRR) was calculated to be 14.1% based on income from the sale of electricity as the benefits, the costs required for the project and operation and maintenance costs as the costs, and the project life after the start of provision as 20 years. A recalculation using the same conditions yields an FIRR of 12.7%. The reason why this figure decreased is cited as the investment period (work period) was extended slightly and the timing of investment recovery was delayed. In addition, when the start of the project life was set as the year of the L/A signing, the FIRR at the time of the project's appraisal was 12.8%, while a recalculation at the time of the ex-post evaluation yielded a result of 8.8%. This is because the time was required from L/A signing to the start of provision; thus, the provision period under the project life was shortened, causing the benefits to be reduced. The construction cost required for this project was within the initial plan, and because the electricity sales price forecast at the time of the project's appraisal was higher than expected (at the time of appraisal: US7 cents/kWh → at the time of ex-post evaluation: US8 cents/kWh or more) and the purchase cost of natural gas (fuel cost) as well as maintenance costs, too, were within the initial assumptions, the rate of decrease in the recalculation was held in check.

Based on the above, project outputs were implemented mostly as planned, and project costs were within the initial plan thanks to the effects of foreign exchange rates and the tax exemption placed on gas turbine generating facilities. In contrast, the project period exceeded the plan by a large margin because more time was required than anticipated for selection procedures for the consultant and contractor. Consequently, while the project cost was within the plan, the project period exceeded the plan; thus, the project's efficiency is fair.

3.3 Effectiveness and Impacts[11] (Rating: ③)

3.3.1 Effectiveness

3.3.1.1 Quantitative Effects (Operation and Effect Indicators)

Two gas turbine generating facilities (Unit 1 and Unit 2) were developed as the main component of this project's gas combined cycle generating facilities. Table 5 presents the quantitative effect indicators of this project. The target values were set at the time of the

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

project's appraisal (2004) and actual results represent those recorded after the generating facilities commence operations.

Table 5: Operation and Effect Indicators (Target and Actual) of this Project

Indicator	Target (2012)	Actual			
		2014	2015	2016	(Reference) 2017 Note 3
	One year after the project completion	At project completion's year	One year after the project completion	Two years after the project completion	Three years after the project completion
【Operation Indicators】					
1) Maximum Output (Unit: MW)	82 *Note 1	75.0	73.23	75.23	75.0 *Note 4
2) Plant Capacity Factor (Unit: %)	75 or more *Note 2	57.15	83.54	92.05	48.90
3) Plant Availability (Unit: %)	85 or more	55.25	83.80	97.73	52.74
4) Gross Thermal Efficiency (Unit: %)	46 or more *Note 1	39% (Unit 1) 41% (Unit 2)	39% (Unit 1) 39% (Unit 2)	40% (Unit 1) 41% (Unit 2)	N/A (Not calculated)
【Effect Indicator】					
5) Net Electric Energy Production (Unit: GWh/year)	523 *Note 1	430	542	598	211

Source: JICA documents (Target), Answers on questionnaire (Actual)
Note 1: At the time of appraisal, it was said that there would be possibility of change, depending on future bidding results, however no new target value was set.
Note 2: Likewise, at the time of appraisal it was said that there would be possibility of change, depending on power supply operation.
Note 3: It is data until around end of August, 2017. At the time of ex-post evaluation (October 2017), since data throughout the year has not been calculated, it is treated as a reference.
Note 4: It ranged from 73 to 75 MW (Unit 1 and 2) from January to February 2017, about 40 MW from the middle of February to around August (Unit 2 only). The average output until August 2017 is 56.0 MW.

The following provides an analysis and review concerning each indicator:

1) Difference between the target value and actual result of maximum output

The initial target value was largely achieved as explained in 3.2.1 Project Outputs. The results for 2017 (average figures) is 56MW, which is lower than the target value. It is because PLTGU Keramasan, which is responsible for the operation and maintenance of the Keramasan Power Plant, carried out major maintenance (periodic maintenance performed after approximately 16,000 hours of operation after installation of the gas turbine generating facilities) on the Unit 1 in February 2017, and found that the fuel nozzle on the Unit 1had burned out requiring repair work on the turbine; as a result, the turbine was shut down until the

end of October 2017. The background of the fuel nozzle burnout and operation stop of Unit 1 is as follows; When PLTGU Keramasan replaced the fuel nozzle of Unit 1 as part of periodic maintenance in February 2017, the fuel nozzle component was sent to a local Indonesian vendor who inspected, processed and refurbished it. This component was reinstalled in the Unit 1 and the gas turbine was restarted, but irregular fuel injection occurred, causing the fuel line and turbine interior to burnout and damaging the turbine blades, etc. Using its own funds, PLTGU Keramasan immediately requested the turbine manufacturer[12] to make repairs and work began. The repairs were completed by mid-October 2017 and at the time of the ex-post evaluation the Unit 1 was operating normally. With regard to what happened, an interview with the vendor revealed, "The gas turbine used for this project is high performance, with both thermal efficiency and output high; thus, the replacement of components must be handled carefully. The type[13] of turbine is only one of a few used in the world. Related parts should be genuine and procured from the manufacturer.[14]" Precision components such as the fuel nozzle must normally withstand temperatures 1,300 Celsius or more, so they must be of high quality. Although it is understood that it takes time to procure components from outside Indonesia and the cost for delivery is high[15], it was desirable that PLTGU Keramasan should have replaced genuine component instead of from a local vendor[16], when exchanging parts that require high quality.

2) Plant capacity factor[17] and 3) Plant availability[18]

Plant capacity factor in 2015 achieved the target value, while plant availability nearly achieved it. In 2016, both indicators cleared the target value at a rate higher than initially anticipated. As

[12] The vender that manufactured and delivered the gas turbine generating facilities through the project's contractor.
[13] There were around 150 units as of 2017.
[14] The manufacturer has indicated that it does not believe there were any problems in terms of the skills and work details of maintenance staff of PLTGU Keramasan associated with the turbine repair work. In addition, it indicated that after the Unit 1 generating facility was shutdown in February 2017, the process of repair request, components procurement, and actual repair work was carried out promptly. The interview also confirmed that fundamental output and thermal efficiency have been secured through trial operations post repair and actual operations.
[15] According to interviews with the management of PLTGU Keramasan, when procuring special components from outside the country, it requires upwards of six to twelve months from procedure to delivery and installation, depending on the type of component. Also, management indicated that the cost was about 60% higher when procuring components from outside the country compared to the cost of procuring the same component from a domestic vendor.
[16] The periodic maintenance for the Unit 2 (As in Unit 1, periodic maintenance for Unit 2 is carried out after 16,000 hours) was performed in mid-November 2017 (nine-day period from November 11 to 18). Taking into account the history with Unit 1, PLTGU Keramasan obtained genuine components for the replacement parts. Both Unit 1 and 2 undergo around 10 days of periodic maintenance, and there are no differences in the work performed, according to interviews with PLTGU Keramasan. The steam turbines and other facilities and equipment used in this project had yet to reach the periodic maintenance interval at the time of the ex-post evaluation. As one example, the main parts of steam turbine are replaced at intervals of approximately 10 years from the beginning of operation.
[17] Calculated as follows: Annual generation amount / (Rated output x Annual hours) x 100
[18] Calculated as follows: (Annual operation hours /Annual hours) x 100

covered above, in 2017 the Unit 1 generating facility was shut down from February to October; thus, the values for each indicator dropped because of lower output. As supplemental information, the main reason why the values in 2014 were lower for each compared to the actual results of other years is because part of the intake filter (filter used for collecting outside air) for Unit 2 was damaged and repairs had to be made[19]. This shutdown period caused both the plant capacity factor and plant availability to decline for the year.

4) Gross thermal efficiency[20]

Since the completion of this project, gross thermal efficiency has ranged around 40% in general. Although this is slightly lower than the target value, according to PLTGU Keramasan, "The target value is merely based on the facility specification at the time of the plan and not the actual target. P3BS, a division[21] of PLN that is responsible for operation planning of the electricity grid on the island of Sumatra, issues orders and determines the operation policy of power plants. In actuality, there is no problem with the operation of facilities. PLTGU Keramasan can increase or lower thermal efficiency by adjusting the output, but it is following the orders of P3BS. Thus, the target value can vary from the time of the plan."

5) Net Electric Energy Production [22]

In 2015 and 2016, the net electric energy production was higher than initially anticipated. Data for 2017 is up to August 31, but for the reason covered above, the amount was lower than the previous year due to the fact that the gas turbine power generation of the Unit 1 stopped operating for a certain period[23].

[19] At the time of the ex-post evaluation, neither PLTGU Keramasan nor manufacturer confirmed the cause unknown. According to an interview with the manufacturer, as a result of peeling of the aluminum film in the duct applied after passing through the filter, the inside of the duct was blocked by the peeled aluminum film and cooling was no longer performed. Therefore, the turbine was stopped for 4 months from September to December 2014. Since it was in the warranty period from December 2013 to December 2014 (see 3.2.2.2 Project Period, Efficiency), the manufacturer repaired mainly at no cost.

[20] It is calculated by (Amount of annual electricity generation × 860) ÷ (amount of annual fuel consumption × fuel heating value) × 100.

[21] P3BS is a division of PLN located in Pekanbaru, the city of Riau Province in central Sumatra Island, Indonesia. The division is in charge of operating instructions for thermal power generation and adjustment of electricity supply.

[22] Net electric energy production indicates the amount of electricity generation obtained by subtracting the electricity used in the power plant from the amount of electricity generation (amount of electricity production) produced at the power plant. The amount of electricity generation is affected by the plant capacity factor and plant availability.

[23] As supplementary information, the reason why the actual figure in 2014 is low is that the Unit 2 was stopped operating for a certain period as it was already mentioned.

In either case, the repair work was completed at the time of the ex-post evaluation and the gas turbine generating facilities were operating normally. Taking this into account, it can be determined that the project's initially anticipated effects are generally realized.

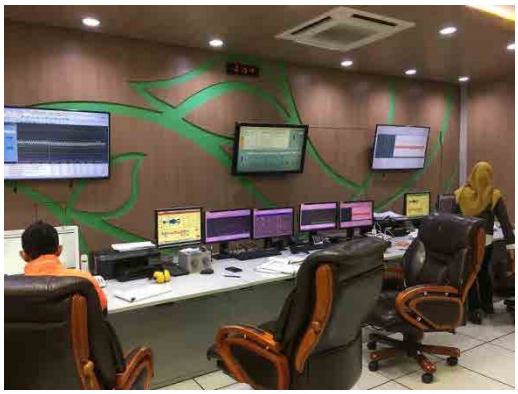


Photo 1: Management Control Room of This Project

Photo 2: Generator for Gas Turbine Unit 1

3.3.1.2 Qualitative Effects (Other Effects)

・Improving the stability of supply and avoiding tight electricity supply-demand conditions in the South Sumatra Grid

Prior to the start of this project, forecasts indicated that electricity supply-demand for the South Sumatra Grid would soon become tight due future population growth and economic development, along with large inflows of investment capital into the South Sumatra area. Therefore, achieving a stable electricity supply through the development of power plants was an urgent task. As Table 1 indicates, electricity demand is rising and the reserve ratio is falling. According to PLN, if the reserve ratio falls below 30%, the risk of tight supply-demand becomes greater. The total installed capacity of the South Sumatra Grid is presented in Table 1, while the total generating capacity of the Keramasan Power Plant is about 350MW (maximum), and of this, the project's installed capacity is 75MW (about 21% of the entire grid mix). The installed capacity of this project is not very large when viewed as a percentage of the grid's installed capacity. However, as Table 1 indicates, taking into account the fact that the reserve ratio increased from 2013 to 2014 around the completion of this project, the installed capacity of this project can be seen as lifting the reserve ratio of the South Sumatra Grid, and it is presumed that it is contributing to the avoidance of tight electricity-supply demand conditions.

Reference: Trend of electricity consumption in South Sumatra Province

Table 6 shows the electricity consumption in South Sumatra Province since 2005. It can be seen that the consumption tends to increase.

(Reference) Table 6: Trend of Electricity Consumption in South Sumatra Province

(Unit: GWh)

2005	2006	2007	2008	2009	2010
1,621.57	1,769.47	1,969.61	2,217.13	2,654.79	3,031.49
2011	2012	2013	2014	2015	2016
2,958.02	3,834.93	4,127.33	4,431.95	4,737.48	4,938.55

Source: PLN

Reference: Future electricity demand and future prospects for the South Sumatra Grid

As Table 2 indicates, the supply-demand condition up to 2018 tends to be tight, but in 2019 and beyond the "35,000MW for Indonesia" for reinforcing generating capacity mentioned in 3.1.2 Consistency with the Development Needs of Indonesia will be completed including for the South Sumatra Grid, which is expected to increase the installed capacity. As a result, the reserve ratio is expected to increase greatly thereafter.

3.3.2 Impacts

3.3.2.1 Intended Impacts

Contribution to Improve the Investment Environment and Economic Development on the Island of Southern Sumatra

Table 7 contains changes in grid connection contracts for PLN's electricity services in South Sumatra Province, Table 8 contains changes in gross regional domestic product (GRDP) of South Sumatra Province, Table 9 contains changes in the amount of money being invested in South Sumatra Province (investment from domestic and foreign sources), and Table 10 contains changes in electricity sales revenue amount for the South Sumatra Grid.

Table 7: Changes in Grid Connection Contracts for PLN's Electricity Services in South Sumatra Province

Classification	2011	2012	2013	2014	2015	2016
General house	1,197,649	1,179,848	1,304,651	1,630,885	1,746,804	1,845,736
Factories	421	449	488	547	598	687
Private enterprises	49,093	44,298	47,617	60,188	63,267	68,110
Public	20,859	19,240	21,145	27,772	30,234	33,326

facilities						
Governmental agencies	4,434	3,922	4,268	5,649	6,203	6,573
Lights in the public roads	2,956	3,004	3,365	4,093	4,658	5,176
Total	1,275,412	1,250,761	1,381,534	1,729,134	1,851,764	1,959,608

Source: PLN

Table 8: Changes in Gross Regional Domestic Product (GRDP) of South Sumatra Province

(Unit: one billion rupiah)

2010	2011	2012	2013	2014	2015 Note*
194,013	226,667	253,265	281,997	308,406	332,727

Source: Statistics Bureau of Indonesia (South Sumatra Branch Office)
Note: Estimated value in 2015
Remarks: This GRDP is the actual price including natural gas and oil sector.

Table 9: Changes in the Amount of Money Being Invested in South Sumatra Province (Investment from domestic and foreign sources)

(Unit: one trillion rupiah)

	2011	2012	2013	2014	2015	2016
Domestic	1,115	690	313	643	855	193
Foreign	525	905	1,408	1,109	1,121	2,955
Total	1,640	1,595	1,721	1,752	1,976	3,148

Source: State Government of South Sumatra

Table 10: Changes in Electricity Sales Revenue Amount for the South Sumatra Grid

(Unit: million rupiah)

2014	2015	2016
5,542,416	6,490,702	6,660,273

Source: PLN

As Table 7 indicates, the number of contracts for all categories has risen over the most recent six years. According to Table 9, although it cannot be said that domestic investment is increasing, foreign investment is increasing. In actuality, the growth in agriculture and mining is large. The amount increased greatly year on year in 2016, which can be attributed to the large investments in mineral resource extraction and agriculture in Palembang, the province's capital, and to the entry of four major foreign companies in the state's mining sector. These companies are believed to be major users of electricity, which explains the rampant increase in electricity demand. Table 10 indicates the changes in electricity sales revenue amount. Since the price differs for contract type, area and conditions, a detailed unit price of electricity prices could not be determined, but it can be confirmed that the price of electricity has increased in general over the most recent three years[24].

[24] As supplementary information, the population growth rate in South Sumatra Province is 1.48% (2015, source is https://knoema.com/atlas/Indonesia/South-Sumatra/Growth-Rate-of-Population (December 15, 2017 Access)), while the whole population growth rate of Indonesia is 1.04% (2017, source is

However, as discussed above, the installed capacity of this project is not very large compared to the total installed capacity in South Sumatra Province; therefore, its contribution to the number of contracts, GRDP shown in Table 7, investment amount shown in Table 9 and electricity sales income shown in Table 10 is not very large either. Meanwhile, interviews with the PLN headquarters and PLTGU Keramasan yielded the following comment, "Without transmission from the Keramasan Power Plant, the reserve ratio for the South Sumatra Grid would be low and there would some form of impacts on the investment environment or economy. With the capital of Palembang experiencing economic development and population growth, a stable supply of electricity is required and the role that this power plant plays will only become more important in the future." Thus, it is believed that PLN has determined that this project has contributed to the stability of electricity supply in the entire province of South Sumatra.

In light of the above, it can be said that this project plays a role in the fact that a stable supply of electricity from an increase in generating facility capacity underpins economic development in the provincial capital of Palembang and the South Sumatra area.

3.3.2.2 Other Positive and Negative Impacts

1) Impact on the Natural Environment

This project is applied to "Japan Bank for International Cooperation's Guidelines for Confirmation of Environmental and Social Considerations" (enacted in April 2002). The preparation of the environmental impact assessment (EIA) report for this project was not required per procedures set forth in Indonesia. For the implementation of this project, PLN prepared an environmental management policy (UKL) and environmental monitoring policy (UPL) [25], and obtained approval from the Environmental Impact Monitoring Bureau (BAPEDALDA) of Palembang City in October 2004.

PLTGU Keramasan conducts monitoring based on UKL and UPL, and it was confirmed through interviews with PLTGU Keramasan and field visits that no negative impacts on the environment (mainly, air pollution, water quality, loud noises, vibrations and negative impacts on the ecosystem, etc.) have occurred after the completion of this project. The area around the Keramasan Power Plant is neither a densely populated residential area nor a commercial area.

---

http://worldpopulationreview.com/countries/indonesia- population / (Access on December 15, 2017)). Because the former population increase is relatively high, there is also possibility that it may act on the actual value of such statistical data.

[25] Environmental Management Policy (UKL) is to manage air pollution, vibration / noise, water quality, impact on ecosystem. The environmental monitoring policy (UPL) is to monitor the progress of UKL and the actual situation.

Table 11 provides the most recent environmental monitoring results for the Keramasan Power Plant. Given that the results data all fall under the environmental standards of Indonesia, environmental impacts on the surrounding area are determined to be minimal[26].It was also confirmed through interviews that there have been no incidents or complaints of adverse health effects on local residents.

Table 11: Environmental Monitoring Results
(Most recent data: measured on August 21, 2017)

Monitoring Index	Unit	Environmental Standards in Indonesia	Actual *Note
Sulfur dioxide (SO_2)	$\mu g/Nm^3$	365	41.75
Hydrocarbon (HC)	$\mu g/Nm^3$	160	0
Dust	$\mu g/Nm^3$	230	134.25
Nitrogen dioxide (NO_2)	$\mu g/Nm^3$	150	39.25
Noise (dB)	dB	70	49.25

Source: PLTGU Keramasan
Note: It shows the average value of four sampling points at Keramasan Power Plant

PLTGU Keramasan carries out regular environmental monitoring within the project site, including the facilities developed as part of this project. Within PLTGU Keramasan, there is a division called K2L, where five employees are responsible for monitoring operations. If any problem arises, K2L will be the center and will take immediate action to resolve it. When necessary, monitoring results are shared with the government of South Sumatra Province and the City of Palembang. It was confirmed through interviews with K2L that no countermeasures were implemented based on monitoring results because no particular negative impacts or problems concerning the environment have occurred since the completion of the project.

2) Resettlement and Land Acquisition

This project did not result in resettlement or land acquisitions. There was no need for the new acquisition of land or for resettlement because the generating facilities of this project were constructed on the site of the Keramasan Power Plant.

[Summary of Effectiveness and Impact]

The target value has largely been achieved with respect to the actual value in 2015, which is

[26] Although monitoring data on water quality, vibration and ecological effects were not available, it was confirmed that the water quality, vibration and ecological effects have cleared the Indonesian environmental standards, through an interview with PLTGU Keramasan.

the target year (one year after project completion) of the operation and effect indicators (quantitative effect indicator). In addition, this project plays a role of avoiding tightness situation of electricity supply and demand which is foreseen in the future and stable supply of electricity. Thus, it can be said that this project has been supporting to improve the investment environment and economic development in the southern part of Sumatra Island. Based on the above, effectiveness and impact of this project are high.

3.4 Sustainability (Rating: ③)

3.4.1 Institutional Aspect of Operation and Maintenance

The executing agency of this project is PLN. PLTGU Keramasan is responsible for the operation and maintenance of the generating facilities developed by this project, and there are 52 employees who engage in the operation and maintenance of the gas combined cycle generating facilities developed by this project. The PLN headquarters (Jakarta) supervises PLTGU Keramasan and both parties conduct regular reporting concerning operations and maintenance work[27].

The workforce in PLTGU Keramasan appears to be sufficient. It was confirmed through onsite visits and interviews with PLTGU Keramasan management that the staff are allocated to each department without shortage or overage and right person is assigned for the right job. The generating facilities developed by this project require an operating system that is 24 hours a day 365 days a year; thus, staff work three shifts, performing management, maintenance and regular inspection work.

In light of the above, it is considered that there is no major problem regarding institutional/organizational aspects of operation and maintenance of this project at the time of ex-post evaluation.

3.4.2 Technical Aspects of Operation and Maintenance

PLTGU Keramasan employs a large number of staff with a wealth of operational experience and knowledge. Tests measuring the operational knowledge of staff responsible for operation and maintenance are carried out once every year (practical test and written test). Skills are categorized into three levels (Level 1 to 3). Level 3 employees supervise and instruct other staff. This ensures technical skills for operations and maintenance.

[27] According to the PLN Headquarters, there is no particular problems with regard to the organizational structure of PLTGU Keramasan as the sufficient personnel have been assigned for operation and maintenance of this project.

A manual has also been prepared on operation and maintenance related to this project's facilities. At the time of the field survey, it was confirmed that this manual is being utilized in a timely manner. At the time of trial operations of these facilities immediately prior to completion of this project, the manufacturer of the gas turbine and other facilities conducted onsite training and seminars on operations for PLTGU Keramasan staff. An employee who took part in this training commented, "I am putting to use what I learned, together with the manual provided, in daily maintenance work."

In regards to training programs, in 2017 after the completion of this project, 34 and 7 employees from PLTGU Keramasan participated in the "steam turbine operation training" and "facility asset management training," respectively. On-the-job training is also provided as needed to newly hired employees.

In light of the above, it is judged that there are no technical problems concerning the operation and maintenance of this project.

3.4.3 Financial Aspects of Operation and Maintenance

Table 12 shows the maintenance cost (most recent four-year period) related to facilities and equipment developed by this project. After operations began in 2014, the budget has been allocated without shortage or overage to PLTGU Keramasan from the PLN headquarters. In 2017, major periodic maintenance required every 16,000 hours was performed, which increased the budget relatively. According to PLTGU Keramasan, "Every year sufficient budget is allocated to maintenance work. There has been no shortage of maintenance due to budget shortfall."

Table 12: Maintenance Cost Related to Facilities and Equipment Developed by this Project

(Unit: one million rupiah)

	2014	2015	2016	2017
Amount of Budget Allocation	N/A (No data)	N/A (No data)	17,259	105,708
Used Amount (Actual)	2,097	5,248	15,711	7,793 *Note

Source: PLN
Note: Data as of the end of September 2017

For reference, PLN's overall fiscal report (profit/loss statement) is shown in Table 13. PLN's electricity sales continue to rise every year. As ④ in the Table indicates, however, PLN would be in the red if it were not for electricity subsidies provided by the Central Government. In other

words, PLN's finances are supported by government subsidies. PLN sells electricity at a cost cheaper than the cost of supply following the "public service mandate," which is a policy of the Central Government. The losses incurred from this are offset by subsidies from the government. At the same time, it was confirmed through interviews with the PLN headquarters that electricity rates are gradually increasing with the aim of achieving stable management of its power generating business.

(Reference) Table 13: PLN's Overall Fiscal Report
(Profit/loss statement of most recent three-year period)

(Unit: million rupiah)

Item	2014	2015	2016
①Operating revenue (Income of electricity sale, etc)	193,417,941	217,346,990	222,821,956
②Operating expenses	247,806,289	225,574,076	254,449,802
③Operating balance =①-②	(54,388,348)	(8,227,086)	(31,627,846)
④Electricity subsidies provided by the Central Government	99,303,250	56,552,532	60,441,520
⑤Operating balance after allocation of subsidies =③+④	44,914,902	48,325,446	28,813,674
⑥Balance of financial income and expenses	(29,910,833)	(64,238,881)	(12,837,193)
⑦Profit before tax =⑤+⑥	15,004,069	(15,913,435)	15,976,481
⑧Tax exemption allowance	(3,934,699)	21,939,942	(5,427,843)
⑨Profit after tax =⑦+⑧	11,069,370	6,026,507	10,548,638

Source: PLN
Note: Numbers in parentheses indicate minus

Table 14 shows PLN's overall balance sheet. From 2014 to 2015, the depreciation methods of tangible fixed assets were revised following changes in accounting principles, increasing from 518,235,453 million rupiah in 2014 to 1,235,026,088 million rupiah in 2015. As an example, later in 2016, non-current liabilities decreased year on year and current liabilities remained at largely the same level, but current assets increased and capital has not declined consistently; thus, the financial soundness of PLN is determined not to pose any particular concerns.

(Reference) Table 14: PLN's Overall Balance Sheet
(Most recent three-year period)

(Unit: million Rupiah)

Item	2014	2015	2016
①Fixed assets	518,235,453	1,235,026,088	1,173,608,898
②Current assets	85,423,738	79,344,793	100,967,332
③Total assets (①＋②)	603,659,191	1,314,370,881	1,274,576,230
④Capital	164,671,226	804,709,617	880,797,712
⑤Non-current liabilities	351,429,688	389,441,371	272,155,163
⑥Current liabilities	87,558,277	120,138,893	121,623,355
⑦ Total capital and liabilities (④+⑤+⑥)	603,659,191	1,314,370,881[28]	1,274,576,230

Source: PLN

In light of the above, it is considered that there is no particular problem on the financial aspect of the operation and maintenance of this project.

3.4.4 Status of Operation and Maintenance

At the time of the ex-post evaluation, the operating status of the gas combined cycle generating facilities, cooling tower and related facilities developed by this project is good. Maintenance work is carried out according to the categorizations of periodic and regular maintenance. As for periodic maintenance, major maintenance is performed once every 16,000 hours with a large budget allocated to this work. Regular maintenance is broken down into work carried out every half year, every three months, every month, every week and every day. As discussed above, PLTGU Keramasan establishes a maintenance implementation plan every year and carries out operations and maintenance following this plan.

Although the procurement of spare parts and response at the time of periodic maintenance on the Unit 1 generating facility in February 2017 cannot be viewed as necessarily appropriate, in all other cases, procurement is being carried out properly in general. As for the damage and repairs to the Unit 1 generating facility (fuel nozzle) that occurred in February 2017, by the end of 2017 PLN agreed with a Japanese company on maintenance inspections and support for the gas turbine generation facilities at the gas combined cycle generating facility. Specifically, PLN employees will be in charge of maintenance work for the generating facilities (as covered before,

[28] Total data of ④ to ⑥ will be 1,314,289,881 million Rupiah. Meanwhile, because this data is provided by PLN, it is set as current description.

there are no problems in terms of technology or skill level), and the Japanese company will be responsible for advice and procurement support when replacing parts with genuine parts at the time of major maintenance (periodic maintenance every 16,000 hours). As discussed above, the replacement parts for the Unit 2 were replaced with genuine parts during the periodic maintenance that has already been performed.

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

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

This project aimed to increase the electricity supply capacity, to improve the stability of supply, and to mitigate tight supply-demand conditions for grid electricity at Keramasan Power Plant connected to the South Sumatra Grid on the island of Sumatra, by expanding the plant's combined cycle power generating facilities; thereby, contributing to an improved investment environment and economic development in the South Sumatra area. Relevance of this project is high because of its confirmed consistency with the policies on the development of new power generation facilities and electricity supply presented in the *General Plan for National Electricity* established by the Government of Indonesia and the *Electricity Supply Business Plan* prepared by PLN, and with the country's development needs for addressing growing electricity demand as well as the assistance policy of the Japanese government. As for efficiency, project outputs were implemented mostly as planned, and project costs were within the initial plan thanks to the effects of foreign exchange rates and the tax exemption placed on gas turbine generating facilities. In contrast, the project period exceeded the plan by a large margin because more time was required than anticipated for selection procedures for the consultant and contractor. Thus, the efficiency is fair. In terms of the project's quantitative effect indicators, maximum output, plant capacity factor, plant availability, gross thermal efficiency, and net electric energy production have generally achieved target values since 2015, and because it is believed that this is underpinning the avoidance of risk of tight supply-demand for electricity and the stable supply of electricity within this grid, the effectiveness and impact of this project are high. There are no particular concerns in terms of institutional, technical or financial aspects of the PLTGU Keramasan, which is responsible for the operation and maintenance of this project. Although a

fuel nozzle for the Unit 1 generating facility burned out in February 2017, requiring repairs, and operations were stopped until the end of October 2017, at the time of the ex-post evaluation, repair work had been completed and operations restarted. There have not been other problems in terms of the operation and maintenance of other equipment and facilities. Thus, the sustainability of the effects realized through this project is high.

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

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

None.

4.2.2 Recommendations to JICA

None.

4.3 Lessons Learned

Securing steady supply of spare parts requiring high quality

Precision components such as the fuel nozzle of the gas turbine generating facilities require high quality. As for repair work including the replacement of spare parts for the project's precision equipment, PLN consigned procurement and delivery to a local company because of the time required for procurement from outside Indonesia as well as the high cost of delivery. As a result, a defect in the locally manufactured product caused damage to the turbine. In regards to procurement of components that require high quality in similar projects in the future, even if there is a premise that procurement of locally manufactured goods is realized at a low cost and delivery in a short period of time, it is desirable for executing agency, during the project implementation or before completion, to confirm the procurement policy which ensures that genuine products are steadily used even after completion of the project, and also to ensure that the budget for parts purchase will be secured for several years.

Comparison of the Original and Actual Scope of the Project

Item	Plan	Actual
1. Project Outputs	1. Procurement/Construction (a) Combined Cycle Power Generation Facility (80 MW class) 1) Installation of gas turbine and generating facilities (two units) 2) Installation of steam turbine and generating facility (two units) 3) Installation of heat recovery steam generator (two units) 4) Extension of accessory equipment (gas supply equipment, 150 kV switchyard etc) necessary for the above equipment (b) Related Civil Engineering and Construction Work (c) Cooling Water System (d) Desalination, Pure Water Equipment (e) Spare Parts (quantity necessary for operation / repair for 2 years after start of operation)	1. Procurement/Construction Mostly implemented as planned. (The capacity of the gas combined cycle power generation facility changed to 75 MW.)
	2. Consulting Services (a) TOR related to the construction and operation of power station: 1) detailed design, 2) bidding assistance, 3) construction supervision, 4) performance evaluation, 5) assistance for operation and maintenance, 6) assistance for environmental management, 7) technology transfer and human resource development, etc. (b) Assistance for strengthening planning functions of PLN and South Sumatra local government officials: 1) Assistance for electric power supply and demand anticipation, 2) establishment of anticipation system, 3) assistance for optimum power supply development plan capacity, 4) assistance for transmission and distribution cable construction plan, 5) assistance for making investment plan	2. Consulting Services Implemented as planned.

2. Project Period	March 2005 – February 2011 (72 months)	March 2005 – December 2014 (118 months)
3. Project Cost Amount Paid in Foreign Currency	8,090million yen	9,169million yen
Amount Paid in Local Currency	3,365million yen （280,416million Rp.）	1,245million yen (132,644million Rp.)
Total	11,455million yen	10,414million yen
ODA Loan Portion	9,736million yen	9,677million yen
Exchange Rate	1 Rp.=0.012 yen 1USD=110.36 yen （As of September, 2004）	1Rp.=0.009386 yen 1USD=88.862 yen （Average between 2007 and 2014, based on rates issued by the IMF's International Financial Statistics Data)
4. Final Disbursement	January 2016	

Republic of Indonesia

FY2017 Ex-Post Evaluation of Japanese Grant Aid Project

"The Project for Urgent Reconstruction of East Pump Station of Pluit in Jakarta"

External Evaluator: Tokiko Ito, Octavia Japan Co., Ltd.

0. Summary

This project aimed at restoring the drainage function of the Pluit Pump Station by carrying out urgent reconstruction of the East Pump Station which had been in dysfunction and maintenance of the sea tide dike at the Pump Station located in North Jakarta City in the Special Capital City Region of Jakarta Province (hereafter referred to as "Jakarta Province"), and thereby mitigating the flood damage in the drainage area of the Pump Station and the Jakarta metropolitan area[1]. At the time of ex-post evaluation, this project has been relevant to the development policy like the *National Medium-Term Development Plan of Indonesia* which aims to reduce flood-prone areas by improvement of water resource management and reduces flood risks, and development needs, as well as Japan's ODA policy. Therefore its relevance is high. Although the project cost was within the plan, efficiency of the project is fair as the project period exceeded the plan. Regarding the effectiveness, it is judged that the indicators as the designed drainage capacity of the whole Pluit Pump Station and East Pump Station were satisfied. Meanwhile, in Jakarta Province, other flood control and drainage control projects are being implemented. In addition, various factors such as the rainfall amount and depth of water channels and reservoirs, etc. are involved in the occurrence, scale and damage expansion of flood. Therefore, regarding impact, it is difficult to judge that flood damage was mitigated by this project alone. However, when the drainage capacity of the Pluit Pump Station had not been restored by this Project, flood damage is considered to be expanding. Thus, it is judged that the project has supported the mitigation of flood damage. In addition, there are no particular problems in the institutional, technical and financial aspects of the operation and maintenance of this project, and the sustainability of this project effects is high.

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

[1] In this project, the area of Jakarta is distinguished as followings: the Jakarta metropolitan area, about 24 million residents = indirect beneficiaries, the Special Capital City Region of Jakarta Province, Jakarta city center or center of Jakarta, about 662.33 ㎢, about 9.14 million residents = secondary direct beneficiaries, and the North Jakarta City in the drainage area of the Pluit Pump Station (34.2 ㎢), approximately 0.18 million residents = primary direct beneficiaries (Source of population is the estimation of the government in 2008). The highlighted part of the map on the left side of Fig. 1 shows the western, central and east flow system, which are the jurisdictional areas of the executing agency, Water Resources Agency of Jakarta Province. The southern end of the drainage area of the Pluit Pump Station is Central Jakarta City in the central flow system.

1. Project Description

Project Location

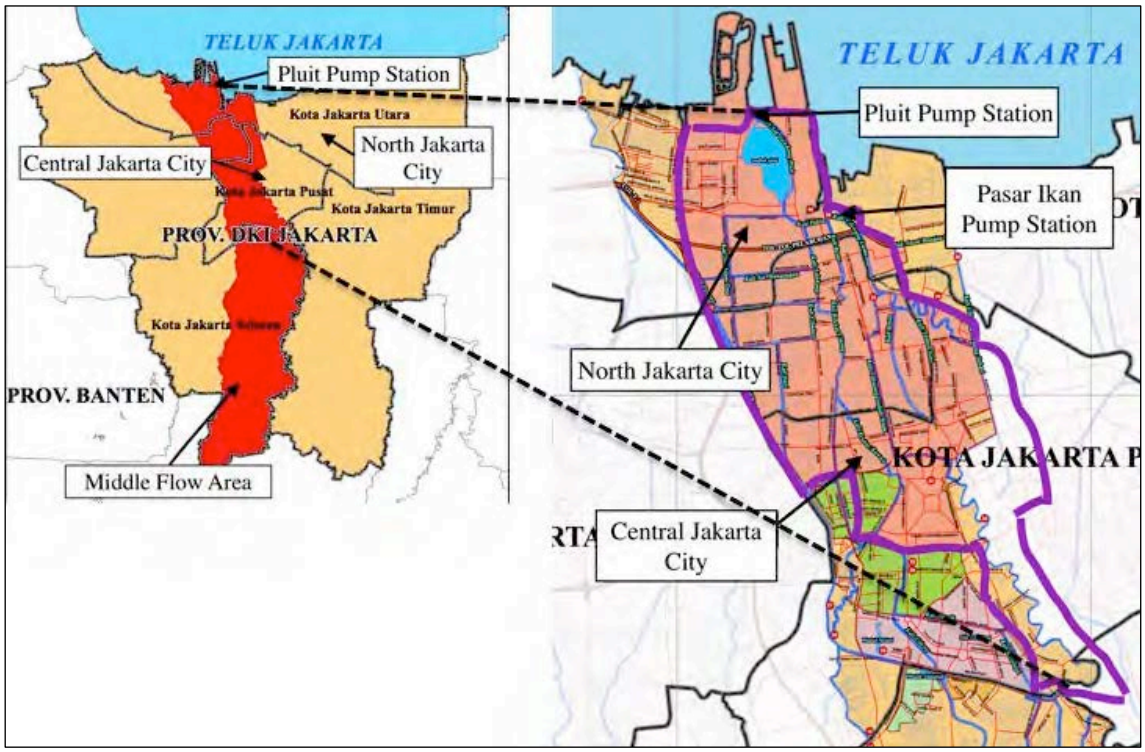
East Pump Station of Pluit after reconstruction[2]

1.1 Background

The Jakarta metropolitan area is vulnerable to floods from topographical conditions, and flood damage has been repeated over the years. Also, in addition to floods caused by the rainfall inundation and inundation by river water[3] due to the excessive population concentration, formation of disorderly densely populated areas, ground subsidence due to excessive pumping up of groundwater, delays in measures for flood control and drainage and inadequacies of drainage facilities, the frequency of floods caused by the climate change increase, and economic damage has been enormous. The Pluit Pump Station is an important facility responsible for the drainage of inland water in Jakarta Province, consisting of three pump stations: East, Central, and West. Among them, the aging of the East Pump Station progressed. The cracks occurred in the side walls, sea tide dike, of the drainage canal and the seawater flowed out of the canal of the Pump Station. There was concern about the loss of function of the entire East Pump Station due to the accompanying large-scale piping destruction[4]. If the entire Pump Station lost its function, the drainage control function in the target area would be suspended, and it was predicted that a large-scale flood damage would occur in areas including densely populated North Jakarta City. In order to improve this situation, the Government of Indonesia requested

[2] Source: Yachiyo Engineering Co., Ltd.
[3] According to the Ministry of Land, Infrastructure, Transport and Tourism, while the water in a river is called "foreland water", the water outside the embankment (river) is called "inland water". The rainfall inundation is the flooding caused by the failure of drainage of rainfall due to the drainage capacity of drainage canals etc. draining into rivers. The inundation by river water is the flooding of houses and fields caused by the overflowing of water from or collapse of embankments.
[4] Piping destruction is a phenomenon in which soil particles are washed away by osmotic force, and a pipe-like water way is formed in the ground. Once the piping occurs partly, the dynamic water gradient in the soil contacting it increases, the osmotic force increases, and piping progresses further. It causes destruction of the reclaimed land or excavated ground.

for the support of reconstruction of the Pump Station by the Grant Aid of the Government of Japan.



Source: Evaluator processed based on the document by Water Resources Agency of Jakarta Province

Figure 1: Drainage area of the Pluit Pump Station (indicated by bold line in the figure on right) and a related pump station.

1.2 Project Outline

The objective of this project is to restore the drainage control function of rainwater and sewage and to restore the tide-keeping function in center of Jakarta and drainage area of the Pluit Pump Station by urgent reconstruction of the Pluit Pump Station located in North Jakarta City in Jakarta Province, thereby contributing to the mitigation of damage caused by the flood.

Grant Limit / Actual Grant Amount	74 million yen / 72 million yen (Detailed Design) 1,985 million yen / 1,825 million yen (Construction)
Exchange of Notes Date /Grant Agreement Date	January 2011 / February 2011 (Detailed Design) August 2011 / September 2011 (Construction)
Executing Agencies	Supervisory Responsibility Agency & Executing Agency:

	Ministry of Public Works and Housing Executing Agency: Water Resources Agency of the Special Capital City Region of Jakarta Province
Project Completion	November 2014
Main Contractor	Hazama Ando Corporation Co., Ltd.
Main Consultant	Yachiyo Engineering Co., Ltd.
Basic Design	October 2009 - July 2010
Related Projects	【Technical Cooperation】 "The Institutional Revitalization Project for Flood Management in JABODETABEK" (March. 2007-March.2010) (Technical Assistance Project Related to ODA Loan) "Project for Capacity Development of Jakarta Comprehensive Flood Management" (October, 2010-October, 2013) 【Japanese ODA Loan】 "The Climate Change Program Loan" (2008, 2009, 2010) 【Other International Organizations and Aid Agencies etc. 】 World Bank "Jakarta Urgent Flood Mitigation Project" (2012-2019)

2. Outline of the Evaluation Study

2.1 External Evaluator

Tokiko Ito, Octavia Japan Co., Ltd.

2.2 Duration of Evaluation Study

This ex-post evaluation was conducted with the following schedule.

Duration of the Study: August 2017 – August 2018

Duration of the Field Study: October 2, 2017 – October 17, 2017, January 28, 2018 – February 3, 2018.

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

3.1 Relevance (Rating:③[6])

3.1.1 Consistency with the Development Plan of Indonesia

The Government of Indonesia has developed the *drainage and flood control basic plan* in 1973 and *Jakarta Flood Control and Drainage Plan* in 1993 and set it up to develop pump stations and drainage canals in drainage trunk lines of existing rivers. At the time of this project planning, one of the important strategic programs was to reduce flood damage through comprehensive water resource management in the *National Medium-Term Development Plan* (2010-2014).

At the time of ex-post evaluation, the Government of Indonesia positioned the reduction of flood-prone areas and ensuring water resistance through flood management as one of strategic priority issues to realize economic independence in the *National Medium-Term Development Plan (2015-2019).* Also, *the Sectoral Strategic Plan of Public Works and National Housing (2015-2019)* stated the reduction of flood risks by improving water resource management, like improvement of coastal infrastructure facilities. In addition, Jakarta Province developed *Medium-Term Development Plan of Jakarta Province (2013-2017)*, and as one of the strategies to solve significant and urgent issues, the development and maintenance of drainage facilities and infrastructure facilities is stated in order to sustainably maintain economic activities in response to the threats of various floods[7].

Thus, the implementation of this project is consistent with the development policy of Indonesia at the time of planning and ex-post evaluation.

3.1.2 Consistency with the Development Needs of Indonesia

The Pluit Pump Station, the target of this project, is an important facility responsible for inland water drainage of a large area of 34.2 ㎢ out of the drainage area including center of Jakarta, about 42.1㎢. At the time of planning, the East Pump Station had been aged more than 45 years since construction, and piping destruction had occurred. There was concern about the loss of function of the entire Pump Station. And if the drainage control function in the target

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

[6] ③: High, ②: Fair, ①: Low

[7] Floods occurring in Jakarta Province are analyzed as having three major factors. i) Extremely strong rainfall to the upper river causing overflow of the river and flooding of the residential area. ii) Extremely strong rainfall at downstream of the lower terrain and Jakarta. iii) High tide. These three factors are thought to be the causes of the major flood that lead to major economic losses in Jakarta Province in 2002 and 2007. (Source: *Special Capital City Region of Jakarta Province Medium-Term Development Plan 2013–2017*, p119)

area are suspended, a large-scale flooding damage was expected to occur. In particular, the drainage area of the Pluit Pump Station includes the center of Jakarta where important facilities such as the Presidential Palace and administrative agencies of Jakarta Province are located. In order to improve such situation, reconstruction of the Pump Station was an urgent issue.

While, at the time of ex-post evaluation, measures to deal with various flood causes are being promoted by related administrative organizations mainly the Directorate General of Water Resources of Ministry of Public Works and Housing, the supervisory responsibility agency and executing agency of this project, here after referred to as "Directorate General of Water Resources", and the Water Resources Agency of Jakarta Province, the executing agency of this project. In the *National Capital Integrated Coastal Development (1st Phase: 2014-2018)*, the development of a sea tide dike surrounding the Jakarta bay and new residential areas and transportation routes for countermeasures to land subsidence and flood and securing of alternative water sources to the groundwater for countermeasures of ground subsidence etc. have been planned, after 2nd phase. The Directorate General of Water Resources and the Water Resources Agency of Jakarta Province have implemented countermeasures against floods such as strengthening embankments of rivers flowing in Jakarta Province and dredging of reservoirs by *Jakarta Emergency Dredging Initiative (2015-2017)*.

From the above, the reduction of flood damage due to flood control and drainage management in Jakarta Province is regarded as a priority issue even at the time of ex-post evaluation. The necessity of securing stable drainage capacity of the Pluit Pump Station is high. Thus, consistency with the development needs is recognized both at the time of planning and ex-post evaluation.

3.1.3 Consistency with the Japan's ODA Policy

In the Ministry of Foreign Affairs' *Country Assistance Plan for Indonesia (November 2004)*, the support for "building a democratic and fair society" was a priority area and priority item. In this, it was supposed to support the countermeasures to natural disasters like frequent floods for the rural sustainable development as "improvement of basic public services", and to support the measures to climate change and development of urban residents' living environment, including countermeasures to natural disaster as "environmental conservation and disaster prevention". Based on the assistance plan, JICA's *Country Assistance Implementation Report for Indonesia (July 2009)* positioned the urgent disaster countermeasures and the climate change countermeasures as assistance programs. This project supports the natural disaster

countermeasures and the climate change countermeasures related to the above priority area and priority item in Jakarta Province, and the consistency with the Japan's ODA policy is recognized.

From the above, this project has been relevant to the country's development plan and development needs, as well as Japan's ODA policy. Therefore its relevance is high.

3.2 Efficiency (Rating: ②)

3.2.1 Project Outputs

Table 1: Outputs of the Project (Plan/Actual)

	Plan (2009: Before the project starts)	Actual (2017: Ex-Post Evaluation)
【Japanese Side】 Reconstruction of Pluit Pump Station and attached facilities		
1	Construction of East Pump House: Reinforced Concrete structure, steel pipe pile foundation, 3-story building, and floor area of approximately 400 ㎡.	As Planned
2	Installation of pump facility in East Pump Station: 3 units of discharge pump facility (Vertical mixed flow type, 5.0 ㎥/sec/unit), 3 units of aboveground pipe line system (diameter 1,500mm), 1 set of emergency generator facility (1,500kVA), 3 units of screen and auxiliaries, and 1 unit of horizontal conveyer.	As Planned
3	Reconstruction of sea tide dike: Extension of approximately 145m of sea tide dike, Cantilever steel pipe sheet pile and counterweight embankment type, diameter 1,200mm	As Planned
【Indonesia】		
1	Maintenance of access road for loading construction materials	As Planned
2	Provision of disposal sites of demolished construction debris and management and disposal of waste	As Planned
3	Relocation of power receiving facility	As Planned
4	Alternate drainage facility during reconstruction of East Pump Station	As Planned
5	Relocation of anchored ships and relocation of Marine Police Station and related facilities	As Planned
6	Preparation, clearance and implementation of Environmental Management Plan and Environmental Monitoring Plan	As Planned
7	Other general necessary undertakings by the recipient country for Japanese Grant Aid	As Planned

Source: JICA Preparatory Survey Report, Answers to the questionnaire from the executing agency

The outputs of Japanese side and Indonesia side were mostly implemented as planned. However, during the project implementation, the contract was changed 5 times between the

consultant of this project, hereafter referred to as “Consultant”, and the Government of Indonesia with the consent of JICA headquarters concerning the construction methods and structure etc. The purpose of the contract change was to ensure drainage capacity during the construction, improvement of the certainty and reliability of blocking of water, and shortening the construction period, etc. The specific contents are the structure of the connection between the east and west end of the sea tide dike and existing revetment, the construction method and structure of the vent part of sea tide dike, and the construction method of removing the underground structure of existing building of the East Pump House, and so on. According to the Directorate General of Water Resources and the Consultant, the reasons why these changes occurred were because “it was impossible to investigate the details at the time of the detailed design survey as there were illegal vessels at the sea tide dike facing the Pluit Pump Station, the existing house was old and the project was planned in the situation that there was no material such as its completion drawing etc., identification of existing structures was impossible even by investigations by divers during the construction period as the transparency in the water was low and it were identified as a result of draining, and requests of the Government of Indonesia were taken account etc.”. Based on the limitation of the survey period at the time of the detailed design study and the points that could not be predicted, it is considered that changes of the contract were unavoidable.

Photo 1: Overall view of the East Pump Station after reconstruction[8]

Photo 2: From the west side of the sea tide dike after reconstruction

3.2.2 Project Inputs

3.2.2.1 Project Cost

Regarding the total project cost of this project, while the initial plan was about 2,229 million

[8] Source: Yachiyo Engineering Co., Ltd.

yen, the amount to be borne by the Japanese side was 2,059 million yen and that of Indonesian side was about 170 million yen, the actual amount by the Indonesian side was not available. The actual amount of Japanese side was 1,897 million yen and was within the plan, 92% compared to the plan.

3.2.2.2 Project Period

This project was planned to be completed in 34 months from July 2011, including the detailed design period[9]. The actual period of the Japanese side was 41 months from July 2011 to November 2014 and exceeded the plan, 121% compared to the plan[10]. According to the Consultant and the person in charge of the project in Ciliwung-Cisadane River Basin Development Agency under the Directorate General of Water Resources, which was in charge of the project during the project implementation, "the project period was exceeded because of the followings: ① in response to the requests of the Government of Indonesia to reduce the number of pumps to stop, it was decided that construction work of the sea tide dike in front of the Central and West Pump Station was done after the completion of the reconstruction of the East Pump Station, ② the change of construction method of the existing East Pump House accompanied some preparation work, and ③ the construction period was reset after about 1 month of construction interruption due to the flood occurred in January 2013." As a result, during the project implementation, the deadline of Consultant's work and contractor's performance were extended for 7 months each. There were also works that progressed in parallel at the same time, and the project was completed in November 2014, which took about 7 months for ① that was implemented after the completion of the East Pump Station in March 2014.

From the above, although the project cost was within the plan, as the project period exceeded the plan, efficiency of the project is fair.

[9] Although the project period is 36 months in the ex-ante evaluation chart, the starting point is unknown. Thus, the progress chart described in the Preparatory Survey Report of the project is adopted as the plan as its basis is clear, and the starting point is set as at the time of the contracting the detailed design. The extended period was the main construction period, and it was actually 32 months against the planned 25 months.

[10] The construction by the Indonesian side was completed by November 2014.

3.3 Effectiveness and Impacts[11] (Rating:③)

3.3.1 Effectiveness

3.3.1.1 Quantitative Effects (Operation and Effect Indicators)

At the East Pump Station of Pluit, at the time of the project planning, the function of all 4 pumps, each 3.2 m^3/sec of drainage capacity, had been stopped due to piping destruction. Through this project, 3 pumps, each 5.0 m^3/sec of drainage capacity, were in place. As an indicator of the quantitative effects, at the time of planning, ① the drainage capacity of the Pluit Pump Station was set as an operation indicator, and ② the probability scale of rainfall in the drainage area was set as an effect indicator. At the time of ex-post evaluation, ③ the drainage capacity of the entire Pluit Pump Station was set as a complementary indicator of the operation indicator. The corresponding information is obtained through this study, and the results of analysis are shown below.

1) Drainage capacity of East Pump Station of Pluit

Table 2: Drainage capacity of the East Pump Station of Pluit (designed capacity)

(Unit : m^3/sec)

Baseline	Target	Actual		
2009	2014	2015	2016	2017
	Completion year	1 year after completion	2 years after completion	3 years after completion
3.2m^3×2pumps ＝6.4 (Drainage capacity of 2 pumps made available for emergency measures)	Normal Time: 5.0m^3×2pumps＝10 (<−0.9mPP [12], up to one pump stand-by)	10	10	10
	Emergency Time: 5.0m^3×3pumps＝15 (−0.9mPP≦,All pumps being operated)	15	15	15

Source: Preparatory Survey Report on the project for before the project starts, Answers to Questionnaire for after the project completion.

According to the person in charge in the Operation and Maintenance System of Central Flow System Section of Coastal and River of Central Flow System[13], hereafter referred to as "the Section", of the Water Resources Agency of Jakarta Province, "in principle, the operators operate the pumps according to the water level of the Reservoir and following the operation

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

[12] "PP" means the lowest sea level, "Priok Peil", set at the Tanjung Priok port in 1925. It is the standard of water level in Indonesia. This report also uses this as the standard water level. If the water level is lower than PP, mPP becomes negative.

[13] At the time of the ex-post evaluation, this section is responsible for the operation and maintenance of the Pluit Pump Station at the Water Resources Agency of Jakarta Province.

rules of the Pluit Pump Station (Supplementary Material Table 1) [14]". According to the chief of the Section and the operators, "although the drainage capacity of the pumps is not actually measured, the maintenance work has been carried out up to the time of the ex-post evaluation after completion of the East Pump Station. And the pumps were generally operating without problems[15], and it is considered that the drainage capacity fulfills the designed capability. Also, the Emergency Time occurs about several times in a year, rainy season, but by the time of ex-post evaluation there is no problem with drainage at the time of operation". As a result, it is judged that the actual value of the drain capacity of the East Pump Station has reached the target value both at the normal time and the emergency time.

2) Drainage Capacity of the entire Pluit Pump Station

Table 3: Drainage Capacity of Pluit Pump Station (Designed Capacity)

(Unit: m^3/Sec)

Baseline	Target	Actual				
2009	2014	2015	2016	2017		2018
				Jan - Feb	Mar - Dec	Jan
	Completion year	1 year after completion	2 years after completion	3 years after completion		2nd field study of ex-post evaluation
Normal Time: n/a	34	34	34	34	n/a	34
Emergency Time: 40.4	49	49	49	49	33	49

Source: Preparatory Survey Report on the project for target, Answers to Questionnaire for after the project completion.

The target value at the normal time, 34m^3/sec, is the total of the designed capacity according to the principle of temporarily stopping one pump at each Pump Station and is 34 m^3/sec in total; East Pump Station, 5 m^3/sec x 2 units, Central Pump Station, 4 m^3/sec x 3 units, and West Pump Station, 6 m^3/sec x 2 units. The target value at the emergency time is the total of the designed capacity of all the pumps and is 49m^3/sec; East Pump Station, 5 m^3/sec x 3 units, Central Pump Station, 4 m^3/sec x 4 units, and West Pump Station, 6 m^3/sec x 3 units. The actual results for the period of 2015 - February 2017 were calculated along the operation rules of the Section in the Water Resources Agency of Jakarta Province (Supplementary Material Table 1) at

[14] According to the operator of the Pump Station, "in addition to the reservoir water level, rainfall amount in upstream, weather forecast etc. are also the standards for judging the starting-up of pump operation. In addition, although not specified in the operation rule, each pump in each Pump Station will be on stand-by after operating a certain hours".

[15] As mentioned later in Indicator 3), there is a case when a pump temporarily stopped.

the time of ex-post evaluation. Between March and December 2017, the Central Pump Station was not in operation in order to repair its electronic cable. For this period, since the operation performance of the East and West Pump Station are irregular, it is decided not to calculate the value at the normal time. Based on the designed capacity, during the repair of the Central Pump Station, the drainage capacity at the emergency time was 16 m^3/sec below the target value. However, according to the person in charge of the Section of the Water Resources Agency of Jakarta Province, "while only the East and West Pump Station were operated during the repair period, there was no problem in drainage status."

From the above, at the time of ex-post evaluation, it is judged that the drainage capacity of the entire Pluit Pump Station generally reached the target value of the drainage capacity.

3) Settings of the rainfall probability scale indicating drainage capacity of Pluit Pump Station (At the time of Planning)

Table 4: Amount of 24-hour Rainfall and Water level of the Pluit Reservoir against the Rainfall Probability Scale set at the time of planning[16]

	Baseline	Target	Actual
	2009	2014 Year of completion	2014 - 2017
Rainfall Probable Year	1/5 probable year	1/10 probable year	
Amount of 24-hour Rainfall (mm/24hr)	220.7	267.0	n/a
Water level of the Pluit Reservoir (mPP)	-1.18	-0.36	n/a

Source: Preparatory Survey Report on the project for Target, Documents provided by Water Resources Agency of Jakarta Province for amount of rainfall, and Answers to the questionnaire for after the project completion.

The effect indicator set at the time of planning is the rainfall probable year indicating the drainage capacity of the Pluit Pump Station. However, there is no data available directly as the "rainfall probable year". Also, as the rainfall changes every year since the time of project planning, the probability scales of rainfall calculated at the time of project planning and ex-post evaluation are different, and it is considered that the rainfall probability scale differs depending on the year of reference. Therefore, for the ex-post evaluation, as shown in Table 4, it was considered that the 24-hour rainfall and the water level of the Pluit Reservoir that were used to

[16] The interpretation of the amount of 24-hour rainfall and the water level of the reservoir is as follows. For example, if the drainage capacity of the Pump Station functions as designed after the recovery, when the amount of 24-hour rainfall is 267.0 mm/24hr, which is the rainfall probability of 1/10 years, calculated water level of the Pluit Reservoir is -0.36 mPP at the highest.

set the probable year at the time of the project planning are used as notes. However, as a result, it was judged that it cannot be used for the evaluation judgment because of the following reasons.

First, the sources and the measurement points of the 24-hour rainfall adopted at the time of planning were unknown. In addition, the 24-hour rainfall data of the Water Resources Agency of Jakarta Province obtained for the ex-post evaluation were measured at 16 points in a wide area of Jakarta Province, and there was a large difference in rainfall of each point[17]. They also include points that are not necessarily in the drainage area of the Pluit Pump Station. It is considered that the heavy rain in a limited area affects the average value, and the influence on the water level of the Pluit Reservoir may be different depending on measurement points. Therefore, it is judged that it was not appropriate to use the average value of 16 points for the analysis. In addition, since a new pump station has been developed upstream of the Pluit Pump Station before the project completion, it is considered that the conditions of the Pluit Reservoir associated to the drainage capacity and the rainfall have changed since the time of project planning[18].

Second, regarding the water level of the Pluit Reservoir, before and after the project completion, in the Jakarta metropolitan area, multiple flood control and drainage countermeasure projects such as a large-scale dredging and cleaning of Pluit Reservoir and waterways and river embankment strengthening projects have been carried out by the Ciliwung-Cisadane River Basin Development Agency and the Water Resources Agency of Jakarta Province as mentioned above (3.1.2 Relevance, Relevance to the Development Needs). According to the Consultant and the Water Resources Agency of Jakarta Province, “the water level of the Pluit Reservoir is affected by sediments of reservoirs, dredging situation, high tide, etc.” Therefore, it is judged that it is not appropriate to judge the drainage capacity based on the water level set at the time of project planning. In addition, the data on the water level of the Pluit Reservoir could not be obtained as it was not compiled throughout the period after completion of the project until the ex-post evaluation. Based on the above, it is judged that it is difficult to judge the effect of the project based on the probable year calculated at the time of project planning.

[17] As an example, on February 9, 2015, the average amount of 24-hour rainfall at 16 measuring points in Jakarta Province was 180.6 mm/24hr. It was 367 mm/24hr at Sunter Kodamar that recorded the maximum amount. It was 12 mm/24hr at Pompa Cideng that recorded the lowest amount.

[18] In the latter half of 2013, the Pasar Ikan Pump Station was completed approximately 3.4 km upstream of the Pluit Reservoir where Pluit Pump Station is located. It has 6 large pumps, 5.0 m^3/sec each, and 4 small-scale pumps, 250 mm^3/sec each, and when all large pumps are operated in the emergency time, the drainage capacity will be 30 m^3/sec.

For reference, between after the project completion, November 2014, and the ex-post evaluation month, September 2017, there is no record that the maximum value of the average of 24-hour rainfall of the 16 points exceeded 220.7mm/24hr that is the amount of the rainfall for the 1/5 probable year[19]. Therefore, it could not be confirmed from the average of actual 24-hour rainfall whether the drainage capacity of 1/10 probable year which is the target value is achieved. According to the person in charge in the Section of the Water Resources Agency of Jakarta Province, "at the Pluit Pump Station, all the pumps may be operated several times a year. But after the project is completed, there have been synergistic effects with the flood control projects of the rivers in the Province, and it is recognized that floods due to the rise in the water level of the Reservoir has not occurred except during the flood in February 2015, as described later[20]".

On the other hand, on February 9, 2015, the average 24-hour rainfall in Jakarta Province recorded the maximum value, 180.6mm / 24hr, after the project completion. On the next day, the highest water level of the Pluit Reservoir recorded +1.50mPP. This greatly exceeds the set water level of the 1/10 probable year at the time of planning. A large-scale flood occurred at that time. And according to the Regional Agency for Disaster Management, it recorded flooding of up to the highest 150 - 200 cm in various parts of Jakarta Province. According to the Water Resources Agency of Jakarta Province, this is because "the Pluit Pump Station stopped for several hours from 11 o'clock on that day". Electricity supply from the state-owned electric power company ceased due to measures to prevent electric leakage in the city, and the East Pump Station suspended[21]. In the Pluit Reservoir, the high tide also overlapped, and the water level rose. As they waited for the water level to drop due to safety consideration, it took time to switch to the private generator. During a few hours, only the Central and Western Pump Station were in operation at the Pluit Pump Station.

According to Deputy Director of the Directorate General of Water Resources and the chief of the Section of the Water Resources Agency of Jakarta Province, "it is thought that the suspension of the East Pump Station of Pluit for several hours have greatly influenced the

[19] Although it is outside the drainage area of the Pluit Pump Station, as shown in Note 17, there are records exceeding this amount depending on the measurement point.

[20] For example, the records of each week at the end of April and August 2017 of the Pluit Pump Station showed that the water level of Pluit Reservoir ranged between -2.00 and -1.65 mPP and between -1.90 and -1.65 mPP each. This includes the time when the Pump stopped. According to the operator, "they start up the pumps when the water level of Reservoir is around -1.70 mPP".

[21] After this incident, by the time of the ex-post evaluation, an alternative power source was secured. It has been improved so that the power supply from the state-owned electric power company to the Pump Station will not be stopped.

expansion of the flood in Jakarta Province[22]. It is thought that this case has demonstrated the drainage function of the Pluit Pump Station is significantly associated with the flooding in central Jakarta". Based on the above, in order to mitigate the expansion of flood damage, it is considered necessary for all Central, East and West Pump Station of Pluit Pump Station to operate soundly.

3.3.1.2 Qualitative Effects (Other Effects)

1) Risk prevention and alleviation of land subsidence, piping occurrence, and sea level rise etc.

The area around the Pluit Pump Station has been exposed to the land subsidence and rise of sea level due to climate change, etc. and has faced with the risk by the loss of the Pump Station. At the East Pump Station, the pump of the aboveground pipe line system was installed by this project, and at the time of ex-post evaluation, it is confirmed that the pump operators visually inspect if the land subsidence occurred or not at the pipe. In addition, the sea tide dike in front of the Pump Station was rehabilitated, and the influence of the high tide had not occurred by the time of ex-post evaluation. It seems that it became possible to respond to the sea level rise and land subsidence due to climate change. And, although it is not frequent, seawater is stopped by using the stop logs[23] installed in the drainage canal in front of the Central and West Pump Stations and the repair and inspection have been carried out. According to the operators of the Pump Station, "Piping destruction has not occurred in the Central and West Pump Stations", and it is thought that the risk of the loss of drainage function of the Central and West Pump Stations has been reduced[24]. From the above, it is judged that the Pump Station has become facilities with structures capable of preventing and mitigating the risk of occurrence of various problems.

3.3.2 Impacts

3.3.2.1 Intended Impacts

1) Mitigation of flood damage around Jakarta (Quantitative Effects)

In the Water Resources Agency of Jakarta Province and the Regional Agency for Disaster

[22] It was said that "it was reported to the President of Indonesia and the Governor of Jakarta Province that the suspension of the East Pump Station became a cause of this flood expansion".

[23] Stop Log is a structure that stacks square lumbers that can be inserted into and removed from a water gate or a revetment opening to serve as a weir.

[24] On the other hand, although it was not the facility targeted for this project, water leakage was seen from the side of the drainage canal of the sea side of the Central Pump Station in the field observation at the time of the ex-post evaluation. According to the consultant, "it is thought that water leakage is caused by the water pressure up to the sea water level in the drainage canal".

Management, there is no data compiled on flood damage before the completion of the project and the scale and damage of all floods occurred after the completion of the project. Therefore the trend of the situation of the occurrence and damage of floods before and after the project completion could not be captured. Therefore, as shown in Table 5, the scale and damage situation of floods which represent large-scale floods occurred after the start of the project were confirmed.

Table 5: Flood Damage in Jakarta Province

Date of Flood	Amount of Rainfall Average in Jakarta Province)		Damage				Operation of Pluit Pump Station etc.
			Jakarta Province		North Jakarta[25]		
	Max in 24-hour (mm/24hr)	Monthly (mm/ month)	District Town	Household The affected Victim	District Town	Household The affected Victim	
① Jan. 2013	n/a	621.9	35 124	506,164 1,226,487 38	5 24	11,349 78,445 0	West & Central Operated
② Jan. 2014	95.1	1,075.0	37 123	70,459 235,634 0	6 25	1,356 3,445 0	West & Central Operated Pasar Ikan Operated
③ Feb. 2015	180.6	639.0	38 133	64,458 231,566 5	6 29	25,695 91,820 3	West & Central Operated East temporally suspended Pasar Ikan Operated

Source: Water Resources Agency of Jakarta Province & Jakarta Province for Rainfall, Regional Agency for Disaster Management for Damage.

Regarding the three floods, maximum value of average 24-hour rainfall, average monthly rainfall, damage situation of Jakarta Province and North Jakarta City where the Pluit Pump Station is located in the Province, the operation situation of Pluit and Pasar Ikan Pump Station were respectively confirmed (Table 5). However, from these data, it was not possible to verify the correlation between the operation situation of the Pluit Pump Station and the flood damage situation. According to the chief of the Section of the Water Resources Agency of Jakarta Province, the main factors of the expansion of flood damage of the flood ① were thought to be "the outdoor water inundation due to the destruction of the channels in the center of Jakarta in addition to the inland water inundation". As for the flood ③, as mentioned above, temporary suspension of the Pluit Pump Station is considered to be a factor of flood damage expansion. Therefore, factors of flood generation and damage expansion are various, and affected area and the damage situation are considered to differ. Also, as confirmed by the Effectiveness

[25] The Pluit Pump Station is located in North Jakarta City in Jakarta Province. Since various flood control and drainage projects are being conducted in the province, it is decided to check the damage situation of North Jakarta including the area around the Pump Station where drainage effect of the Pump Station is likely to appear.

(Quantitative Effect), various projects for drainage and flood control have been implemented in Jakarta Province before and after the project, and stakeholders concerned with the Directorate General of Water Resources altogether have the view point that "it is difficult to measure the impact of the project alone on flood damage, because there are multiple factors of floods other than drainage capacity of pump stations". Therefore, it is judged that it is difficult to judge the impact of the Pluit Pump Station on the mitigation of the flood damage from the above-mentioned available data.

However, when the flood ③ occurred, its maximum value of the average 24-hour rainfall was more than that of the flood ② in the table 5, but its scale of damage in Jakarta Province was almost the same as the flood ②. The magnitude of the damage of North Jakarta City of the flood ③ greatly exceeded that of the flood ②. In addition, although the average monthly rainfall of the flood ② is larger than that of flood ③, the average rainfall for one week including 3 days before and after the day recording the highest 24hour rainfall was 42.1 mm for the flood ② and 44.6 mm for the flood ③. In the flood ③, it is considered that there was a large amount of rain in a short time. It is also possible that the 24-hour rainfall was large in the Northern area and the damage scale of North Jakarta City may have increased. But it is considered highly probable that if the East Pump Station of Pluit was functioning normally without suspension, the flood damage was further mitigated. Furthermore, regarding the monthly rainfall in Jakarta Province, there is no particular trend to increase or decrease before and after the project completion[26]. Under such circumstances, if the frequency, scale or damage of floods have been mitigated, it is considered that the effect of this project and other flood control and drainage projects may have been influenced. According to the chief of the Section of the Water Resources Agency of Jakarta Province, "apart from large-scale floods, the number of floods that are remembered is decreasing especially in the flood-prone areas around the Pluit Pump Station. There is an impression that flood damage in Jakarta Province is mitigated". From the above, although it was not possible to judge whether there is impact on flood damage by this project alone, it is thought that this project is supporting the mitigation of flood damage around the center of Jakarta by the synergistic effect with other projects. However, because the quantitative data that can be the basis of persuasive logic are not available, qualitative effects

[26] Comparing the average monthly rainfall in Jakarta Province between 2010 and November 2014, before the Project completion, and between December 2014 and 2016, after the project completion, the amount of the rainfall of the latter exceeded the former in 2 months in the rainy season and 3 months in the dry season. It is conceivable that the average amount will be affected when a torrential rain in a limited area or large-scale rainfall occurs, and it is necessary to pay attention to a simple comparison. However, it is considered that there is no tendency of rainfall to increase or decrease particularly before and after the completion of the project. (Source: Statistics of Jakarta Province, Jakarta in Figures 2011-2017)

are also analyzed.

2) Improvement of living and hygiene environment of the beneficiaries by realizing mitigation of flood damage (Qualitative Effects)

In the ex-post evaluation, a key informant interview survey was conducted on the administrative agencies of a district and towns and the residents in the vicinity of the Pluit Pump Station in North Jakarta City.[27] According to the administrative agencies of towns, "in the past, floods occurred 4 or 5 times a year, but in recent years there is an impression that the major damage has decreased". According to the former chiefs of the Neighboring Assembly, "in the vicinity of the Pluit Pump Station, floods caused inundation about twice a month in the previous rainy seasons, and there were places where water was inundated for 40 to 50 cm for 2 to 4 days for 5 to 6 times a year. However, the number of floods that had damaged daily life is decreasing from the impression of the flooding hour and depth in houses. From February 2015, there is no flooding that remained in memory".

According to the former chiefs of the Neighboring Assembly, "once the flood occurred, the number of symptoms of diarrhea tended to increase". According to a mother in her 20s in the area, "there was a lot of inundations caused by floods before and the child became dermatitis. Cholera and dengue were also occasionally occurring. Recently, the flood has decreased, and the occurrence of infectious diseases has not been heard". However, according to the mayor of Penjaringan Town, "the hygiene environment is originally bad around the poor area. Improvement of the environment around the Pluit Reservoir can be seen through the development of the Reservoir side and the measures against illegal residents (relocation to newly-built public housings etc.), implemented for flood control since 2015".

Meanwhile, according to the former chiefs of the Neighboring Assembly and a mother, "with the decrease in flood frequency and damage, the stress to prepare for the flood of the local residents is relieved, and that they live with a sense of security more". According to the

[27] In the drainage area of the Pluit Pump Station, Water Resources Agency of Jakarta Province mediated to select the Mayer of Penjaringan District, Secretary, the Mayor of Penjaringan Town and the Mayer of Pluit as representatives of the administrative agencies. Regarding the residents, two former chiefs of the Neighboring Assembly in the eastern area of the Pluit Pump Station were elected as persons who grasped the situation before and after the Project completion. The interview with a woman in order to grasp the hygiene environment was also conducted. Penjaringan District has jurisdiction over the drainage area of the Pluit Pump Station. Penjaringan Town has jurisdiction over the area from the east to south side of Pluit Pump Station including the poor area. Pluit Town has jurisdiction over the area of the west side of Pluit Pump Station including the residential area of wealthy people. The area in the east side of the Pump Station is an area below sea level surrounded by the Pluit Reservoir, the sea separated by a sea tide dike, harbor facilities and rivers flew from the center of Jakarta. It is considered to be the poor area in Jakarta Province with a dense population and there are also illegal residents.

administrative agencies of a district and towns and the former chiefs of the Neighboring Assembly, “the drainage area of the Pluit Pump Station is long vulnerable to floods, and flood controls have been implemented and flood damage has been mitigated recently. It is considered that the area depends on Pump Station which plays an important role”.

As described above (Impact, Quantitative Effects), it is considered that there is no trend of increase or decrease in monthly rainfall before and after completion of the project. Although it is necessary to pay attention to the fact that the interview survey was subjected to a small group and it is not the opinion of the concerned entire people, but from the above, in the area, the floods that remains in memory decreases after the large-scale flood in February 2015. It is seen that the mitigation of the flood damage to living has been realized, and the hygiene environment is improved somewhat. In other words, it is thought that it is not caused by this project alone, but it can be inferred that this project plays a role in mitigating floods.

3) Mitigation of damage to economic activities of important facilities in the flooded area (Qualitative Effects)

In the ex-post evaluation, interviews with economic facilities in the Pluit drainage area were conducted[28]. According to the fisheries corporation and companies that had had damages of floods, “there were flood damages 4 to 5 times a year, and buildings, equipment, etc. were damaged. It used to be necessary to move electronic equipment, fixtures and goods prior to a flood, there were also business suspension due to blackouts, and many companies were economically damaged[29]. There were many complaints from companies in the fishing port. A lot of companies inundated even in February 2015. Since then, no damage that remained in memory has occurred and the stress on flood occurrence and economic damage has been relieved”. In the thermal power plant, “there have been no damage to generator and power generation due to its own countermeasures at a time of flood, but there is the impression that damages such as inundation in the premises that used to occur before had been mitigated”.

[28] As a result of consultation with the Directorate General of Water Resources, the Water Resources Agency of Jakarta Province mediated to select the interviewees as follows: the fisheries corporation (Perusahaan Umum Perikanan Indonesia), Jakarta Port Branch, which is under the jurisdiction of the Ministry of State Enterprises, a frozen food processing and exporting company located in the port of Jakarta, which had been affected by the floods, a shoemaker located in the east side of the Pluit Pump Station and a thermal power plant (PT. Pembangkitan Jawa Bali (PJB) Muara Karan Unit) located in the western coast of the Pluit Pump Station.

[29] According to the fisheries corporation, regarding the economic damage of one large flood accompanied by inundation, “there are over 100 companies in the entire port, about 110 ha, of jurisdiction. And the damage will be totally about 100 billion Indonesian Rupiah, hereafter referred to as “IDR”, 840 million yen, or more”, and according to the interviewed frozen food company, “about 20 million to 30 million IDR, about 170,000 to 250,000 yen”. 1yen=118.64IDR (exchange rate of October 1, 2017).

As mentioned above, although it is necessary to pay attention to the constraints of the obtained data and the relevance of the rainfall amount and the factors of the floods, there are impressions that the flood damages are mitigated. If the entire Pluit Pump facilities are functioning soundly in February 2015, it is also inferred that flood damage of companies in the port was further mitigated. Although clear impact cannot be demonstrated, it is judged that this project supports the mitigation of flood damage to economic activities of important facilities located in the drainage area.

4) Impact on the economic activities etc. of approximately 24 million residents of the Jakarta metropolitan area (Qualitative Effects)

The drainage area of the Pluit Pump Station includes the center of Jakarta where the government agencies and many companies are located, and many working people live in the metropolitan area and commute to work. According to the chief of the Section of the Water Resources Agency of Jakarta Province, “the flood in the center of Jakarta affects the living opportunities of workers in the surrounding area as well as the means of commuting, and indirectly affecting our daily lives. If the pump station in the central basin does not function even at one location, it will have a major obstacle to the drainage in the center of Jakarta. It is very important for all pump stations to demonstrate the planned drainage capacity for flood control in the center of Jakarta”. This study cannot measure the impact of this project alone on economic activities etc. of approximately 24 million residents of the Jakarta metropolitan area, as the implementation of other flood control and drainage projects and various flood factors are taken into consideration. However, it is judged that as long as it’s designed drainage capacity is maintained, the Pluit Pump Station mitigates the flood damage in the center of Jakarta and supports the mitigation of the damage of the economic activities in the Jakarta metropolitan area by synergistic effects with other pump stations, flood control and drainage projects.

Photo 3: Pluit Pump Station
Aboveground pipe line system

Photo 4: Pluit Pump Station
The reservoir water level is visually monitored

3.3.2.2 Other Positive and Negative Impacts

1) Impacts on the Natural Environment

At the time of planning, this project was to reconstruct the existing facilities, and the environmental impact assessment (EIA) was judged unnecessary. However, according to the Consultant, "environmental monitoring in accordance with simpler environmental management plan and environmental monitoring plan approved by Environment Agency of Jakarta Province was conducted". However, at the time of project evaluation, both the Directorate General of Water Resources and the Water Resources Agency of Jakarta Province did not store data, and the Water Resources Agency of Jakarta Province did not establish an environmental monitoring implementation system. Therefore, through the interviews with the Consultant, the administrative agencies of a district and towns around the Pluit Pump Station and the former chiefs of the Neighboring Assembly of residential area of the eastern side, it was confirmed that there was no occurrence of exhaust gas generation, noise, vibration or traffic accidents during the project implementation or after the project completion. According to the chief of the Section of the Water Resources Agency of Jakarta Province, "an appropriate response will be carried out if necessary". It is considered that there is a low possibility that a negative environmental impact has occurred after the completion of the project.

2) Resettlement and Land Acquisition

It was confirmed that this project was mainly to reconstruct the existing facilities and there was no new land acquisition through the interview with the chief of the Section of Water Resources Agency of Jakarta Province. By the time the project start, the number of illegal

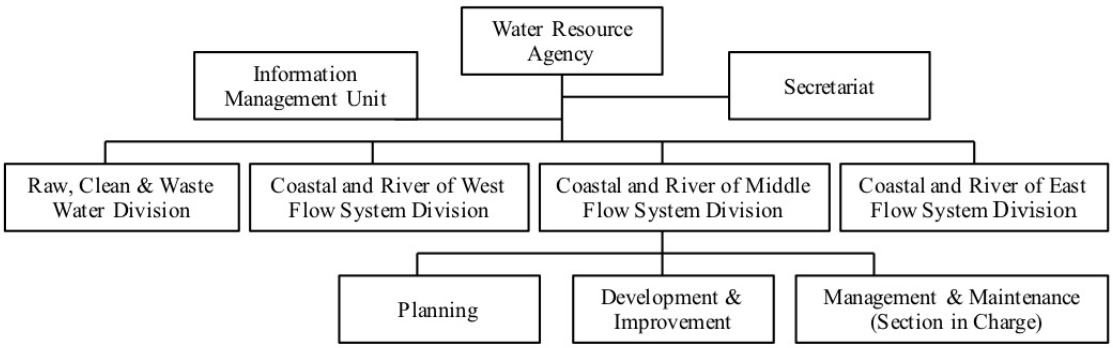
residents in the Pluit Reservoir side of the Pump Station had moved to the public housings constructed by the Jakarta Province and World Bank projects. It was confirmed that there were no complaints, etc. and that there was no problem in the relocation process through the interview with the former chiefs of the Neighboring Assembly of the area concerned.

From the above, this project has mostly developed the effect as planned. Therefore, effectiveness and impacts of the project are high.

3.4 Sustainability (Rating: ③)

3.4.1 Institutional Aspect of Operation and Maintenance

The executing agency during the project implementation and the supervisory responsibility agency after the project completion of this project is the Directorate General of Water Resources. Meanwhile, the Water Resources Agency of Jakarta Province has jurisdiction over the operation and maintenance of the reconstructed Pump Station. The organization chart of the Water Resources Agency of Jakarta Province is shown in the Figure 2.



Source: Created by the evaluator based on the document by Water Resources Agency of Jakarta Province

Figure 2: Organizational Chart of Water Resources Agency of Jakarta Province

At the time of ex-post evaluation, the total number of organization staff in the Water Resources Agency of Jakarta Province as a whole is 5,578. In the Management and Maintenance Section of the Coastal and River of Central Flow System Division, it is 343 people including 219 operators of 17 Pump Stations including the Pluit Pump Station[30]. At the time of

[30] In Jakarta Province, the organizational structure has changed in 2014. The Water Resources Agency of the Jakarta Province at the time of ex-post evaluation was formerly the Public Works Bureau of the Province. The organizations were separated in 2014, and the Water Resources Agency which has jurisdiction over pump stations became an

the ex-post evaluation, at the Pluit Pump Station, under one chief, 14 operators are divided into 2 teams of 7 people each, and with a shift system of every 24 hours, the operation and maintenance of the Pump Station is carried out[31]. When visiting the Pluit Pump Station during the field study, it was confirmed that the number of operators was sufficient to manage the Pump Station through interviews with operators. Regarding the operation and maintenance, the operators carry out the basic inspection and repair and outsource if necessary.

Furthermore, after completion of the project, the Directorate General of Water Resources and the Ciliwung-Cisadane River Basin Development Agency are not involved in the operation and maintenance of the Pluit Pump Station. It had been decided that the reconstructed East Pump Station facilities and the facilities related to sea tide dike were to be transferred from the Ciliwung-Cisadane River Basin Development Agency to the Water Resources Agency of Jakarta Province as assets after the completion of the project, but they have not been transferred by the time of the ex-post evaluation. According to the chief of the Section of the Water Resources Agency of Jakarta Province, "it means that the budget and personnel are allocated on the assets which are not owned by Jakarta Province, and it is essential to transfer them from the viewpoint of auditing". The Water Resources Agency of Jakarta Province is aware that it is the competent authority of the East Pump Station of Pluit, and in terms of the budget and personnel allocation, the entire Pluit Pump Station is regarded as one facility. The East Pump Station of Pluit is operated and maintained without being separated from the Central and West Pump Stations by the Water Resources Agency of Jakarta Province. Based on the above, it is judged that there is no big concern regarding the institutional aspect of operation and maintenance of this project at the time of ex-post evaluation.

independent organization. In addition, prior to the organizational separation, under the Water Resources Conservation Department which was the competent department at that time, competent divisions were organized based on a work contents such as water resource conservation planning, facilities management and utilization, and flood control facility maintenance. At the time of ex-post evaluation, divisions are organized by regional jurisdiction.

[31] At the time of planning, there were a total of 12 operators, and by the time of the ex-post evaluation, 2 members have been increased.

3.4.2 Technical Aspect of Operation and Maintenance

Under the jurisdiction of the Water Resources Agency of Jakarta Province, 14 operators are allocated. Lead by 3 operators with the experience of from 11 to 13 years, 8 operators who have attended the training of operation and repair of the equipment of electrical system implemented by the contractor during the project are also assigned to the Pluit Pump Station. According to the operation rules of the Water Resources Agency of Jakarta Province, they have sufficient knowledge of operation of the Pump Station through the use of this project's operation and maintenance manual as necessary. The repair and inspection of electrical systems may be outsourced to private contractors as necessary, but minor repairs can be handled by the operators. New operators learn the knowledge and skills of the method of operation and maintenance of all pumps of the Pluit Pump Station through on-the-job training and a training that is held about once a year. From the above, it is judged that there is no particular problem on the technical aspects of operation and maintenance.

Photo 5: An operator operating the pumps at East Pump House

3.4.3 Financial Aspect of Operation and Maintenance

Table 6 shows the expenses of operation and maintenance, including personnel expenses of contract staff of 17 pump stations[32], of the Coastal and River of Central Flow System Division of Water Resources Agency of Jakarta Province. According to the Section, the personnel expenses of regular staff and the water and utility expenses of the pump stations are not included in the table because they are under the jurisdiction of other division within the Water Resources Agency of Jakarta Province.

[32] According to the Section of the Water Resources Agency of Jakarta Province, 307 persons including a part of office workers and operators are contract employees among the 343 persons in the Section.

Table 6: Operation and maintenance expenses of Coastal and River of Central Flow System Division, Water Resources Department of Jakarta Province

(Unit: 10billion IDR)

Financial Year	Budget	Actual	Human Expenses of Operators in Pluit Pump Station[33]	
			Budget	Actual
2015	52.941	9.975	n/a	0.421
2016	45.441	27.455	n/a	0.671
2017	58.414	24.739	n/a	0.714
2018	59.295	n/a	0.827	n/a

Source: Created by the evaluator from the documents by Coastal and River of Central Flow System Division, Water Resources Agency of Jakarta Province

Although there is an increase/decrease in actual results according to fiscal years, the approved budget is on an upward trend. The personnel expenses of operators of the Pluit Pump Station are also on the rise. Through interview with the chief of the Section, it is confirmed that the expenses related to the operation and maintenance work of the Pluit Pump Station, including the repair cost of the Central Pump Station and the construction of the monitoring cabin of the Reservoir water level, have been spared without problems in FY 2017, and there is no problem of prospect of the future budget allocation. Based on those points, concerning the financial aspect including the operation and maintenance expenses, there is no concern at the time of ex-post evaluation. From the above, it is judged that there is no particular shortage in the operation and maintenance budget of this project, and it is judged that no major problems on the financial aspect can be seen.

3.4.4 Status of Operation and Maintenance

At the time of the ex-post evaluation, through observation at the time of field study and interview, it is confirmed that the East Pump Station of Pluit has no malfunction or damage for the operation performance, there is no damage to the sea tide dike and it is demonstrating its function as a pump station through the operation and maintenance of inspection and repair.

Regarding the spare parts, the storage situation is not particularly problematic. For the equipment for which it takes time to obtain spare parts, measures like controlling room temperature to avoid failures, etc. are being addressed. It is confirmed that there is no particular problem in the procurement system of spare parts through the observation and interview.

Regarding the day-to-day operation situation of the Pump Station, operating pumps, operating

[33] At the time of ex-ante evaluation, the assumed amount of personnel expenses for FY2010 was 366 million IDR.

time and water level, through the visual inspection and interview at the field survey, it is confirmed that almost all records are taken, but a part of information, pump temperature etc., related to the mechanical and electrical characteristics has not been recorded. However, the operators check the pump temperature at any time. In addition, regarding the periodic maintenance items of facilities defined by the project: drainage pipes, civil engineering facilities, and sea tide dikes, there was no regular schedule or record for such checking as the deterioration situation of the sea tide dike structure and main facility: cracks, defects, peeling of concrete framework, leakage, ground subsidence and collapse etc. However, it is said that a visual inspection has been carried out by the operator. According to the chief of the Section of the Water Resources Agency of Jakarta Province, "all the monitoring items have not been recognized due to the replacement of the section chief". Although no problems have occurred by the time of ex-post evaluation, it is considered necessary to carry out these inspection works in order to grasp the risk of future problems.

From the above, no major problems have been observed in the institutional, technical and financial aspects of the operation and maintenance system. Regarding the current status of the operation and maintenance, there are some issues to be improved in thorough monitoring and inspection, but no major problems have occurred at the time of ex-post evaluation. Therefore, sustainability of the project effects is high.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

This project aimed at restoring the drainage function of the Pluit Pump Station by carrying out urgent reconstruction of the East Pump Station which had been in dysfunction and maintenance of the sea tide dike at the Pluit Pump Station located in North Jakarta City in Jakarta Province, and thereby mitigating the flood damage in the drainage area of the Pump Station and the Jakarta metropolitan area. At the time of ex-post evaluation, this project has been relevant to the development policy like the *National Medium-Term Development Plan of Indonesia* which aims to reduce flood-prone areas by improvement of water resource management and reduces flood risks, and development needs, as well as Japan's ODA policy. Therefore its relevance is high. Although the project cost was within the plan, efficiency of the project is fair as the project period exceeded the plan. Regarding the effectiveness, it is judged that the indicators as the designed drainage capacity of the whole Pluit Pump Station and East

Pump Station were satisfied. Meanwhile, in Jakarta Province, other flood control and drainage control projects are being implemented. In addition, various factors such as the rainfall amount and depth of water channels and reservoirs, etc. are involved in the occurrence, scale and damage expansion of flood. Therefore, regarding impact, it is difficult to judge that flood damage was mitigated by this project alone. However, when the drainage capacity of the Pluit Pump Station had not been restored by this project, flood damage is considered to be expanding. Thus, it is judged that the project has supported the mitigation of flood damage. In addition, there are no particular problems in the institutional, technical and financial aspects of the operation and maintenance of this project, and the sustainability of this 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 Executing Agency

- Facilities by this project are still assets of the Ciliwung-Cisadane River Basin Development Agency at the time of ex-post evaluation. Although there is no problem at the time of ex-post evaluation, there is a possibility that obstacles may arise in the future allocation of personnel and budget to facilities that are not assets of the Water Resources Agency of Jakarta Province and furthermore, operation and maintenance there. The Directorate General of Water Resources should obtain necessary information from JICA appropriately so as to transfer assets promptly and proceed with the procedure.
- The periodic inspections and record of checking the electrical system of the Pluit Pump Station and the deterioration situation of the sea tide dike and the main facility, etc. are not thoroughly conducted. In order to ensure the durability of the facility and the stability of long-term drainage capacity as a facility to prevent flood damage expansion, it is recommended that the inspection methods according to the facility manual and the operation and maintenance manual of Pluit Pump Station are confirmed, and the operation and maintenance is ensured.
- At the time of ex-post evaluation, the drainage capacity of the entire Pump Station becomes unstable due to aging of the West Pump Station. In order to mitigate flood damage in central Jakarta, it is said that it is necessary that all pumps should function soundly. In order to secure the long-term effect, it is recommended to deal with the repair of the West Pump Station early by raising funds, etc.

4.2.2 Recommendation to JICA

None

4.3 Lesson Learned

Necessity for setting appropriate indicator for the Effectiveness, Quantitative Effect.

In this project, the probability scale of rainfall, rainfall probable year, was set as an effect indicator with regard to the quantitative indicator of the project effect on the recovery of drainage capacity of the Pump Station. However, it was an indicator that is difficult to judge the effect of restoring drainage capacity for the following reasons. The rainfall probability scale itself is not a numerical value showing the drainage capacity of a pump station directly. It is calculated from the past rainfall amount. There is a possibility that it may change depending on the reference year. If the rainfall of the set probability scale did not occur, it cannot be grasped whether the effect is expressed or not. The measurement point and the source of the rainfall which calculated the rainfall probability scale at the time of planning are unknown, and the rainfall amount cannot be grasped. The water level of the adjacent reservoir which is associated with the rainfall probability scale would be influenced by the external conditions like the drainage environment in a wide area where multiple large-scale drainage and flood control projects have been implemented and has been changed by the time of the ex-post evaluation. The rainfall probability scale may have been reasonable when a project evaluation is implemented immediately after the completion of a project or if it is used for a design basis of the drainage capacity. From now on, in a similar project, it is considered worth considering that setting the available indicators of the direct effect of the recovery of the drainage capacity without being affected by the changes over time or the change of the environment etc. Regarding the rainfall amount, it is necessary to clarify the measurement conditions, which measurement point data comes from, if the data is an average value of plural measurement points or not, and which source used, etc.

Supplementary Material Table 1 Capacity and Operation Rule of Pluit Pump Station

Reservoir Level (mPP)	Discharge Amount Total (m^3/Sec)	Discharge Amount of Each Pump (m^3/Sec)									
		East			Central				West		
		1	2	3	1	2	3	4	1	2	3
Above -0.8	Same as below										
-0.9	49.0	5.0	5.0	5.0	4.0	4.0	4.0	4.0	6.0	6.0	6.0
-1.0	37.0	5.0	5.0	5.0	4.0	4.0	4.0	4.0	6.0		
-1.1	31.0	5.0	5.0	5.0	4.0	4.0	4.0	4.0			
-1.2	31.0	5.0	5.0	5.0	4.0	4.0	4.0	4.0			
-1.3	26.0		5.0	5.0	4.0	4.0	4.0	4.0			
-1.4	22.0	5.0	5.0		4.0	4.0	4.0				
-1.5	18.0		5.0	5.0			4.0	4.0			
-1.6	14.0	5.0	5.0		4.0						
-1.7	8.0				4.0	4.0					
-1.8	8.0				4.0	4.0					
-1.9	4.0					4.0					
-2.0											

Source: Water Resources Agency of Jakarta Province