Republic of the Philippines

FY2018 Ex-Post Evaluation of Japanese ODA Loan Project

"Pinatubo Hazard Urgent Mitigation Project (Phase III)"

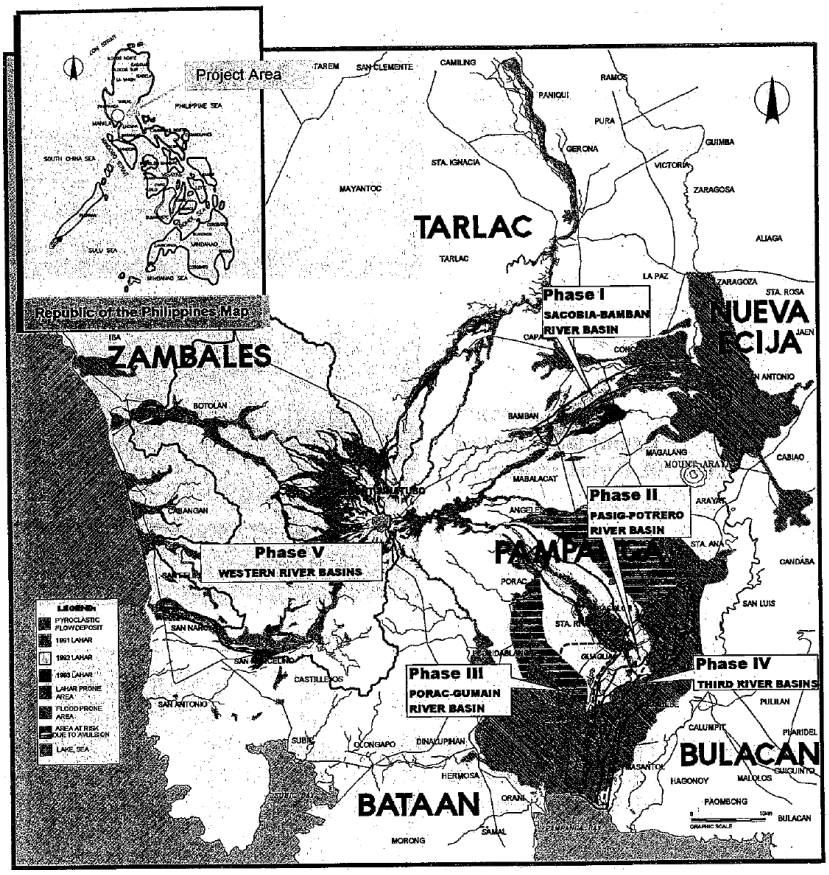
External Evaluator: Miho Sakuma, International Development Center of Japan, Inc.

0. Summary

In Central Luzon in the Philippines, after the eruption of Mt. Pinatubo, large amounts of volcanic ash have accumulated in rivers and drainage channels, causing flooding due to riverbed rises and channel closures. This project was implemented to mitigate flood and inundation damage in the target river basin through improving drainage channels, diversion channels, rivers, and roads, thereby securing logistics and improving hygiene in the environment.

This project is highly relevant to the Philippines' development policy, development needs, and Japan's ODA policy. Therefore, its relevance is high. The project period significantly exceeded the plan and the project cost was higher than planned as the civil works were suspended by typhoons and carried out in stages according to the progress of inflation (price increase of materials), land acquisition, and the resettlement of affected residents. Therefore, efficiency is low. Although it was impossible to assess the quantitative effects since the neutral and reliable data for the operation and effect indicators were not available in the target area, the effectiveness and impacts are fair because certain effects have been observed such as positive changes in the business environment due to securing and improving transportation and logistics routes through this project's implementation. In addition, regarding the operation and maintenance of the flood control facilities constructed through this project, no major problems have been observed in the institutional / organizational, technical, financial aspects and current status. Therefore, sustainability of the project effects is high. In light of the above, this project is evaluated to be partially satisfactory.

1. Project Description



Project Location

1.1 Background

The eruption of Mt. Pinatubo—located in Central Luzon—in June 1991 was one of the century's largest eruptions. After the eruption, typhoons and heavy rainfalls resulted in the outflow of pyroclastic sediments (mudflow (lahar) in downstream) each year, and massive mudflow disasters occurred in the Sacobia-Bamban and Pasig-Potrero rivers east of Mt. Pinatubo. Under these circumstances, restorations of rivers and roads in the Sacobia-Bamban and Pasig-Potrero river basins were implemented by the Pinatubo Hazard Urgent Mitigation Project Phases I and II. However, the riverbed elevation and river clogging due to lahar deposition in the downstream region of the Pasig-Potrero River, which joins the tributaries of the Porac-Gumain River, have not been eliminated. Therefore, main roads and urban areas suffered flood damage during typhoons and prolonged rains during the rainy season, which had a major impact on social and economic activities such as interrupting traffic and logistics and the stagnation of commercial activities and caused environmental deterioration in the surrounding areas. This project was regarded as part of the development of Subic Clark, where the Philippine government is promoting investment

as key to economic growth, and early implementation of flood control in the region was strongly desired.

1.2 Project Outline

This project's objective is to mitigate flood damage in Central Luzon of the Philippines through improving drainage channels, rivers, roads, and constructing diversion channels, thereby securing physical distribution, improving the environmental hygiene, and contributing to the region's sustainable development as part of the development of the Subic-Clark corridor promoted by the government of the Philippines.

Loan Approved Amount/ Disbursed Amount	7,604 million yen / 7,444 million yen
Exchange of Notes Date/ Loan Agreement Signing Date	December 2007 / December 2007
Terms and Conditions	(1) Civil Work Interest Rate 1.5% Payment Period 30 years (Grace Period 10 years) (2) Consulting Service Interest Rate 0.01% Payment Period 30 years (Grace Period 10 years) Conditions for Procurement General Untied
Borrower/ Executing Agency	Government of the Philippines / Department of the Public Works and Highways (DPWH)
Project Completion	August 2017
Target Area	City of San Fernando, Municipalities of Guagua, Lubao, Sasmuan, Mexico, Santo Tomas, and San Simon (Province of Pampanga)
Main Contractors (Over 1 billion yen)	Toyo Construction Co., Ltd. (Japan), China International Water and Electric Corporation (China)
Main Consultants (Over 100 million yen)	Nippon Koei Co., Ltd. (Japan) / Philkoei International Inc. (Philippines) / Woodfields Consultants, Inc. (Philippines) / Pertconsult International (Philippines)

Related Studies (Feasibility Studies, etc.)	Feasibility study (F/S) of Phase III was conducted as a part of Pinatubo Hazard Urgent Mitigation Project (Phase II) in 2002. Supplemental F/S was conducted in 2006.
Related Projects	[ODA Loan] Pinatubo Hazard Urgent Mitigation Project (Phase I) (March 1996) Pinatubo Hazard Urgent Mitigation Project (Phase II) (September 1999)

2. Outline of the Evaluation Study

2.1 External Evaluator

Miho Sakuma, International Development Center of Japan, Inc.

2.2 Duration of Evaluation Study

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

Duration of the Study: August 2018－November 2019

Duration of the Field Study: November 14, 2018-December 8, 2018, June 29, 2019-July 4, 2019

2.3 Constraints during the Evaluation Study

(1) Scope of qualitative surveys

There are 10 local government units (LGUs) along the Porac, Gumain, and Pasig-Potrero rivers, which have benefited from the structural and non-structural measures implemented in this project, although the degree and mode of benefit differed for each LGU. It is desirable to conduct the evaluation through a wide range of interviews with all relevant national and local agencies and residents of the 10 LGUs. However, due to time and budgetary constraints, opinions and data available from the executing agency and related organizations that could be visited within the scope of this evaluation study were collected and qualitative surveys (interviews with LGU staff, residents in the vicinity of construction sites, and relocated residents) were conducted in the seven LGUs that were directly subjected to this project to conduct the evaluation as objectively and fairly as possible.

(2) Quantitative effects of effectiveness

When measuring the developmental effects (disaster risk mitigation effects derived from the relationship between flood probability, inundation depth, and duration) that were assumed at the time of appraisal, how often flooding occurred after project's completion

was assessed (probability assessment), and the target value was estimated at the time of annual probable flood in an attempt to measure whether the actual figures had reached this level. A probability assessment[1] was conducted based on the F/S probability assessment method and implemented based on advice from flood control experts. Although consent was obtained on the procedures from the executing agency and related organizations, the target value for the operation and effect indicators based on probability assessment (five-year probability floods) was an estimate. However, the available actual data on operation and effect indicators, including inundation depth and duration, were based on reports from each LGU and based on disaster reports created by the Regional Disaster Risk Reduction Management Council of the Region III[2] and Provincial Disaster Risk Reduction Management Council of Pampanga. According to information obtained from the stakeholders, however, each LGU that supplied data used different measurement locations for inundation depth, measurement methods, and definitions of inundation duration, and it is highly likely that these data were affected by both flooding and poor drainage, so these data have limited neutrality and reliability. Therefore, in this evaluation, the target values (for five-year return period) set at the time of appraisal and actual values are treated as reference values, and measured quantitative effects based on these reference values are considered as a reference for evaluation.

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

3.1 Relevance (Rating:③[4])

3.1.1 Consistency with the Development Plan of the Philippines

The government of the Philippines has been implementing projects for flood control and erosion control measures. *The Philippine Medium-term Development Plan (2004–2010)* focused on the identification of high-risk areas for national disasters and the implementation of local disaster risk reduction and management plans in such areas. One of the ten development points of *the Philippine Medium-term Development Plan (2004–2010)* stated that Subic–Clark corridor would be developed as a hub of services and logistics with international competitiveness.

Regarding flood and drainage management, Chapter five of *the Philippine Medium-term Development Plan (2011–2016)* of the Aquino administration also stated that disaster mitigation measures were insufficient, the DPWH's budget for structural measures and its operation and maintenance expenses were insufficient, and populated

[1] As described in 3.3.1. Effectiveness, the flood that occurred in the target area in August 2016 was evaluated as a five-year probability flood.
[2] The Philippines is divided into 17 regions including Metro Manila. The seven target LGUs of this project are located in the Province of Pampanga in the Region III, where Clark and Subic are also located.
[3] A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory
[4] ③: High, ②: Fair, ①: Low

areas and the centers of economy and agriculture should be given priority for countermeasures.

In addition, Chapter 19 of the current *Philippine Medium-term Development Plan (2017–2022)* also cited the increasing frequency and damage of floods from climate change as a challenge. Strengthening logistics in the Subic–Clark–Manila–Batangas corridor has been a goal in the Philippine Medium-term Development Plans of both the Aquino and Duterte administrations.

Therefore, this project is consistent with the development policy of the Philippines from the time of appraisal to the time of ex-post evaluation.

3.1.2 Consistency with the Development Needs of the Philippines

The target area of this project was severely damaged by the 1991 Pinatubo eruption. The main cause of flooding in the target area is blockages of the river flow due to pyroclastic flow deposits and the Philippine government has made strong requests for flood control projects from Japan. Initially, at the time of appraisal, this project was requested to cover the Lower Porac-Gumain River, including the municipalities of Guagua, Lubao and Sasmuan.[5] However, it was later decided to include the neighboring provincial capital San Fernando City and the surrounding areas in this project's coverage area since these areas had also suffered repeatedly from flood damage[6] and San Fernando City strongly requested an early response by allocating a million pesos from the city budget for resettlement.[7] Even at the time of the ex-post evaluation, the project's seven target local governments and local residents are hoping for further flood mitigation measures.[8] Thus, this project's contribution to the regional economy's development is highly consistent with the development needs.

3.1.3 Consistency with Japan's ODA Policy

In *Japan's Country Assistance Program for the Philippines (August 2000)*, "Environment and disaster risk reduction and management" has been cited as one of

[5] According to documents provided by JICA and interviews during the field studies, the target area of this project is generally low; there are places lower than the sea level, which is why the major industry is aquaculture rather than agriculture, and fishponds are scattered throughout the area. Sandbanks were formed near the river mouths by deposits of volcanic ash. These sandbanks blocked the river's flow in the whole San Fernando area and caused road floods whenever it rained.

[6] According to documents provided by JICA and interviews during the field studies, San Fernando City and the surrounding areas were planned to be included in the Phase IV. The river running in the center of San Fernando City was narrow, and the drainage condition of drainage channels were deteriorated with a large amount of volcanic ash, water plants and garbage deposited on the riverbed and surface.

[7] The city council resolved to allocate the amount from the city's general development budget in 2008, 2009 and 2010.

[8] At the time of the ex-post evaluation, Phase IV is being implemented in the target area with the support of the Korean government and Phase V for coastal areas is expected to be implemented with a budget provided by the Philippine government.

the priority assistance areas. *The JBIC Overseas Economic Cooperation Operations Policy (May 2005)* stated that economic infrastructure has become a hindrance to the Philippines' economic growth, and a priority area of assistance was specified as the "environmental protection measures, including disaster risk reduction and management." In addition, *the Country Assistance Implementation Policy (December 2006)* focused on the "Subic–Clark–Batangas Growth Corridor" and stated that "projects in the area of disaster reduction should be assisted from the perspective of preventing disasters that are considered a factor that hinders economic growth." Therefore, the consistency between Japan's ODA policy and this project is high.

As stated above, this project has been highly relevant to the Philippines' 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

Table 1 shows the planned and actual project outputs and the reasons for the changes. Many changes were observed in the current situation of the construction sites since there was a large gap between the F/S being conducted (2002) to the start of construction (2009). For this reason, some planned civil works were canceled because some parts of rivers and channels planned to be dredged and excavated, or bridges planned to be constructed, had already been dredged, excavated or constructed by the DPWH or LGUs, while some civil works that match the current situation were added. For example, plans were changed in the dense residential areas to avoid the issue of land acquisition but the actual project outputs were designed to be almost the same as planned. Based on the site visit and interviews with DPWH and consultants, when the length of excavation/dredging was shortened in accordance with the river's current condition, the amount of water flow was intended to be unchanged by making the excavation deeper than planned. Based on the actual project outputs, it is considered to have been changed to be equivalent, and the actual project outputs are considered to have the same effect as the plan. Although there is a slight difference between the planned and actual project outputs, the gap is not significant and the scope set at the time of the appraisal is considered appropriate.

Table 1 Project Outputs (Plan and Actual)

Items	Plan	Actual	Reasons of Change
Civil Works			
1.Excavation/ dredging of local drainage channels, Construction of channel diversion	Excavation/ dredging of local drainage channels (14.7 km), Construction of channel diversion (4.5 km)	Excavation/ dredging of local drainage channels (7.2 km), Construction of channel diversion (3.3 km) [Additional works] Replacement of 2 bridges, Road raising (54.6 m)	- Dredging and excavation of the Sapang Luma were canceled because the construction of three new bridges was required to construct the Sapang Luma drainage channels (1.25 km), and the issue of land acquisition was raised (The target area was a dense residential area). Instead, drainage was improved by dredging/excavating the adjoining Marimla Creek (0.98 km). - Additional work was carried out in accordance with widening and constructing the drainage channel.
Construction of diversion channel of lower Porac-Gumain River	Construction of channel diversion with dike (7.2 km), Construction of channel diversion without dike (11.5 km)	Construction of channel diversion with dike (7.67 km), Construction of channel diversion without dike (8.652 km) [Additional works] Construction of side channel (3 km), Construction of Engineer’s Field Office, Planting of mangroves 30,000 sq.m	- The downstream portion of the diversion without a dike was partially shortened as the area was found to be full of mangroves, which cannot be cut under Philippine law; however, the constructed water discharge channel was almost as long as planned because the 3 km side-channel was constructed as additional works. The water discharge channel is functional as planned.
3. Widening/ dredging rivers (San Fernando River) and drainage channels in City of San Fernando	Dredging of rivers (16 km)	Dredging of rivers (14 km) [Additional works] Construction of cut-off channel (1.28 km), Construction of 5 bridges	- The excavation was canceled because the Lalam-baka Creek (1.7 km) was closed to prevent backflow. - A cut-off channel was constructed to disperse the inflow of water. - Three bridges were rebuilt and two bridges were raised to meet the need to widen rivers and drainage channels and raise existing bridges. - Regarding land acquisition for this project, one family was opposed to selling their land in San Fernand City. Only that part was excluded from the project’s scope as the construction works could not be carried out as planned.
4. Dredging of major rivers	Dredging of rivers (19.2 km)	Dredging of rivers (12.72 km) [Additional	- Dredging the Pasac River (2.9 km) was canceled because it was wide enough that there was no need to excavate. - Excavation of the Upper Guagua River

		works] Restoration of 1 bridge, Construction of temporary closure dike, Construction of access road (700 m), Restoration of fishpond dike	was canceled because it had already been excavated by the DPWH. Additional construction works were carried out in accordance with the river's current condition.
5. Road/bridge raising, Construction of bridges	Road raising (16 km), Bridge raising (8 bridges), Construction of 5 bridges	Road raising 10.3km, Construction of 6 bridges [Additional works] Construction of side drainage (2.09 km), Reinforced concrete box culverts and drainage outfalls	- The 6.6 km of highway elevation was canceled as it had already been implemented in the budget of the DPWH. - Four of the 12 bridges planned to be constructed and raised at the time of appraisal (It was 12 bridges rather than 13 in the documents provided by the Philippine side) had been constructed by the DPWH district engineering offices or LGUs; therefore, eight bridges were planned to be constructed and raised in this project. However, one bridge could not be constructed with ODA loans and the construction of another bridge was canceled due to a strong opposition from adjacent church.
Consulting Services			
Part 1: Flood control works for Porac-Gumain River Basin	Detailed design, Assistance for tender process, Construction supervision, Assistance and monitoring works during construction	As planned	
Part 2: Monitoring and planning of non-structural measures and institutional capacity building	Water management, Land use planning, Flood forecasting and warning system, Disaster preparedness and management, Institutional capability building	As planned	

Source: Project Completion Report, Documents provided by DPWH

3.2.2 Project Inputs

3.2.2.1 Project Cost

The total project cost (actual) was 12,176 million yen (of which the ODA loan portion was 7,444 million yen and the Philippine government shouldered 4,732 million yen) and slightly higher (112%) than the planned project cost (10,854 million yen, of which ODA loan portion was supposed to be 7,604 million yen with the Philippine government shouldering 3,250 million yen). Project inputs increased as a result of partial changes in output plans, rising material prices, and extending the project period.

Table 2 Project Cost (Plan)

Items	Foreign Currency Portion (million yen)		Local Currency Portion (million yen)		Total (million yen)	
	Total	JICA Portion	Total	JICA Portion	Total	JICA Portion
Civil Works	3,388	3,388	2,554	2,554	5,942	5,942
Consulting Services	606	606	493	493	1,099	1,099
Price Escalation	253	253	0	0	253	253
Physical Contingency	182	182	128	128	310	310
Land Acquisition and Resettlement	-	-	1,957	0	1,957	0
Administration cost	-	-	380	0	380	0
Taxes (VAT and duties)	-	-	913	0	913	0
Grand Total	4,429	4,429	6,425	3,175	10,854	7,604

Source: Documents provided by JICA
Exchange rate: US$1 = 119 yen、US$1 = 51.4 peso, 1 yen = 0.43 peso, Assumed rate of price escalation: Foreign 1.7%, Local 0%, Contingency 5.0%, Base year of the cost estimation: December 2006

Table 3 Project Cost (Actual)

Items	Foreign Currency Portion (million yen)		Local Currency Portion (million yen)		Total (million yen)	
	Total	JICA Portion	Total	JICA Portion	Total	JICA Portion
Civil Works	499	499	8,377	5,863	8,876	6,362
Consulting Services	576	576	652	507	1,228	1,082
Price Escalation	-	-	-	-	-	-
Physical Contingency	-	-	126	-	126	-
Land Acquisition and Resettlement	-	-	1,578	-	1,578	-
Administration cost	-	-	368	-	368	-
Taxes (VAT and duties)	-	-	-	-	-	-
Grand Total	1,075	1,075	11,101	6,370	12,176	7,444

Source: Project Completion Report
Note: Since the numbers after the decimal point are rounded off, the total of the breakdown may not match the total value.
Weighted average exchange rates (IMF *International Financial Statistics Yearbook 2008-2016*): US$1 dollar = 97.5 yen, US$1 dollar = 44.7 pesos, 1 yen = 0.46 pesos

3.2.2.2 Project Period

Although the project period (planned) was November 2007 to July 2013 (69 months), the project period (actual) was November 2007 to August 2017 (117 months) and thus much longer than planned (170%).

Table 4 shows the implementation schedule (comparison between the plan and actual) for this project. According to the ex-ante project evaluation report, the project completion date was defined as the date of "the end of the one-year warranty period after all constructed facilities have been transferred to those responsible for operation and maintenance". Although the warranty period began immediately after the completion of civil works in the implementation schedule (plan) at the time of appraisal, the project completion report and interviews with DPWH clarified that the defect liability period ended one year after the date of construction completion, as specified by the certificate of completion.[9] Therefore, it was decided to consider the project had completed one year after the date of the certificate of completion. In this project, civil works 1-5 in Table 1 are divided into eight contract packages so that the project was considered to have been completed when the defect liability period of the contract package seven was ended (May 8, 2017).

The major reasons for the delay were typhoons and monsoon rains, the interruption of civil works by outbursts of the closure dike built in Phase II, and requiring a long time for land acquisition and resettlement. Initially, cost overrun was expected from inflation (material prices soaring); therefore, civil works were implemented starting with high-priority areas or areas in which land acquisition and resettlement had been completed, and the scope that was initially abandoned because of cost overruns was included in this project when the remaining project cost was sufficient to cover the expenses for civil works.

[9] According to the project completion report and interviews during the field studies, the flowchart of DPWH procedures after the civil works were completed is as follows. 1) After completing the construction, the Quality Assurance Unit at DPWH headquarters would inspect whether construction had been carried out according to the plan and instructions at the time of contract. When it passed inspection, the Certificate of Completion was issued, and the one-year defect liability period started at the completion date. 2) DPWH Headquarters' Quality Assurance Unit examined whether all points mentioned as defects had been repaired and inspected whether there were defects in the constructed facility, and that materials etc. had been used as instructed at the time of contract. A Certificate of Acceptance was issued when a facility passed inspection. The construction contractor submitted a warranty bond issued by the bank that was valid for a year. 3) After the warranty period matured, the constructed facility was transferred to the regional office of DPWH-Region III, which is responsible for the operation and maintenance with a certificate of handover.

Table 4 Implementation Schedule (Plan and Actual)

	Plan	Actual
Consulting Services	January 2009 – July 2013	November 2008 – February 2016
Land acquisition and resettlement	November 2007 – October 2010	April 2008 – April 2015
Tender and contract	November 2009 – October 2010	February 2009 – December 2013
Civil works	November 2010 – July 2012	August 2009 – August 2016
1-year defect liability after the completion of civil works	August 2012 – July 2013	September 2016 – August 2017

Source: Documents provided by JICA, Ex-Ante Evaluation Report, Project Completion Report, Documents provided by DPWH

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

The economic internal rate of return (EIRR) at the time of appraisal was 25.1%.[10] This was calculated based on the estimated project life (35 years), the estimated cost of civil engineering work and operation and maintenance required for this project, and the estimated benefits are mitigated flood damage (properties, agricultural products, public infrastructure, and income losses) from this project in the target area.

At the time of ex-post evaluation, since detailed documents for the EIRR calculation (methods and conditions) were not found at the time of appraisal, the EIRR was recalculated using the EIRR calculation methods and conditions in the project completion report.[11] At the time of ex-post evaluation, the EIRR was calculated based on the estimated project life at 35 years, the costs (actual at the time of ex-post evaluation) and benefits (updated at the 2018 consumer price level), and the result was 34.23%. The difference between the EIRR at the time of appraisal and that at the time of the ex-post evaluation can be attributed to the rise in consumer price indicators.

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

[10] Documents provided by JICA

[11] Based on the F/S report for EIRR calculation. In the F/S report, EIRR were calculated separately for Phase III (The target area was only the Municipalities of Guagua, Lubao, and Sasmuan) and Phase IV (The target area was San Fernando City and its 15 neighboring municipalities.). Thus, this differs from the value of EIRR at the time of appraisal.

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

3.3.1 Effectiveness

3.3.1.1 Quantitative Effects (Operation and Effect Indicators) (Reference value)

In the F/S for this project, the estimated flood levels for this project (levels of flooding targeted for countermeasures) are assumed to occur once every 2–20 years. The target values of the operation and effect indicators are set as the inundation depth, inundation duration, affected the population and the amount of flood damage, among other factors, during the two-year return period and the 20-year return period. Therefore, measuring this project's quantitative effect based on the operation and effect indicators requires identifying the floods to be evaluated, evaluating the probability year for the floods to be evaluated (determining how often flooding will occur) (probability assessment), and estimating the inundation depth, inundation duration, affected population, and the amount of flood damage for the probability year before collecting data on the actual values. Then, calculations were made[13] after making the following adjustments.

First, when identifying what floods are to be evaluated, the requirements were that the floods in question occurred during the period after the civil works in this project had been substantially completed (February 2016[14]) until the ex-post evaluation[15] and were subject to conditions that the seven target LGUs in this project were affected by the flooding,[16] disaster damage reports were in place[17] and the flood was deemed independent.[18] It was decided to compare the actual values of a flood that occurred in August 2016 with the target values based on information from the executing agency and related organizations, and with advice from experts (Pampanga River Basin Flood Forecasting & Warning Center).

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

[13] Target values other than those for two-year and 20-year probability floods are not listed in related documents such as F/S reports.

[14] Based on the project completion report and interviews with the executing agency.

[15] According to the materials provided by the Pampanga Disaster Risk Reduction and Management Council, the frequency of floods that occurred in the seven target LGUs was once in 2016 (The inundation duration is 5-13 days, all seven LGUs affected), twice in 2017 (The inundation duration is 5-13 days in total, affected only Sasmuan municipality and San Fernando city), 15 times in 2018 (The inundation duration is 30-81 days in total, all seven LGUs affected).

[16] There are two sets of operation and effect indicators: one for the San Fernando area (City of San Fernando, Municipalities of Mexico, Santo Tomas, and San Simon) and the other for the areas closer to the river mouth (Municipalities of Guagua, Lubao, and Sasmuan). The target values for each area are the highest depth of flooding, the longest inundation duration, and the total amount of damage in the area, etc.

[17] In the case of small-scale floods, there are cases where reports have not been prepared and damage data are not available.

[18] The operation and effect indicators assume damage caused by a single flood. In reality, however, tropical depressions and low pressure areas continue, floods occur multiple times, and the inundation period is often prolonged. In such cases, the entire inundation period is combined into one damage report. (For example, the Pampanga Provincial Disaster Risk Reduction and Management Council made a report when there were six floods in the target area between July 9 and August 7, 2018. After the 30-day inundation period, the status of damage for 30 days was summarized in one report).

Next, the ex-post evaluator assessed the probability that the flood that occurred in August 2016 based on the probability assessment in this project's F/S. The F/S adopted the method of estimating the flood probability year based on the probable rainfall[19] for the five days before the flood occurred, so the ex-post evaluator compared the five-day (12–16 August 2016) rainfall measured at the San Fernando and Porac rainfall stations situated upstream of the target area with the rainfall table for each probability year written in the F/S report for the flood in August 2016. Thus, we were able to confirm that the rainfall equated to approximately the five-year probability rainfall (430 mm) and the August 2016 flood was therefore estimated as the five-year probability flood. Then, the target values for the five-year return period were estimated from the target values for the two-year return period and the 20-year return period.

However, as described in 2) Quantitative Effects of Effectiveness of 2.3 Constraints during the Evaluation Study, the target values of the indicators based on probability assessment (five-year probability floods) are approximate values, and the neutrality and reliability of the available data of the operation and effect indicators such as inundation depth, inundation duration, etc. are limited. For this reason, the target values (for five-year return period) and actual values are treated as reference values, and the results of measuring the quantitative effects based on these values are used as a reference for evaluation. As a result of interviews with the executing agency and related organizations, it was found that no agency had collected either the number of inundated houses or the duration; therefore, this indicator was excluded from the scope of this evaluation. "Affected population[20] and duration" means "number of residents in inundated houses, and inundation duration (of houses)." This indicator was also excluded since no data is collected for this indicator.

Based on the above, the baseline values, target values, and actual values of the operation and effect indicators in the Municipalities of Guagua, Lubao, and Sasmuan were summarized/estimated in Table 5. In the Municipalities of Guagua, Lubao, and Sasmuan, they were flooded over a wide area, the observed actual inundation depth (max) varied from 0.3 to 1.5 meters depending on the measurement point.[21] The actual

[19] A value that indicates how many times a certain phenomenon occurs on average is called "reproduction period," and precipitation that is considered to occur once in a certain reproduction period is called "probable precipitation." For example, at a location where the probability of precipitation with a recurrence period of 100 years is 200 mm, it means that heavy rain of 200 mm or more can occur once every 100 years on average.
[20] According to Pampanga Provincial Disaster Risk Reduction and Management Council, the definition of an "affected" population is "a group of persons who experience a destructive event, affected in a direct and indirect manner either in need or not needing assistance." (NDRRMC Operations Manual of 2016). In the definition, meaning of "affected" is not necessarily limited to "inundate."
[21] The average inundation depth (max) of Guagua, Lubao, and Sasmuan is 0.56 m (the average of 88 measurement points in 59 barangays).

inundation period (max) and the actual affected period (max) were six days, slightly exceeding the target value (five days). Meanwhile, the actual flood damage was 92 million pesos, which was significantly lower than the estimated value (1,327 million pesos).[22]

Table 5 Operation and Effect Indicators (Municipalities of Guagua, Lubao and Sasmuan)

Indicators	Bseline2002	Target 2015 2 Years After Completion	Actual (Reference) 2016 Completion Year*
Inundation depth (max) and duration (max)			
(2 years return period)	0.3-0.4 m / 9 days	0.1-0.2 m / 2 days	
(5 years return period) (Reference)		**0.3-0.48 m / 5 days**	**0.3-1.5 m / 6 days**
(20 years return period)	1.5-1.8 m / 45 days	0.6-0.9 m / 10 days	
Affected population and duration			
(2 years return period)	129,570 / 9 days	65,021 / 2 days	
(5 years return period)		**82,146 / 5 days**	**N.A.**
(20 years return period)	143,676 / 45days	108,053 / 10 days	
Flood damage (agricultural products, public infrastructure such as roads/bridges)			
(2 years return period)	3,598 million pesos	850 million pesos	
(5 years return period) (Reference)		**1,327 million pesos**	**92 million pesos**
(20 years return period)	6,534 million pesos	2,049 million pesos	
Annual maximum number of inundated houses and duration			
(2 years return period)			
(20 years return period)	24,214 / 9 days 26,835 / 45 days	12,418 / 2 days 20,293 / 10 days	N.A.

Source: Documents provided by JICA, Regional Disaster Risk Reduction and Management Council 3, "Memorandum for the Executive Director, NDRRMC & Administrator, OCD" dated on 26 August 2016, Pampanga Provincial Disaster Risk Reduction and Management Council, "Situational Report August 13-25, 2016."
Note*: Civil works are completed in 2016.

Table 6 shows the baseline values, target values, and actual values of the operation and effect indicators (the City of San Fernando, Municipalities of Mexico, Santo Tomas,

[22] The amount of flood damage (actual) is calculated based on estimates by the victims for agriculture and fish farming, and estimates by LGUs and government agencies for roads and bridges. According to interviews with the executing agency, related organizations, and target LGUs, farmers and fish pond managers are taking measures such as refraining from planting during times of frequent typhoons and moving fish to safer places, or there is a possibility that damages are not reported because it is not necessarily fully compensated even if the damage is reported.

and San Simon). In the City of San Fernando, Municipalities of Mexico, Santo Tomas, and San Simon, where flooding was widespread, the actual inundation depth (maximum value) varied from 0.3 to 1.5 meters depending on the measurement point.[23] The actual inundation period (max) and affected period (max) were 13 days, significantly exceeded the target value (1 day); however, the actual flood damage was 143 million pesos, which was significantly lower than the estimated value (639 million pesos).

Table 6 Operation and Effect Indicators (City of San Fernando, Municipalities of Mexico, Santo Tomas, and San Simon)

Indicators	Baseline 2005	Target 2015 2 Years After Completion	Actual (Reference) 2016 The Completion Year *
Inundation depth (max) and duration (max)			
(2 years return period)	0.1-0.4 m / 5 days	0-0.2 m / 1 day	
(5 years return period) (Reference)		**0.1-0.44 m / 1 day**	**0.3-1.5 m / 13 days**
(20 years return period)	0.6-1.6 m / 22 days	0.24-0.8 m / 1 day	
Affected population and duration			
(2 years return period)	180,590 / 5 days	90,624 / 1 day	
(5 years return period)		**114,534 / 1 day**	**N.A.**
(20 years return period)	200,251 / 22 days	150,600 /1 day	
Flood damage (agricultural products, public infrastructure such as roads/bridges)			
(2 years return period)	1,730 million pesos	410 million pesos	
(5 years return period) (Reference)		**639 million pesos**	**143 million pesos**
(20 years return period)	3,143 million pesos	986 million pesos	
Annual maximum number of inundated houses and duration			
(2 years return period)	30,233 / 5 days	15,168 / 1 day	N.A.
(20 years return period)	33,505 / 22 days	25,337 / 1 day	

Source: Regional Disaster Risk Reduction and Management Council 3, "Memorandum for the Executive Director, NDRRMC & Administrator, OCD" dated on 26 August 2016, PDRRMC Pampanga, "Situational Report, August 13-25, 2016.
Note*: Civil works are completed in 2016.

From the above, although the operation and effect indicators are treated as references, there are unachieved target values, and other quantitative data showing the same effect of

[23] The average inundation depth (max) of San Fernando, Mexico, Santo Tomas and San Simon is 0.66 m (the average of 48 measurement points in 41 barangays).

mitigating flood and inundation damage as the achievement of target values for operation and effect indicators could not be found.

3.3.1.2 Qualitative Effects (Other Effects)

A local drainage channel adjoining the project site, necessary to remove silting accumulated on the reverbed and plants on the river surface

As a result of interviews with the executing agency and related organizations, officials of the seven target LGUs, [24] and beneficiaries (residents residing in the vicinity of the project construction sites[25] and project affected families subject to relocation[26]), a number of positive evaluations were obtained, saying such things as: "Thanks to the project, rivers were dredged, excavated, and widened. Drainage channels were also dredged, excavated, widened, and newly constructed. Flooded water can be drained in a short time," "The flood affected areas became smaller than prior to the project, the depth of flooding became lower, and the flooding period became shorter," and "The project ensured accessibility to schools, public markets, etc., and the number of class suspension decreased, and positive changes were observed in the economic aspect."

On the other hand, although the effects of this project have been recognized, there are many drainage channels and waterways in the target area, including the Pampanga River and its tributaries, which are not covered by this project. In addition to volcanic ash, weeds and garbage have accumulated on the river beds and surfaces, causing poor drainage. Therefore, it was pointed out that these might be the cause of flooding.

[24] Semi-structured interviews were conducted, based on the questionnaires but allowing additional questions, in the seven target LGUs for the chief executives, engineers, development planning officers, natural resources and environment officers, disaster risk reduction and management officers, social welfare and development officers, and agricultural officers.

[25] During the site visits, semi-structured interviews were conducted for the residents residing in the vicinity (5 males and 11 females, 16 in total).

[26] During the resettlement site visits, semi-structured interviews were conducted for the relocated residents (7 males and 23 females, 30 in total).

3.3.2 Impacts

3.3.2.1 Intended Impacts

(1) Improving the living environment of local residents by reducing flood and flood damage

As described in 3.3.1.2, based on the result of interviews with the executing agency and related organizations, local officials of the seven target LGUs, beneficiaries (residents residing in the vicinity of the project sites and the project affected families forced to relocate), the flood damage has been reduced, the inundate period has been shortened, access to schools, public institutions, commercial facilities and financial institutions during the flooding has been ensured, and the living environments of local residents has been improved. The rivers and drainage channels became clean as a result of removing the large amount of volcanic ash accumulated on the river beds as well as grasses and solid wastes on the surface through dredging and excavation carried out in this project.

According to the Population Census in 2015, the total population of the seven target LGUs increased by about 15% from 750,000 at the time of the appraisal to 861,228. The population of Pampanga Province as a whole decreased from 1,532,615 in 1990 to 1,401,756 in 1995 after the eruption of Mt. Pinatubo. Later, lahar and flood control measures began to be effective, the population increased to 1,882,730 in 2000 and reached 2,610,000 in 2015. This indicates that the living environment after the eruption of Mt. Pinatubo has been continually improving.

(2) Development of investment environment by securing and improving transportation and logistics routes

The percentage of the gross regional domestic product of Region III to total GDP in the Philippines has also increased steadily from 8.9% in 2015, 9.0% in 2016, to 9.2% in 2017. According to interviews with the seven target LGUs and related organizations, large-scale shopping centers and hotels have been built in recent years, and branches of hospitals and banks have been established in the region. This project is considered to have contributed to improving business environments by reducing flood damage, shortening inundate duration, and securing transportation and logistics routes.

(3) Increasing awareness of disaster preparedness among local residents through education campaigns

In the Philippines, the Disaster Risk Reduction and Management Law was enacted in 2010, and the focus of the Philippine government’s disaster policy changed from support for victims and reconstruction after disasters to prevention

and preparedness before disasters. This project was implemented just at this time, and it is considered that the education campaigns for local residents and support for formulating community-based disaster risk reduction and management plans (including confirmation of evacuation routes in the event of flooding) , implemented as a component of the "Monitoring and Planning of Non-structural Measure and Institutional Capacity Building," contributed to the increase of awareness among local residents.

In interviews with residents residing in the vicinity of the project sites, it was confirmed that they fully understood the importance of daily monitoring of rivers and dikes by themselves, the necessity of river cleaning and plant removal, and the usefulness of raised roads and bridges as vertical evacuation routes.

3.3.2.2 Other Positive and Negative Impacts

(1) Land acquisition and resettlement

Pieces of Land owned by a family in San Fernand City were excluded from the scope of the project[27] because the land owners did not agree to sell the land even after the court's decision to confiscate the land. In addition, a catholic church in Lubao, which has been recognized as a historical building, did not agree on a project plan that would impair the appearance and landscape on the site (instead of raising the surrounding roads and bridges, installing a pump to remove flood water from the churchyard). Therefore the church compound was excluded from the scope of the project. Currently the church compound is lower than the surrounding area, and rainwater tends to accumulate in the churchyard. Based on the responses to questionnaires from and interviews with the executing agency, except for these two cases, there is no significant problem in the land acquisition, although it took longer than expected to close negotiations. Compensation for legal land owners has been completed.

Regarding the relocation of project affected families, a total of 514 households were relocated, including 384 households in San Fernando City, 33 households in Lubao Municipality, and 97 households in Guagua Municipality. A summary of resettlement is presented in Table 7. According to interviews with relocated residents, prior to their relocation, they lived along rivers with good access to public markets, fish ponds, and other workplaces although they did not have the legal right to lands or residences. Their houses were inundated for a long period of time due to high tides or typhoons, and they were forced to evacuate to higher grounds. Several years have passed since the relocation, and relocated residents have generally been adapted to the impact on livelihoods although

[27] DPWH will continue to negotiate with the land owners, and once the land is acquired, will implement this part of the project as planned with the government budget.

immediately after the relocation, in many cases, the burden of transportation costs became heavier because access to the original workplace became poor, it took time to find a new job near the resettlement site, and there were some households whose income got lower than before. Most relocated residents found that flood damage decreased and the living environment improved. According to interviews with the LGUs and the National Housing Agency, in San Fernando City and Guagua Municipality, it took a long time to convince the project affected families to relocate because the resettlement sites were far from their major workplaces, however, no major problem has been observed after once resettlement started.

Table 7 Outline of resettlement

LGU	Outline of resettlement
San Fernando	- 384 households resettled in 2010. - The relocation site was developed by the National Housing Authority for the affected households not only for this project but also for the other national projects such as railway construction projects. The land was secured in San Fernando City, houses were built and lent for 200-300 pesos per month. - 60% of the premises are residential, 40% are used by the LGU (public facilities, water, etc.), and the Department of Education (schools) for their respective purposes. - Staff of the National Housing Agency are stationed in the site, and livelihood programs are provided to residents by the Technical Education and Skills Development Authority (TESDA), etc. The women's group formed by the livelihood project as a component of the "Monitoring and Planning of Non-structural Measure and Institutional Capability Building" of this project continues to produce and sell handicrafts even at the time of ex-post evaluation.
Lubao	- 33 households resettled in November 2015 - As requested by the residents, the LGU provided the public land in the same barangay as before the relocation. Many residents built their homes using 10,000 pesos compensated by the LGU at the time of relocation. - A church and basket courts are developed by the town government.
Guagua	- Between 2011 and 2015, 97 households were relocated. - The National Housing Authority developed the site and built houses in Guagua. Houses have been rented for 200-300 pesos per month. - Affected households received 3,000 pesos each by the LGU as preparation/compensation for relocation. - TESDA Pampanga Office supported to implement livelihood training such as food processing, welding, dress-making, massage, and so on.

Source: Prepared by the evaluator based on interviews with relocated residents, LGU officials, and related organizations.

(2) Dissemination of design of road dikes and raised roads for the purpose of securing vertical evacuation and evacuation routes

The old road (Center in the photo) and the new road raised by the project（Upper left in the photo）

In this project, road dikes and raised roads were designed to secure vertical evacuation and evacuation routes in the event of flooding from the initial design stage. As a result of the F/S, it has been confirmed that it is difficult to completely eliminate floods in delta areas such as the target river basins. Therefore, from the viewpoint of how to mitigate flood damage, not only structural measures such as dikes and river excavation, but also non-structural measures focused on securing vertical evacuation and evacuation routes for residents, and ensuring the passage of emergency vehicles in the event of flooding were proposed in the project.

Prior to the implementation of this project, full-scale road elevation was not implemented in the target area. This is considered to be due to the fact that the inundation was observed in large scale, that the roads should be raised higher than those which can generally be dealt with (several dozen centimeters), and that construction of the drainage channel was also necessary with the raising of the road.

This project made it possible to systematically and continuously raise roads that required high raising over a long distance in total, and to construct drainage channel as well. As a result, the local projects followed after this project to raise roads on branch lines other than the main roads, resulting in the spillover effect of raising roads in the entire region as a whole.

(3) Negative effects on the environment and negative impacts

According to interviews with the executing agency and each LGU, and the joint monitoring reports, joint monitoring was conducted by the executing agency, related organizations, and the target LGUs during civil engineering works, and mitigating measures were taken as necessary. Negative effects on the environment and negative impacts were not observed.

As stated above, the quantitative effects were treated as a reference value because the neutrality and reliability of the actual value data of the operation and effect indicators were limited. No other quantitative data was available to clearly determine that the effects of mitigating flood and inundation damage were observed. The positive impacts confirmed in

this study are based on qualitative information, and it is difficult to say that all positive impacts were brought about by the project alone. Therefore effectiveness and impacts of the project are fair since certain effects have been observed.

3.4 Sustainability (Rating: ③)

3.4.1 Institutional / Organizational Aspect of Operation and Maintenance

Dredged and widened local drainage channel

Flood-control facilities such as raised roads, bridges, dikes, and local drainage channels constructed by this project have been handed over to the DPWH regional office of Region III and the district technical offices that have jurisdiction over the facilities have been in charge of operation and management. Thus, no particular problems have been found.

The major rivers and drainage channels dredged and excavated in this project are under the jurisdiction of DPWH, while San Fernando City is in charge of the operation and maintenance of the local drainage channels and waterways in the City. No particular problems have been observed.

3.4.2 Technical Aspect of Operation and Maintenance

In addition to specialists in roads, bridges, and flood-control facilities, specialists in dredging and excavation are assigned to the DPWH regional office of Regional III and district technical offices, and various training sessions are held annually for these technical staff. In July 2018, 43 participants joined training on road construction technology, and in August 2018, 43 participants joined training on building construction technology (no duplication with the participants in July 2018) for maintaining and improving the level of technical skills.

There is no major problem in the technical aspects of the operation and maintenance of the facilities constructed in this project.

3.4.3 Financial Aspect of Operation and Maintenance

DPWH is responsible for funding the operation and maintenance of the raised roads, bridges and the flood control facilities constructed, and the major rivers dredged and excavated in this project. The operation and maintenance budgets for flood control facilities constructed in Phases I, II, and III of this project are 70 million pesos in

FY2017, 70 million pesos in FY2018, and 50 million pesos in FY2019. According to the DPWH, even after the completion of Phases I, II, and III, civil works were implemented to strengthen or rehabilitate the flood control facilities constructed in these projects, and dredging and excavation of major rivers have been carried out. Two projects (total of 684 million pesos) in FY2016 and six projects (total of 1,836 million pesos) in FY2018 were launched, and some parts of these projects are still on-going.

After the project completion, San Fernando City continues to operate and maintain the drainage channels constructed in San Fernando and to dredge the San Fernando River within the scope of the city's budget. Table 8 shows the amounts and major budget items of the Local Disaster Risk Reduction and Management Fund of San Fernando City. In the City, civil works such as the raising of roads and construction of revetment slopes are implemented with the general development budget.

Table 8 Summary of the Disaster Risk Reduction and Management Fund of San Fernando City

	Budget amount (Unit: pesos)	Major budget items
2016	87,857,000	Dredging of rivers and drainage channels, construction of flood control facilities, purchase of equipment and medicine for disaster response, etc., construction of evacuation centers and emergency response centers, etc.
2017	90,000,000	
2018	78,571,000	

Source: Documents provided by San Fernando City

When large-scale repairs are required, the local chief executives may request funds from the DPWH regional office of Region III. DPWH regional office of Region III may request the DPWH headquarters to allocate an additional budget if the budget is insufficient. The total budgets for the DPWH increased to 397.1 billion pesos in FY2016, 467.7 billion pesos in FY2017, and 650.87 billion pesos in FY2018. Among these budgets, the construction, operation, and maintenance of flood control facilities increased to 64.2 billion pesos, 75.2 billion pesos, and 127.7 billion pesos, respectively. Therefore, there is no particular problem in the financial aspect.

3.4.4 Status of Operation and Maintenance

As a result of site visits in the seven target LGUs of this project, there are no problems in the status of operation and maintenance. In 2013, San Fernando City launched a river patrol team composed of community residents, monitoring rivers

and flood control facilities by boats,[28] and requesting community residents to remove solid wastes from local drainage channels and waterways. In this way, daily operation and maintenance activities have been carried out with a small budget, and no particular problem has been observed.

Meanwhile, it was revealed from interviews with the target LGUs that the operation and maintenance of tributaries and small-scale local drainage channels flowing into major rivers and drainage channels dredged and excavated in this project are major challenges for the municipalities with relatively small income although it is not within the scope of this project. If desilting of these tributaries and local drainage channels is not carried out continuously and properly, the drainage will become poor and cause flooding. The Pampanga Provincial Disaster Risk Reduction and Management Fund has also contributed budgets to repairing embankments and removing sediments from tributaries and local drainage channels. However, the financial supports from the Province are not sufficient,[29] and small LGUs highly expect assistance from the DPWH that has engineers and heavy equipment for dredging and excavation.

As stated above, no major problems have been observed in the institutional / Organizational, technical, financial aspects and current status of the operation and maintenance system. Therefore sustainability of the project effects is high. However, if tributaries flowing into rivers and drainage channels covered by this project are not properly maintained, the effects of this project may be hindered.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

In Central Luzon in the Philippines, after the eruption of Mt. Pinatubo, large amounts of volcanic ash have accumulated in rivers and drainage channels, causing flooding due to riverbed rises and channel closures. This project was implemented to mitigate flood and inundation damage in the target river basin through improving drainage channels, diversion channels, rivers, and roads, thereby securing logistics and improving hygiene in the environment.

[28] One of the patrol team members is a stonemason who can make simple repairs of the dikes.

[29] According to documents provided by the Pampanga Provincial Disaster Risk Reduction and Management Council, the amount of the Pampanga Provincial Disaster Risk Reduction and Management Fund is as follows: 132 million pesos (of which, 1.2 million pesos for desilting, 5 million pesos for the operation and maintenance of flood control facilities such as dikes) in FY 2017, 137 million pesos (of which, 1 million pesos for desilting) in FY 2018, 149 million pesos (of which, 1.5 million pesos for desilting, 1 million pesos for the operation and maintenance of flood control facilities such as dikes) in FY 2019.

This project is highly relevant to the Philippines' development policy, development needs, and Japan's ODA policy. Therefore, its relevance is high. The project period significantly exceeded the plan and the project cost was higher than planned as the civil works were suspended by typhoons and carried out in stages according to the progress of inflation (price increase of materials), land acquisition, and the resettlement of affected residents. Therefore, efficiency is low. Although it was impossible to assess the quantitative effects since the neutral and reliable data for the operation and effect indicators were not available in the target area, the effectiveness and impacts are fair because certain effects have been observed such as positive changes in the business environment due to securing and improving transportation and logistics routes through this project's implementation. In addition, regarding the operation and maintenance of the flood control facilities constructed through this project, no major problems have been observed in the institutional / organizational, technical, financial aspects and current status. Therefore, sustainability of the project effects is high. In light of the above, this project is evaluated to be partially satisfactory.

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

Strengthen the monitoring system for flood damage situations (Operation and Effect Indicators)

As a result of discussions among the executing agency, target LGUs, Office of Civil Defense-Region III, and the Pampanga River Basin Flood Forecasting and Warning Center under the Philippine Atmospheric, Geophysical and Astronomical Services Administration, on monitoring the flood damage situation (measured by the operation and effect indicators), the data of inundation depth and inundation period stated in the flood damage reports by the Regional Disaster Risk Reduction and Management Council and Pampanga Provincial Disaster Risk Reduction and Management Council were collected from each LGU, and each used different measurement locations for inundation depth, measurement methods and definitions of inundation duration; therefore, these data had limited neutrality and reliability.

It is recommended that the executing agency together with the Office of Civil Defense-Region III and the Pampanga River Basin Flood Forecasting and Warning Center should review the measurement methods and definitions of inundation depth and inundation duration in the flood damage reports and unify the standards for LGUs' measurement to monitor the flood damage situation more accurately and use the records for future flood control (for example, using the data to identify and prioritize the small and medium-sized rivers and drainage channels that require assistance for desilting).

4.2.2 Recommendations to JICA

None

4.3 Lessons Learned

Setting operation and effect indicators that can be collected by the executing agency

This project set operation and effect indicators that required probability evaluation. Therefore, it was first necessary to evaluate whether the flood that occurred in the target year was a "flood that occurs at a probability of once every set number of years." After estimating the target values, they were compared with the actual flood damage data and it was then necessary to measure the extent to which the data reached the values of the actual flood. However, the Weather Bureau in the Philippines had not reached the stage of analyzing and announcing whether precipitation was "rainfall that occurs at a probability of once every set number of years" based on the past records. Therefore, the executing agency needed to independently collect the necessary data, conduct a probability evaluation, and estimate target values. In addition, although it was preferable to measure neutral and highly reliable data, based on standard procedures, can be easily collected as actual data, in the target region, measurement locations of inundation depth, measurement methods, and definitions of inundation duration differ depending upon the local region, which makes obtaining this kind of data difficult. From these various constraints, the executing agency did not monitor the operation and effect indicators at the time of ex-post evaluation.

When setting the operation and effect indicators, after careful consideration between JICA and the executing agency, it is important to set indicators that can appropriately measure the project's effects based on the data that is relatively easily available. It might be a good idea to incorporate capacity-building training for the executing agency and any related organizations involved in monitoring the project's soft component activities and to design the project to strengthen the monitoring system as a part of the activities.

End

Comparison of the Original and Actual Scope of the Project

Items	Plan	Actual
1. Project Outputs		
Civil Works		
Excavation/dredging of local drainage channels, Construction of channel diversion	Excavation/dredging of local drainage channels (14.7 km), Construction of channel diversion 4.5km	Excavation/dredging of local drainage channels (7.2 km), Construction of channel diversion (3.3 km) [Additional works] Replacement of 2 bridges, Road raising (54.6 m)
Construction of diversion channel of lower Porac-Gumain River	Construction of channel diversion with dike (7.2 km), Construction of channel diversion without dike (11.5 km)	Construction of channel diversion with dike (7.67 km), Construction of channel diversion without dike (8.652 km) [Additional works] Construction of side channel (3 km), Construction of Engineer's Field Office, Planting of mangroves (30,000 sq. m)
Widening/dredging rivers (San Fernando River) and drainage channels in City of San Fernando	Dredging of rivers (16 km)	Dredging of rivers (14 km) [Additional works] Construction of cut-off channel (1.28 km), Construction of 5 bridges
Dredging of major rivers	Dredging of rivers (19.2 km)	Dredging of rivers (12.72 km) [Additional works] Restoration of 1 bridge, Construction of temporary closure dike, Construction of access road (700 m), Restoration of fishpond dike
Road/bridge raising, Construction of bridges	Road raising (16 km), Bridge raising (8 bridges), Construction of 5 bridges	Road raising (10.3 km), Construction of 6 bridges [Additional works] Construction of side drainage (2.09 km), Reinforced concrete box culverts and drainage outfalls
Consulting Services		
Part 1: Flood control works for Porac-Gumain River Basin	Detailed design, Assistance for tender process, Construction supervision, Assistance and monitoring works during construction	As planned
Part 2: Monitoring and planning of non-structural measure and institutional capacity building	Water management, Land use planning, Flood forecasting and warning system, Disaster preparedness and management, Institutional capability building	As planned
2. Project Period	November 2007- July 2013 (69 months)	November 2007- August 2017 (117 months)

3. Project Cost Amount Paid in Foreign Currency Amount Paid in Local Currency Total ODA Loan Portion Exchange Rate	4,429 million yen 6,425 million yen (2,763 million pesos) 10,854 million yen 7,604 million yen 1 peso = 2.33 yen (As of December 2006)	1,075 million yen 10,544 million yen (4,850 million pesos) 11,619 million yen 7,444 million yen 1 peso = 2.17 yen (Average between 2008 and 2015)
4. Final Disbursement	April 2015	