Ex-Post Project Evaluation 2019: Package Ⅱ - 7

(Cambodia, Jordan)

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Kingdom of Cambodia

FY2019 Ex-Post Evaluation of Japanese Grant Aid Project

"The Project for Expansion of National Maternal and Child Health Center"

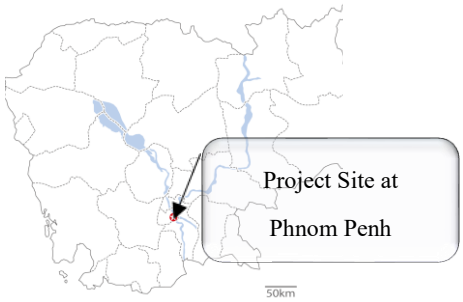
External Evaluator: SASAKI Atsushi, Katahira & Engineers International

0. Summary

The project was implemented aiming at expanding the training function and improving the quality of perinatal care at the National Maternal and Child Health Center, hereinafter referred as "NMCHC," by constructing a new training center, renovating the existing facilities and providing equipment, thereby contributing to enhancing its function as the top institution for maternal and child health care in Cambodia. The project has been highly consistent with the Cambodian development plan and needs which emphasize maternal and child health as one of the priority issues, and Japan's ODA policy. Therefore, the relevance of the project is high. In the course of its implementation, although the project cost was within the plan, the project period exceeded the plan. Therefore, the efficiency of the project is fair. With regard to the effectiveness, the project achieved in 2018 its quantitative targets for the year 2020 in each aspect of clinical function, inpatient ward and training function. Qualitative effects were found to improve the quality of emergency obstetric care and trainings. Positive impacts were also confirmed such as geographical ripple effects. Therefore, effectiveness and impacts of the project are high. As for the operation and maintenance, there are two kinds of equipment not utilized because the NMCHC selected to use a new external institution for these types of analysis to save on its operation cost, but the project related facilities and equipment are well maintained in general. 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.

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

1. Project Description



Project Location

NMCHC

(Left: Training Center)

1.1 Background

In Cambodia, a remarkable improvement of pregnancy-related mortality ratio per 100 thousand births has been achieved, from 437 in the year 2000 to 170 in the year 2014[1]. However, key indices of maternal and child health, hereinafter referred as "MCH," still needed further improvements when compared to the levels of neighboring countries at the time of the project planning. The NMCHC was constructed in 1997 by the Grant Aid of the Government of Japan as the top national institution for MCH. It provides three types of functions, i.e., clinical care, training and policy (secretariat for national MCH programs). With regard to the clinical care function of the NMCHC, perinatal care services at a higher level became necessary to cope with increasing high-risk patients, such as increasing number of surgical operations. As for the training function of the NMCHC, expansion of its facilities became urgent to provide appropriate trainings in line with increased and diversified needs for both pre-service and in-service trainings. Under such circumstances, the Government of Cambodia requested a Grant Aid to the Government of Japan for the improvement of the clinical and training function of the NMCHC.

1.2 Project Outline

The objective of this project is to expand the training function and to improve the quality of perinatal care at the NMCHC by constructing a new training center, renovating the existing facilities and providing equipment, thereby contributing to enhancing its function as the top institution for MCH in Cambodia.

Grant Limit / Actual Grant Amount	1,193 million yen / 1,091 million yen
Exchange of Notes Date / Grant Agreement Date	March 2014 / March 2014
Executing Agency	Ministry of Health, NMCHC
Project Completion	October 2016
Target Area	NMCHC at Phnom Penh
Main Contractors	Construction: Taisei Corporation Equipment: Mitsubishi Corporation
Main Consultants	Consortium of Nihon Sekkei, Inc. and Fujita Planning Co., Ltd.
Preparatory Survey	July 2013 – March 2014

[1] Source: Cambodia Demographic and Health Survey 2014

Related Projects	➢ "The Project for Construction of the National Maternal and Child Health Center," Grant Aid, Exchange of Notes in 1995 ➢ "Project on Promotion of Medical Equipment Management System," Technical Cooperation, Cooperation Period from Jan. 2006 to Dec. 2008 ➢ "Project for Improving Continuum of Care with focus on Intrapartum and Neonatal Care (IINeoC Project)," Technical Cooperation, Cooperation Period from May 2016 to May 2021

2. Outline of the Evaluation Study

2.1 External Evaluator

SASAKI Atsushi, Katahira & Engineers International

2.2 Duration of Evaluation Study

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

Duration of the Study: September 2019 – November 2020

Duration of the Field Study: December 1, 2019 – December 20, 2019,
March 2, 2020 – March 6, 2020

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

3.1 Relevance (Rating: ③[3])

3.1.1 Consistency with the Development Plan of Cambodia

At the time of planning, the Government of Cambodia emphasized the health sector as the priority issue in its *National Strategic Development Plan 2009‐2013*. In the *Health Strategic Plan 2008‐2015*, MCH was mentioned as one of the top priorities in the health sector. At the time of ex-post evaluation, health improvement was emphasized as the key basis for human resource development, both in the *Rectangular Strategy for Growth, Employment, Equity and Efficiency Phase IV 2019‐2023*, the supreme development strategy of the nation, and the *National Strategic Development Plan 2019‐2023,* formulated under the said Rectangular Strategy. In the *Third Health Strategic Plan 2016‐2020*, MCH was mentioned as one of the top priorities in the health sector. Therefore, the project has been consistent with the development plan of Cambodia throughout the periods of planning and ex-post evaluation.

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

3.1.2 Consistency with the Development Needs of Cambodia

With regard to the clinical care function of the NMCHC at the time of planning, perinatal care services at a higher level became necessary to cope with the increasing number of high-risk patients who are referred to the NMCHC under the strengthened referral system[4] of the country. As for its training function of the NMCHC, the expansion of the training facilities became urgent to provide appropriate trainings in line with diversified and increased training courses. At the time of ex-post evaluation, high level perinatal care services continue to be important to cope with high-risk patients, e.g., number of surgical operations in 2018 exceeds the 2020 target by 16% as described in detail in section 3.3.1.1(a). Training facilities continue to be important to meet increasing and diversifying training needs, e.g., number of trainees in 2018 exceeds the 2020 targets for pre-service training by 22% and for in-service training by 92%, respectively, as described in detail in section 3.3.1.1(c). From the above, the project is in line with the development needs of Cambodia's MCH services through the NMCHC both at the time of planning and ex-post evaluation.

3.1.3 Consistency with Japan's ODA Policy

The *Country Assistance Policy for Cambodia, April 2012*, of the Government of Japan included the "Promotion of Social Development" as one of the priority areas, where strengthening of health system was stated as a key program. Among the health sector support, MCH care was clearly indicated as a focus area. Therefore, the project was consistent with Japan's ODA policy at the time of planning.

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

3.2 Efficiency (Rating: ②)

3.2.1 Project Outputs

At the NMCHC, the project constructed a new training center, renovated the existing facilities and provided equipment. Table 1 shows details of the project outputs. It was confirmed through hearings and a field survey at the NMCHC that all the planned contents for each item of the project were fully implemented. As for the renovation works of the sewerage, in addition to the original plan to replace the damaged part of the septic tank, pumps were replaced because they were found to be broken before starting the renovation works. This replacement of broken pumps is considered to be a reasonable addition of works since it was necessary to restore the sewerage function for the existing main building.

[4] Referral system of the health sector means sending (referring) a patient to a higher-level institution from a lower-level institution which cannot properly treat that patient.

Table 1 Outputs of the Project

Item	Actual Outputs	Remarks
Construction of a New Training Center	➢ Four-story building with total area of 2,900 m^2 ➢ Training rooms: 40 seats x 1 room, 20 seats x 4 rooms ➢ Problem Based Learning Rooms[5]: 10 seats x 4 rooms ➢ Clinical Simulation Lab x 1 room ➢ Dormitory ➢ Management office, etc.	A new training center was constructed as planned.
Renovation of the Existing Facilities	➢ Renovation of South Wing 3rd floor and North Wing 2nd floor with total area of 1,754 m^2 ➢ Neonatal Care Unit[6] with 20 beds ➢ Intensive Care Unit[7] with 6 beds ➢ Recovery Room with 10 beds ➢ Kangaroo Care Room with 4 beds ➢ Inpatient ward rooms: 8-bed x 12 rooms, 4-bed x 6 rooms, 2-bed x 3 rooms, 1-bed x 8 rooms, Total 134 beds in 29 rooms ➢ Installation of stretcher elevators ➢ Replacement of damaged part of sewerage ➢ Replacement of broken part of incinerator	The existing facilities were renovated as planned. In addition, the pumps of the sewerage were replaced because they were found to be broken. Total number of ward beds is maintained at 134 while the share of 8-bed rooms was reduced by this renovation.
Medical and Training Equipment	42 kinds of equipment including the following major equipment: ➢ General X-ray Unit ➢ Mobile X-ray Unit ➢ Electrolyte Analyzer[8] ➢ Blood Gas Analyzer[9] ➢ CRP Analyzer for Micro Sample[10] ➢ Simulation Models for training	42 kinds of equipment were supplied as planned.
Outputs by the Cambodian side	Installation of general furniture, curtains and blinds at the new training center	Cambodian side also completed as planned.

Source: Questionnaire answers by the NMCHC

[5] Problem Based Learning (PBL) rooms are used for group discussions.
[6] Neonatal Care Unit, NCU, is a special facility for the intensive care of neonates.
[7] Intensive Care Unit, ICU, is a special facility for the intensive care of mothers.
[8] Blood analyzer for measuring electrolytes in specimen materials.
[9] Measures electrolyte and partial pressure of blood gas for diagnosis of newborn respiratory functions.
[10] Measures CRP reaction for diagnosis of infections.

3.2.2 Project Inputs

3.2.2.1 Project Cost

The project cost was planned to be 1,193 million yen on the Japanese side and 9 million yen on the Cambodian side. The actual cost born by the Cambodian side for furniture, curtains, etc., was not available because it was not recorded separately from the other routine expenditure of the NMCHC. Consequently, the project cost was evaluated by comparing the planned and actual cost born by the Japanese side. The actual cost by the Japanese side was 1,091 million yen, falling within the plan and accounting for 91% of the planned cost. The competition at the time of bidding resulted in a lower contract price than the original estimation, even after the contract amount increased around 2 million yen to cover the cost for replacing the sewerage pumps.

3.2.2.2 Project Period

The project period from the commencement of detailed design until the completion of civil works was planned to be 24 months, from April 2014 until March 2016. According to the NMCHC, start of tendering was delayed by four months to determine the details of the correction since a reinforcement bar mis-arrangement in the floor of the existing facility was found after starting the detailed design. In addition, construction work was suspended for three months until the determination of the countermeasures to reinforce the footing beam because of the insufficient bearing capacity of one of the piles caused by faulty construction. Due to the two factors mentioned above, total project period was delayed by seven months. As a result, the actual project period exceeded the plan and amounted to 31 months, from April 2014 until October 2016 (accounting for 129% of the planned period).

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

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

3.3.1 Effectiveness

3.3.1.1 Quantitative Effects (Operation and Effect Indicators)

At the time of planning, quantitative indicators with baseline and target figures were set for (a) clinical function, (b) inpatient ward and (c) training function, respectively. For the ex-post evaluation, some indicators are added and actual data after the completion year are analyzed. The targets were set for the year 2020 but the ex-post evaluation was conducted in fiscal year 2019 which is three years after the project completion.

(a) Quantitative effects for the clinical function

Table 2 shows quantitative indicators of the NMCHC perinatal care function comparing data for baselines, targets and actual figures.

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

Table 2 Clinical Function Indicators

	Baseline	Target	Actual		
	2010-2012 Average	2020	2016	2017	2018
		4 Years After Completion	Completion year	1 Year After Completion	2 Years After Completion
(1) Number of Operations (cases/year)	2,337	2,500	2,303	3,190	2,906
(2) Number of Neonates Treated at NCU (cases/year)	723	1,400	1,148	990	882
(3) Share of Neonates Treated at NCU out of Total Deliveries (%)	11	20	15	14	12
(4) Average Bed Occupancy Rate (BOR)[12] at NCU (%)	66 (2010-2011 average)	Max. 80	113	72	70

Source: Preparatory Survey Report, Questionnaire answers by the NMCHC

Note: The NMCHC revised its criteria to select neonates to be treated at NCU after 2017. Further details are described in the main text below.

The number of surgical operations in both 2017 and 2018 exceeded the target for the year 2020. Since the patients to undergo operations are high-risk patients, this indicator shows that the NMCHC continues to cope with increasing high-risk patients. As for the number of neonates treated at NCU and its share out of total deliveries, actual figures were below the targets because the NMCHC revised its criteria to select neonates to be treated at NCU after 2017. Until 2016, neonates of premature[13] delivery were all treated at NCU. Since it became possible to treat neonates of premature delivery without complications at the ward, the selection criteria of neonates were revised to reflect this improvement of the care system. The lowering indicators of neonates treated at NCU do not imply lowered needs to treat high-risk neonates but they reflect the above-mentioned revision of selection criteria. Therefore, figures below the targets are not considered to be negative signs in view of the project effects. The Bed Occupancy Rate, BOR, at NCU in 2016 was at a critical level of 113% with a possible risk of nosocomial infections. After 2017, it was improved to the proper level below the maximum target of 80% as a result of almost doubling the number of NCU beds from 11 to 20 by the project as well as due to the above-mentioned revision of criteria.

[12] Bed Occupancy Rate, BOR, is the percentage share of days a bed is occupied out of 365 days in a year.
[13] Deliveries before the 37th week of pregnancy.

(b) Quantitative effects for the inpatient ward

Table 3 shows quantitative indicators of the NMCHC's patient ward comparing data for baselines, targets and actual figures.

Table 3 Inpatient Ward Indicators

	Baseline	Target	Actual		
	2010-2012 Average	2020	2016	2017	2018
		4 Years After Completion	Completion Year	1 Year After Completion	2 Years After Completion
Bed Occupancy Rate, BOR (%)					
8-bed rooms	65	Max. 90	75	87	88
4-bed rooms	72	Max. 90	89	79	83
2-bed rooms	76	Max. 90	87	79	81
1-bed rooms	84	Max. 90	77	74	77
Number of poor[14] patients whose ward fee was covered by NMCHC or HEF[15] (persons/year)	818 (2011)	No target set	742	659	772
Amount of ward fee covered by NMCHC or HEF for the poor patients (thousand US$/year)	46.4 (2011)	No target set	57.2	53.0	84.6
Total amount of inpatient ward fee (thousand US$/year)	419.3 (2012)	502.6	932.5	1,074.9	1,348.3

Source: Preparatory Survey Report, Questionnaire answers by the NMCHC

Actual BOR figures in 2018 were in the range between 77% and 88% for all types of rooms from 8-bed to 1-bed. The ward rooms renovated by the project are, therefore, well utilized at a proper level below the maximum target of 90%. With regard to the ward fee support for poor patients, it was originally covered by the NMCHC's own budget at the time of planning but a new support scheme has been started since the system amendment of the national HEF in 2018. The

[14] Poor people are either the members of households identified as poor by the survey of the Ministry of Planning, effective for 3 years, or those who are identified as poor by the survey of a medical institution effective for 1 year.
[15] The Health Equity Fund, hereinafter referred as HEF, is a national grant scheme to support medical expenses of the poor people financed by a pool fund of the government budget and development partner contributions. The NMCHC started to receive HEF benefits after 2018.

inpatient ward fee for 772 poor patients in 2018, accounting for 94%[16] of the baseline of 818 patients in 2011, were covered by either the NMCHC's own budget or the HEF benefits. In terms of amount, it increased notably from the baseline of US$ 46.4 thousand in 2011 to US$ 84.6 thousand in 2018, reflecting the additional support from the HEF. These indicators show that the NMCHC is extending sufficient services for poor patients. The total amount of inpatient ward fee income of the NMCHC reached US$ 1,348.3 thousand in 2018, more than double of the target amount for 2020. This large increase was realized by the new medical insurance benefits from the National Social Security Fund, NSSF[17] added after 2017, in addition to the above mentioned HEF benefits for the poor.

(c) Quantitative effects for the training function

Table 4 shows quantitative indicators of the NMCHC training function comparing data for baselines, targets and actual figures.

Table 4 Training Function Indicators

	Baseline	Target	Actual		
	2011-2012 Average	2020	2016	2017	2018
		4 Years After Completion	Completion Year	1 Year After Completion	2 Years After Completion
Number of pre-service trainees (persons/year)	522	650	869	953	793
Number of in-service trainees (persons/year)					
Total	1,316	2,050	N.A.	N.A.	3,927
Excluding short-term workshops	463	788	N.A.	740	800
Available number of training room seats (seats)	80	120	120	120	120
Available number of PBL room seats (seats)	-	40	40	40	40

Source: Preparatory Survey Report, Questionnaire answers by the NMCHC

Actual number of trainees for pre-service students in 2018 was 793 persons, exceeding the 2020 target of 650 persons by 22%. Actual number of trainees for in-service medical doctors and

[16] The number of poor patients is not increasing although they do not need to pay their medical fees. According to the NMCHC explanations, poor patients feel it is a burden to pay transportation costs and worry about reduced income by taking a leave to go to a hospital. To cope with these situations, the government introduced a new scheme in 2019 to provide cash for poor mothers and children if they visit a medical institution for their scheduled check-ups.

[17] The National Social Security Fund, NSSF, managed under the Ministry of Labor and Vocational Training is a social security system which started accident compensation insurance for employees in 2008. The NSSF started its medical insurance nationwide from 2016, and the NMCHC became eligible to benefit from it after 2017.

midwives in 2018 was 3,927 persons, close to double the target of 2,050 persons and exceeding by 92%. Out of this total number of in-service trainees, actual number of trainees, excluding short-term (one day) workshops[18], in 2018 was 800 persons; exceeding the 2020 target of 788 persons. The number of available seats for both training rooms and PBL rooms are maintained as planned. The quantitative effects for trainings are achieved by number of trainees exceeding the plans for both pre-service and in-service trainings.

As explained in the above sections (a) through (c), the actual figures for the year 2018 exceeded the targets (or remained at a proper level less than the maximum figures) for the year 2020 in each aspect of clinical function, inpatient ward and training function. Therefore, quantitative effects of the project are achieved.

[18] Almost a half of the in-service trainings excluding short-term (one day) workshops is technical trainings for clinical services, and the remaining half is trainings on the contents of the national MCH programs. Short-term (one day) workshops include various activities for the national MCH programs such as development and revision of program guidelines, development of training materials and discussions with partners related such as donors and NGOs.

Patient Monitor used at the ICU

8-bed Room

Training Room used for an In-Service Training

Number of Daily Deliveries Displayed with Different Colors by Gender

[Box] Efforts by the Cambodian Government to Reduce the Patients' Burden for their Medical Expense

The Government of Cambodia has realized a series of efforts in recent years to reduce the patients' burden for their medical expense. The evaluator considers that these policy reforms have contributed as a good basis to improve the positive effects of the project. As previously mentioned in section 3.3.1.1(b), the NMCHC became eligible to receive benefits from the medical insurance of the NSSF after 2017. Poor patients do not need to pay their medical expense by themselves while the NMCHC started to receive benefits from the HEF to cover the medical cost for the poor patients after 2018. These schemes by the government ease the burden of patients for their medical expense and contribute to increasing the number of patients for the NMCHC while they also contribute to improving the financial status of the NMCHC by receiving benefits from these schemes. In addition, a new conditional cash transfer program has been started by the government in 2019 for the mothers and children of poor families to provide cash for scheduled check-ups during the period of pregnancy and children up to 2 years old. This new scheme will contribute to increasing the check-ups of poor families and it is expected to further improve key MCH indices in Cambodia.

3.3.1.2 Qualitative Effects (Other Effects)

At the time of planning, the project was expected to have qualitative effects on two aspects, i.e., (a) quality improvement of the emergency obstetric care for mothers and newborns of the poor families, and (b) quality improvement of pre-service and in-service trainings. In order to obtain information on these qualitative effects and impacts to be stated later in section 3.3.2, the evaluator conducted individual interviews with key informants of the project. The interviewees, 17 persons in total, consisted of 2 managements of the NMCHC (Deputy Director and Chief of Training Unit), Chief Advisor of the JICA technical cooperation "Project for Improving Continuum of Care with focus on Intrapartum and Neonatal Care (IINeoC Project)," 7 medical doctors and 7 midwives who were trained at the NMCHC.

(a) Quality improvement of the emergency obstetric and newborn care for the poor

According to the interviews with 14 doctors and midwives working at 4 hospitals, pregnant women from the poor families tend to have common problems such as malnutrition, unbalanced diet, unsanitary living environment, lack of knowledge on health and insufficient prenatal check-ups. These situations increase the risk of their deliveries to be associated with complications such as severe bleeding, convulsions and mother-to-child transmission. Therefore, the Emergency Obstetric and Newborn Care, hereinafter referred as "EMONC,"[19] is crucially important to manage the monitoring and treatment of emergencies based on a proper protocol for their deliveries and postpartum periods.

The project improved the environment to properly implement EMONC services for the deliveries with complications, common risk of patients from poor families, by expanding NCU/ICU which also contributes to controlling the risk of nosocomial infections, and by supplying medical equipment which was improved in terms of both quality and quantity. In addition, EMONC training courses has been continuously implemented utilizing the training center constructed by the project and the training equipment supplied by the project. Many of the interviewees mentioned that these EMONC training courses had positive effects to improve the knowledge and skills of not only the NMCHC staff but also many medical doctors and midwives in provinces thereby contributing to improving the quality of EMONC services which meet the risk characteristics of the patients from the poor families.

In sum, the project contributed to improving the quality of EMONC services which are necessary to properly manage deliveries associated with complications common to patients from the poor families, by expanding necessary facilities and equipment as well as training human resources for EMONC services.

[19] The NMCHC training course for midwives on the Basic EMONC includes 7 skills, i.e., (1) administration of antibiotics, (2) administration of uterotonic drugs, (3) administration of anticonvulsants, (4) manual removal of placenta, (5) removal of retained products, (6) assisted delivery and (7) neonatal resuscitation. The NMCHC training course for medical doctors on the Comprehensive EMONC includes, in addition to the above 7 skills, 2 more skills, i.e., (8) cesarean section operation and (9) blood transfusion.

(b) Quality improvement of pre-service and in-service trainings

In 2012 before the project, all the pre-service trainees were students of national universities. At the time of planning, the target trainees for pre-service training in 2020 was also planned to be the same. According to the actual 2018 data, after the project constructed the training center and the number of trainees was expanded, it became possible for the NMCHC to meet with diversifying needs of pre-service training by receiving many students from private universities.

With regard to the in-service training for medical doctors and midwives, number of participants for the EMONC Training-of-Trainers Course was 61 persons in 2018 exceeding the 2020 target of 48 persons which contributes to improving training capacities of the other institutions including those in provinces (further details on geographical ripple effects will be described later on the impacts in section 3.3.2). According to explanations by the NMCHC, this trend is in line with the government policy to decentralize the training function. This support by the NMCHC to decentralize EMONC trainings contribute to managing the risk factors common to the mothers and children from poor families as described in the above section (a). As for the short-term in-service activities such as one day workshops on national MCH programs, more than 3 thousand persons participated in 2018, far surpassing the 2020 target of 1,264 persons. According to explanations by the NMCHC, they include various activities, e.g., development and revision of national MCH program guidelines, development of training materials and strengthening the cooperation with partners related such as donors and NGOs.

With respect to facilities and equipment for trainings, PBL rooms for group discussion were newly constructed other than lecture rooms and simulator models were supplied for trainings of assisted delivery and resuscitation. Several midwife interviewees mentioned that group discussions at the PBL room after lectures and simulations using simulator models were effective to learn each skill for the emergency obstetric care in a practical manner.

In sum, the project contributed to improving the quality of both pre-service and in-service trainings at the NMCHC such as meeting with diversifying needs to receive students of private universities and also the needs to increase the Training-of-Trainers for provinces, strengthening cooperation with development partners through short-term workshops on national MCH programs, and utilizing training equipment supplied by the project for practical trainings.

3.3.2 Impacts

3.3.2.1 Intended Impacts

At the time of planning, there was no concrete item explicitly indicated as an impact. In view of the NMCHC's position as the top referral hospital and the new training center constructed as a main component of the project, the ex-post evaluation analyzed the following two aspects as impacts; (a) contributions as the top referral hospital for MCH by receiving increasing number of patients referred from the other medical institutions, and (b) contributions to improve MCH services in provinces with the expanded training function of the NMCHC.

(a) Contributions as the top referral hospital

As the top referral hospital for MCH, the NMCHC has been receiving patients who cannot be properly treated by the other medical institutions since the time before the project. According to explanations by the NMCHC, the project contributed to enhancing its function as the top referral hospital through the improved clinical function and inpatient environment owing to facilities and equipment developed by the project. The total number of inpatients at the NMCHC before the project was close to an average of 8.5 thousand persons/year during 2010-2012. It increased by 30% after the project completion year to around 11 thousand persons/year. Out of this increasing total inpatients, actual number of inpatients referred from other institutions has continued to increase every year since 2016, and the share of inpatients referred from other institutions out of total inpatients has also increased from 10% in the project completion year of 2016 to 13 % in 2018.

Table 5 Inpatients Referred from Other Institutions

	Baseline	Actual		
	2010-2012 Average	2016	2017	2018
		Completion Year	1 Year After Completion	2 Years After Completion
Total Number of Inpatients (persons/year)	8,490	11,230	10,851	11,322
Number of Inpatients Referred from Other Institutions (persons/year)	N.A.	1,074	1,303	1,485
Share of Inpatients Referred from Other Institutions (%)	N.A.	10	12	13

Source: Questionnaire answers by the NMCHC

Note: Baselines and targets were not set for the inpatients referred from outside at the time of planning.

(b) Contributions to improve maternal and child health services in provinces

With regard to the MCH services in provinces out of the capital city, many of the interviewed doctors and midwives mentioned that common problems were prevailing in the service supplier side such as limited medical facilities (e.g. no operating theater nor NCU), limited capacity of medical staff (e.g. cesarean section is possible but uterus operation is not possible) and lack of necessary systems (e.g. transfusion is not possible because a blood bank system is lacking). The interviewees also mentioned that common problems of pregnant women in provinces, particularly serious for those from poor families in remote areas, included malnutrition, unsanitary living environment, lack of knowledge on health and insufficient prenatal check-ups. While these problems of pregnant women in provinces are common to the problems of pregnant

women from the poor families in the capital city as already described in section 3.3.1.2(a), the limitations of the service supplier side are more serious in provinces.

According to hearings with several management members of the NMCHC, EMONC skills are most needed to deal with the above MCH situations in provinces. The NMCHC is contributing to improving human resources for health services in provinces through EMONC training courses where almost 90% of trainees participate from provinces. While the share of trainees from provinces has been constantly high even before the project, actual numbers of trainees from provinces have increased because the total number of trainees has increased after the project constructed the new training center building. The NMCHC is responsible for the assessment works[20] of provincial institutions to evaluate if they are capable of providing the essential EMONC services as a whole team, and six medical institutions were regarded as upgraded EMONC facilities after 2016. In line with the government policy to decentralize training functions to all provinces, the first training units were established to improve medical human resources nationwide at three provincial hospitals in the provinces of Kampong Cham, Battambang and Takeo. The NMCHC has been continuously supporting staff trainings and Training-of-Trainers for provincial hospitals and provincial health departments. The NMCHC is also currently implementing the JICA technical cooperation "Project for Improving Continuum of Care with focus on Intrapartum and Neonatal Care (IINeoC Project)" to support health professionals in the provinces of Kampong Cham and Svay Rieng. For the establishment of a new NCU at Svay Rieng provincial hospital in August 2018, related trainings were provided at the NMCHC. Through various activities mentioned above, the project has geographical ripple effects contributing to improving MCH services in provinces.

3.3.2.2 Other Positive and Negative Impacts

(a) Impacts on the Natural Environment

"JICA Guidelines for Environmental and Social Considerations" proclaimed in April 2010 is applied to the project and it is classified as a Category-C project. It was confirmed through hearings at the NMCHC and a field survey that wastewater from the main building was treated at the treatment plant repaired by the project and connected to the municipal sewerage system. Wastewater from the new training center building was also treated at the new treatment plant and connected to the municipal sewerage system. Wastewater was all connected to the municipal sewerage as planned without any other discharge. As for wastes from the NMCHC, medical waste was separated from general waste and incinerated at the incinerator whose parts were replaced by the project. General waste was collected by Phnom Penh municipality. Both wastewater and wastes were treated as planned and no specific negative impact on natural environment was observed.

[20] This assessment evaluates whether a medical institution is capable as an organization to implement EMONC services, in addition to personal skills of its staff for EMONC services.

(b) Resettlement and Land Acquisition

No resettlement nor land acquisition was necessary since the expansion project was implemented within the existing area.

This project has achieved its objectives. Therefore, effectiveness and impacts of the project are high.

3.4 Sustainability (Rating: ③)

3.4.1 Institutional/Organizational Aspect of Operation and Maintenance

At the time of ex-post evaluation, the NMCHC continues to be, as was the case at the time of planning, the top national institution for MCH and provides three types of functions, i.e., clinical care, training and policy.

Table 6 Staff Allocation of the NMCHC

(Unit: persons)

Department	Position/Specialty	Baseline 2013		Actual 2019	
		Permanent	Contract	Permanent	Contract
Director		1	-	1	-
Deputy Director		3	-	5	-
Technical Bureau	Medical Doctors	76	-	80	4
	Nurses	55	-	47	12
	Midwives	79	-	92	16
	Other technical staff	25	-	15	14
National MCH Programs	Director	5	-	2	-
	Administrative staff	63	29	41	7
Training Center	Chief of Center	-	-	-	-
	Administrative staff	3	-	7	1
Administration Bureau	Head of Department	1	-	1	-
	Administrative staff	10	88	7	62
	Internship/Leave	17	-	7	-
Accounting Bureau	Director	1	-	1	-
	Administrative staff	11	11	12	14
Total		350	128	318	130
		478		448	

Source: Preparatory Survey Report, Questionnaire answers by the NMCHC

Table 6 shows staff allocation of the NMCHC comparing allocations at the time of planning and ex-post evaluation. The NMCHC is operated by 448 staff including contract staff as of 2019. Total number of staff decreased from the baseline in 2013 reflecting the policy of the Ministry of Health in recent years to allocate newly employed staff in principle only to provincial medical institutions. The NMCHC is coping with this situation by streamlining the administration function while the number of technical staff such as medical doctors and midwives, as well as staff

allocated for NCU/ICU, has been secured and increased. Number of staff for the training center has also increased. According to explanations by the executing agency, total staff number has been agreed to slightly increase from the year 2020. Therefore, no major problems are observed in the institutional and organizational aspects of the operation and maintenance.

3.4.2 Technical Aspect of Operation and Maintenance

The project related facilities and equipment, except for some advanced equipment, are maintained by the Engineering/Medical Workshop of the NMCHC as planned. This workshop consists of 8 members, and 7 core engineering staff remain the same members since the time of planning while only 1 staff changed. They were trained in various occasions including the JICA technical cooperation "Project on Promotion of Medical Equipment Management System," and they sometimes instruct provincial institutions on technical maintenance. No major problems are observed in the technical aspect of the operation and maintenance.

3.4.3 Financial Aspect of Operation and Maintenance

Table 7 shows financial data of the NMCHC.

Table 7 Financial Data of the NMCHC

(Unit: US$ thousand)

	2012	2016	2017	2018
Government Budget	2,763	3,957	9,010	9,835
Medical Service User Fee	870	1,041	1,175	1,442
Others	13	15	13	6
Total Annual Income	3,646	5,013	10,197	11,283
Staff Salary, Drugs, etc.	3,261	4,646	9,601	10,798
Facility/Equipment Expenditure	391	304	552	345
Total Annual Expenditure	3,652	4,951	10,153	11,143

Source: Preparatory Survey Report, Questionnaire answers by the NMCHC

Note: Facility/Equipment Expenditure includes outsourcing cost for maintenance.
Totals may not be exact due to rounding.

Total annual income of the NMCHC increased mainly due to the substantial increase of government budget allocated for vaccines, etc., and total annual expenditure also increased within the increase of its income level. Therefore, financial status of the NMCHC is sound. Medical service user fee income also increased mainly by the new source of income from NSSF after 2017 as mentioned in section 3.3.1.1(b). The project renovated the inpatient ward and reduced the share of 8-bed rooms. This renovation of ward contributed to meeting the growing demand for ward rooms with smaller number of beds reflecting the improved national level of living standards, but

financial contributions by this renovation was limited in comparison to the contributions of increased income from the medical insurance. In sum, the financial position of the NMCHC is healthy and sound.

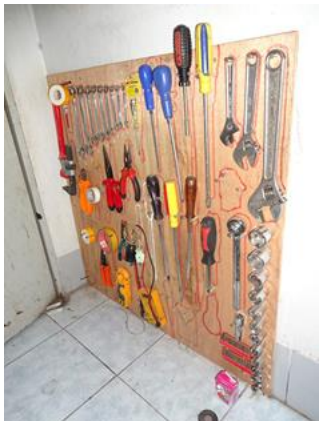
3.4.4 Status of Operation and Maintenance

Through hearings at the Engineering/Medical Workshop of the NMCHC and a field survey at related facilities, it was confirmed that maintenance equipment was stored well in order, and necessary documents such as manuals and ledgers were properly managed and utilized. Regular maintenance records were displayed at the walls of the power generator room and the transformer room. The project related facilities and equipment are generally well maintained.

At the time of final draft explanation of the JICA preparatory survey, it was agreed and recorded in the Minutes of Discussions that the Cambodian side would outsource periodical maintenance, in view of its technical level, through contracts with local agents for five of the total 42 kinds of equipment supplied by the project. The evaluator surveyed the current status and confirmed that following three kinds of equipment were properly utilized and maintained regularly by local agents based on the contract as planned: (a) General X-ray Unit, (b) Mobile X-ray Unit and (c) Electrolyte Analyzer. The original Electrolyte Analyzer was not utilized in the beginning because the equipment could not analyze small number of samples without showing an error result. After consulting with the agent, a new Electrolyte Analyzer applicable for only one sample was supplied in exchange and has been well utilized since then. The remaining two kinds of equipment, (d) Blood Gas Analyzer and (e) CRP Analyzer for Micro Sample, were not utilized and no contract was made for their maintenance. The operating cost including their reagents and special detergents after use were higher, at around US$ 30 per analysis, than outsourcing the same analysis to an external institution, 'Clinique Centrale,' at the cost of US$ 10‐15 per analysis. These two kinds of equipment are not utilized because of this operating cost difference compared with the external institution. According to hearings with several management members of the NMCHC, no external institution to outsource these analyses existed in Cambodia at the time of planning. Therefore, it is considered to be an unforeseeable change of situation. NMCHC management members had a concern if the external institution could continue its analysis in a timely manner at a low price, and they expressed their intention to continue searching for cheaper suppliers of consumables such as reagents so that those two kinds of equipment could resume to be utilized again. The NMCHC decided not to utilize them in view of their operation cost, and it is considered to be an unavoidable choice. The NMCHC is expected to continue its investigation searching for the other suppliers of consumables and their price regularly, and consider utilization of these two kinds of equipment again.

In sum, two kinds of equipment were not utilized because the NMCHC decided to outsource to an external institution in view of the cost for the analysis as an unavoidable choice, but the project related facilities and equipment are generally well maintained without problems.

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.



Maintenance equipment in good order

CRP Analyzer for Micro Sample (left) and Blood Gas Analyzer (right)

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

The project was implemented aiming at expanding the training function and improving the quality of perinatal care at the NMCHC by constructing a new training center, renovating the existing facilities and providing equipment, thereby contributing to enhancing its function as the top institution for maternal and child health care in Cambodia. The project has been highly consistent with the Cambodian development plan and needs which emphasize maternal and child health as one of the priority issues, and Japan's ODA policy. Therefore, the relevance of the project is high. In the course of its implementation, although the project cost was within the plan, the project period exceeded the plan. Therefore, the efficiency of the project is fair. With regard to the effectiveness, the project achieved in 2018 its quantitative targets for the year 2020 in each aspect of clinical function, inpatient ward and training function. Qualitative effects were found to improve the quality of emergency obstetric care and trainings. Positive impacts were also confirmed such as geographical ripple effects. Therefore, effectiveness and impacts of the project are high. As for the operation and maintenance, there are two kinds of equipment not utilized because the NMCHC selected to use a new external institution for these types of analysis to save on its operation cost, but the project related facilities and equipment are well maintained in general. 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.

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

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

Among various equipment supplied by the project, the Blood Gas Analyzer and CRP Analyzer for Micro Sample are not currently utilized. They are not utilized because the cost for the new choice to outsource the same analysis to an external institution became cheaper than the operating cost of the equipment such as the cost of reagents. This is considered to be an unavoidable choice under a change in the situation which was unforeseeable at the time of planning. The NMCHC managements have the intention to resume the utilization of the supplied equipment if possible.

Based on the above situation, the NMCHC is recommended to continue searching for suppliers of consumables for these two kinds of equipment and their price regularly, at least once a year. The result of this research should be compared with the price and speed of the analysis provided by the external institution as a basis of its consideration to resume utilization of the equipment. It is also necessary to keep the equipment in good condition for possible re-utilization.

4.2.2 Recommendations to JICA

The JICA technical cooperation “Project for Improving Continuum of Care with focus on Intrapartum and Neonatal Care (IINeoC Project)” is currently implemented as a related project at the NMCHC to improve MCH care through capacity building of health professionals in the provinces of Kampong Cham and Svay Rieng as mentioned in section 3.3.2.1(b) Intended Impacts. Japan also has been providing grant aid for the expansion projects of provincial hospitals in the same provinces.

In view of continuous cooperation between the two countries for MCH in these provinces, an evaluation analysis covering all the related projects, in addition to each ex-post evaluation on a project-by-project basis, may provide a good opportunity to obtain knowledge on comprehensive impacts or important lessons from such viewpoints as synergistic effects realized or missing components for further positive effects. JICA is, therefore, recommended to consider the possibility to conduct a comprehensive evaluation analysis covering the related projects after completion of the IINeoC Project.

4.3 Lessons Learned

None

Kingdom of Cambodia

FY2019 Ex-Post Evaluation of Japanese Grant Aid Project

"The Project for Expansion of Water Supply Systems in Kampong Cham and Battambang"

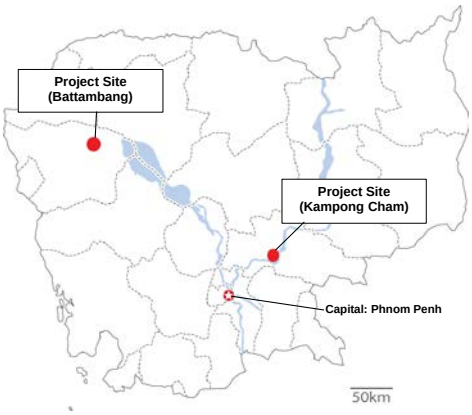
External Evaluator: Masumi Shimamura, Mitsubishi UFJ Research and Consulting Co., Ltd.

0. Summary

This project expanded water supply facilities in Kampong Cham City and Battambang City to improve access to safe water for residents of both Cities. This project, which aims to improve water supply capacity, is consistent with Cambodia's development policy, development needs and Japan's assistance policy at the time of planning and the ex-post evaluation. Therefore, the relevance of the project is high. In terms of project implementation, both the project cost and project period were within the plan. Therefore, efficiency of the project is high. As for project effects, quantitative indicators set at the time of planning are mostly achieved. As for qualitative effects, it was confirmed from the interviews with local residents that improvement of insufficient water volume and pressure from taps have realized and stable water supply has achieved. Regarding impacts, it can be considered that the project has contributed to the improvement of hygiene situation, promotion of employment of women and facilitation of school attendance of children, based on the interviews with local residents. In addition, this project has effectively collaborated with other donors' support and contributed to the promotion of water connections for poor households. Therefore, this project has mostly achieved its objectives and thus, effectiveness and impacts of the project are high. No negative impacts on natural environment and resettlement have been reported. Regarding operation and maintenance, 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 highly satisfactory.

1. Project Description



Project Location

Flocculation Basin (front) and Sedimentation Basin (back) (Kampong Cham)

1.1 Background

In Cambodia, after the civil war, with the support of Japan and other donors, development support of water supply facilities in the capital city of Phnom Penh and development support of human resources for operation and maintenance have been provided to improve water supply capacity. On the other hand, water supply capacity in local cities other than the capital was still low, and safe water supply to the entire population was not realized. In 2006, in Cambodia's local cities, Kampong Cham City and Battambang City, water supply facilities were expanded with the support of the Asian Development Bank (hereinafter referred to as "ADB"). In addition, in Kampong Cham City, the United Nations Human Settlement Program (hereinafter referred to as "UN-HABITAT") provided support for development of water distribution pipes. Furthermore, from 2007 to 2011, JICA implemented a technical cooperation project "The Project for Capacity Building for Water Supply System (Phase 2)" with the aim of improving capacity of the staff of the waterworks in 8 local cities including the both Cities. In this way, in Cambodia, both in terms of hard measures and soft measures, water supply capacity of local cities was being improved, however, there was an urgent need to expand water supply facilities to further improve water supply capacity.

1.2 Project Outline

The objective of this project is to improve access rate to safe water by expanding water supply facilities in Kampong Cham City and Battambang City, thereby contributing to the improvement of urban living environment of residents in both Cities.

Grant Limit/Actual Grant Amount	3,355 million yen/3,327 million yen
Exchange of Notes Date /Grant Agreement Date	June 2013/June 2013
Executing Agency	Ministry of Industry and Handicraft: MIH
Project Completion	June 2016
Target Area	Kampong Cham City and Battambang City
Main Contractors	Kubota Construction Co., Ltd.
Main Consultants	Nihon Suido Consultants Co., Ltd./Kitakyushu City Water and Sewer Bureau/CTI Engineering International Co., Ltd. (JV)
Preparatory Survey	May 2012 – March 2013
Related Projects	[Technical Cooperation] - The Project on Capacity Building for Water Supply System (Phase 1–3) (2003–2006, 2007–2011, 2012–2017) [ODA Loan] - Niroth Water Supply Project (March 2009–August 2014) [Grant Aid] - The Project for Replacement and Expansion of Water Distribution Systems in Provincial Capitals (2011–2013) [ADB] - Provincial Towns Improvement Project (2000–2006) [UN-HABITAT] - The Mekong Water and Sanitation Programme (2005–2015)

2. Outline of the Evaluation Study

2.1 External Evaluator

Masumi Shimamura, Mitsubishi UFJ Research and Consulting Co., Ltd.

2.2 Duration of Evaluation Study

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

Duration of the Study: September 2019–November 2020

Duration of the Field Study: December 1–20, 2019, March 2–12, 2020

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

3.1 Relevance (Rating: ③[2])

3.1.1 Consistency with the Development Plan of Cambodia

At the time of planning, Cambodian government's *the National Strategic Development Plan (2014–2018)* set out as one of priority development objectives to secure access to safe water. In addition, *the National Policy on Water Supply and Sanitation (February 2003),* which was valid at the time of planning clearly stated the policy of strengthening urban water supply in each province. Cambodian government has been developing water supply sector with the aim of ensuring that people receive safe water supply, have sanitation facilities, and enjoy safe, sanitary and environmentally-friendly living environment.

At the time of the ex-post evaluation, Cambodian Government's *the Rectangular Strategy Phase IV (2019–2023)* points out the importance of further investment in water supply infrastructure development and rehabilitation. Furthermore, *the National Strategic Development Plan (2019–2023)* states the target to realize 100% access to safe water in urban areas by 2025. Cambodian government also aims to provide affordable water supply services, ensuring quality, safety and sustainability. Thus, the implementation of the project is also consistent with the development policy of Cambodia at the time of the ex-post evaluation.

3.1.2 Consistency with the Development Needs of Cambodia

At the time of planning, quality of water supply service in local cities of Cambodia was low, and water supply rate was only 33%[3] (2008). Kampong Cham City (population of about 65,000) and Battambang City (population of about 145,000), which are the target Cities of the project, are the 4th and the 2nd most important cities in terms of population size, but water supply rates remained at about 32% and 31%,[4] respectively due to insufficient supply capacity of water treatment plants. Thus, development of water supply facilities was urgently needed.

At the time of the ex-post evaluation, stable supply of water continues to be essential for improving the living environment of residents. Population of Kampong Cham Province and Battambang Province in 2019 is 895,763 and 987,400, respectively.[5] The figures are much larger than the population served by Kampong Cham Waterworks and Battambang Waterworks which is 53,243 and 136,725, respectively in 2019.[6] In both provinces, expansion of water supply area by each Waterworks and increasing population with access to safe water continues to be an urgent issue, and for this purpose, it is necessary to further strengthen water supply

[1] A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory
[2] ③: High, ②: Fair, ①: Low
[3] Information from the materials provided by JICA.
[4] Ibid.
[5] Data from the General Population Census of the Kingdom of Cambodia 2019.
[6] Information from the materials provided by Kampong Cham Waterworks and Battambang Waterworks.

capacity of both Waterworks. From the above, the importance of the project is still maintained at the time of the ex-post evaluation.

3.1.3 Consistency with Japan's ODA Policy

At the time of planning, Project Development Plan (April 2012) of Japan's *Country Assistance Program for Cambodia* placed "development of water supply and sewage infrastructure" as one of the important development issues. In addition, *the Country Assistance Policy* (April 2012) stipulated to support development of water supply in major cities in the provinces with the aim of improving access to safe water based on the know-how of the Phnom Penh Water Supply Authority (hereinafter referred to as "PPWSA"), which has achieved a high level of operation and technology through Japan's support to water supply sector. In addition, JICA's *Country Analysis Paper* (March 2014) put up its policy that collaboration among ODA schemes will take place to contribute to the improvement of water services and realization of sound management of major waterworks in the provinces. The purpose of the project is to improve access rate to safe water by expanding water supply facilities in Kampong Cham City and Battambang City. The aim was to extend the PPWSA's successful cases to the local public waterworks, through collaboration with technical cooperation projects. All of these are in line with the above policy.

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

3.2 Efficiency (Rating: ③)

3.2.1 Project Outputs

This project expanded water supply facilities in Kampong Cham City and Battambang City to improve access rate to safe water for residents. Tables 1, 2 and 3 compare the planned and actual outputs of major outputs.

Table 1: Comparison of Major Planned and Actual Outputs (Construction of Facilities)

Plan		Actual/ Comparison
Item	Facility Scale	
Kampong Cham		
Intake Facility	12,650 m^3/day, Intake Pump: 4 sets	As planned
Conveyance Facility	Conveyance pipe length: 0.9 km	As planned
Treatment Facility	11,500 m^3/day, Rapid Sand Filtration	As planned
Transmission Facility	Transmission pipe length: 0.9 km	As planned
Distribution Facility	Distribution pipe network length: 57.8 km, Distribution Flow Monitoring System	Distribution pipe network length: 57.9 km
Battambang		
Intake Facility	24,200 m^3/day, Intake Pump: 3 sets	As planned
Conveyance Facility	Conveyance pipe length: 4.4 km	4.3 km
Treatment Facility	22,000 m^3/day, Rapid Sand Filtration	As planned
Distribution Facility	Distribution pipe network length: 65.5 km, Distribution Flow Monitoring System	Distribution pipe network length: 64.8 km

Source: Results from questionnaire survey of Kampong Cham Waterworks and Battambang Waterworks

Table 2: Comparison of Major Planned and Actual Outputs (Installation of Facilities)

Plan			Actual/ Comparison
Category	Item	Quantity	
Kampong Cham			
Equipment for Water Quality Analysis	Jar Tester	1 set	As planned
	Turbidity Continuous Measurement Equipment	1 set	As planned
	Residual Chlorine Analyzer	1 set	As planned
	Reagents	1 set	As planned
	Glassware	1 set	As planned
Tools for Mechanical Equipment	Vibration Checker	1 set	As planned
Equipment and Materials for Service Connections	Socket Fusion Equipment	1 set	As planned
	Materials and Equipment for Service Connections	2,529 sets	As planned
Battambang			
Equipment for Water Quality Analysis	Jar Tester	1 set	As planned
	Distillation Apparatus	1 set	As planned
	Turbidity Meter	1 set	As planned
	Turbidity Continuous Measurement Equipment	1 set	As planned

	Laboratory Table	1 set	As planned
	Residual Chlorine Analyzer	1 set	As planned
	Chlorine continuous measurement equipment	1 set	As planned
	Uninterruptible Power System (UPS)	1 set	As planned
	pH Meter (glass electrode)	1 set	As planned
	pH Meter (BTB)	1 set	As planned
	Reagents	1 set	As planned
	Glassware	1 set	As planned
Tools for Mechanical Equipment	Vibration Checker	1 set	As planned
Equipment and Materials for Service Connections	Socket Fusion Equipment	1 set	As planned
	Materials and Equipment for Service Connections	5,346 sets	As planned

Source: Results from questionnaire survey of Kampong Cham Waterworks and Battambang Waterworks

Table 3: Comparison of Major Planned and Actual Outputs (Consulting Services)

Item	Actual/ Comparison
Detailed design, tendering assistance, construction supervision	As planned
Capacity building program (Soft Component) • Operation and maintenance of treatment facility • Operation and Maintenance of transmission and distribution facility • Production management	As planned

Source: Results from questionnaire survey of Kampong Cham Waterworks and Battambang Waterworks

Regarding construction of facilities, there were some changes from the initial plan – changes in distribution pipe network length in Kampong Cham and conveyance pipe length and distribution pipe network length in Battambang took place. Change in distribution pipe network length in Kampong Cham was due to the modification of construction section by the other donor (UN-HABITAT). Reduced length of conveyance pipe in Battambang was due to reexamination of underground buried materials along the conveyance pipe route, and reduced distribution pipe network length in Battambang was due to the progress of development by Battambang Waterworks. All of these modifications have taken place to correspond to changes in various conditions after the preparatory survey and are considered appropriate.

Regarding installation of facilities and consulting services, it was confirmed through interviews with the Ministry of Industry and Handicraft (hereinafter referred to as “MIH”), which is the executing agency, and the project consultants that they have been implemented as

planned.

Among the items to be borne by the Cambodian side, as for the “connection of water pipes to each house and procurement and installation of water meters,” as a result of interviews with both Waterworks in Kampong Cham and Battambang, the progress is as follows at the time of the ex-post evaluation. As for Kampong Cham Waterworks, of the 2,529 sets of water supply materials provided, 2,339 sets (92%) have been installed, and for Battambang Waterworks, installation of all 5,346 sets has been completed in April 2018. The reason why it is taking time to connect to each house in Kampong Cham is that Kampong Cham Waterworks is securing construction budget, taking into consideration water revenue (commercial feasibility), etc. The newly connected households of the Waterworks originally used well water and rainwater, and the volume of water consumption is less compared to the existing connected households. In addition, there are households which do not connect even if water pipes are installed up to the front of their houses, because connection fee and other charges (initial cost) are required. Kampong Cham Waterworks is proceeding with construction work, while ensuring commercial feasibility, taking into account these situations. While it is taking time to connect to each house, it is expected that the installation will be completed by the end of 2020 through securing planned budget. As a result of interviews with the MIH, it was confirmed that other tasks to be undertaken by the Cambodian side (land acquisition and leveling of water treatment plant site, obtaining permission of water intake from the river, drawing in electricity to new water intake plants and water treatment plants, etc.) have been duly implemented without any problems.

Intake Pump
(Kampong Cham)

Operation Room of Intake Pump and Generation Room (Exterior of the Building)
(Kampong Cham)

Chemical Feeding Facility (Kampong Cham)

Sedimentation Basin and Administration Building (Battambang)

Transmission Pump and Distribution Pump (Battambang)

Pump Station Control Room (Battambang)

3.2.2 Project Inputs

3.2.2.1 Project Cost

The project cost was planned to be 3,355 million yen on the Japanese side and 38 million yen on the Cambodian side. Of which, the actual cost born by the Cambodian side for connection of water pipes and installation of water meters to each house, drawing in electricity to the new water intake and the water treatment facilities, etc., was not available because it was not recorded separately from the other routine expenditure of the Waterworks. Consequently, the project cost was evaluated by comparing the planned and actual cost born by the Japanese side. The actual cost by the Japanese side was 3,327 million yen, falling within the plan and accounting for 99% of the planned cost.

3.2.2.2 Project Period

While the overall project period was planned as 36 months – from July 2013 (at the start

of detailed design) to June 2016 (completion of construction), the actual period was 35 months – from August 2013 (at the start of detailed design) to June 2016 (completion of construction), which is within the plan (97% of the initial plan). Table 4 summarizes the comparison of planned and actual project period.

Table 4: Comparison of Planned and Actual Project Period

Plan	Actual
July 2013–June 2016 (36 months)	August 2013–June 2016 (35 months)
Breakdown: Detailed Design and Tendering Period	
July 2013–March 2014 (9 months)	August 2013–April 2014 (9 months)
Breakdown: Construction and Procurement Period	
April 2014–June 2016 (27 months)	June 2014–June 2016 (25 months)

Source: Information provided by JICA and results from questionnaire survey of the MIH

Note 1) The definition of project initiation is at the start of detailed design and the definition of project completion is at the time of completion of construction. Project period does not include warranty period for both plan and actual.

Both the project cost and project period were within the plan. Therefore, efficiency of the project is high.

3.3 Effectiveness and Impacts[7] (Rating: ③)

3.3.1 Effectiveness

3.3.1.1 Quantitative Effects (Operation and Effect Indicators)

At the time of planning, "served population," "daily average water supply volume," "service ratio," and "number of service connection" were set as quantitative effects of the project. Table 5 summarizes baseline, target and actual figures between 2017 and 2019 for each indicator. As the project completion is June 2016, the target year to be compared is 2019, 3 years after completion. The target achievement rates are shown in parentheses in the table.

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

Table 5: Quantitative Effects of the Project

Indicators	Baseline	Target	Actual		
	2011	2019 3 Years After Completion	2017 1 Year After Completion	2018 2 Years After Completion	2019 3 Years After Completion
Kampong Cham Note 1)					
Served Population (person)	21,571	58,719	39,302	45,027	53,243 (91%)
Daily Average Water Supply Volume (m^3/day) Note 2)	5,155	13,500	9,208	9,943	11,606 (86%)
Service Ratio (%) Note 3)	32.8	84.8	45.11	51.56	61.11 (72%)
Number of Service Connections	4,499	12,248	9,140	10,464	12,382 (101%)
Battambang Note 4)					
Served Population (person)	45,377	126,696	101,485	119,600	136,990 (108%)
Daily Average Water Supply Volume (m^3/day) Note 5)	8,132	27,518	17,884	21,124	24,946 (91%)
Service Ratio (%) Note 6)	31.1	84.8	44.46	47.10	56.79 (67%)
Number of Service Connections	9,065	25,310	20,297	23,920	27,398 (108%)
Reference (Non-revenue water) Note 7)					
Kampong Cham	—	—	7.21%	6.58%	6.00%
Battambang	—	—	10.56%	8.39%	8.07%

Source: Information provided by JICA and results from questionnaire survey of Kampong Cham Waterworks and Battambang Waterworks

Note 1) Water supply area of Kampong Cham Waterworks includes the support areas of the ADB and the UN-HABITAT. At the time of planning, 4 communes were covered, but at the time of the ex-post evaluation, water supply area was expanded to 8 communes.

Note 2) Daily average water supply volume (m^3/day) is the volume derived by dividing the annual water supply of each Waterworks by 365. For reference, water supply volume on the peak day of each year is 11,017 m^3 (June 24, 2017), 10,514 m^3 (April 23, 2018) and 12,765 m^3 (May 25, 2019).

Note 3) Service ratio (%) = number of people receiving water from each Waterworks/population within each Waterworks' service area. At the time of planning, figures were for 4 communes, but the actual figure is the service ratio for 8 communes. For reference, service ratios for the original 4 communes were 88.53% (2017), 96.29% (2018), and 97.83% (2019).

Note 4) Water supply area of Battambang Waterworks includes the ADB's support area. At the time of planning, 10 communes

were covered, but at the time of the ex-post evaluation, water supply area was expanded to 17 communes.

Note 5) Daily average water supply volume (m^3/day) is the volume derived by dividing the annual water supply of each Waterworks by 365. For reference, water supply volume on the peak day of each year is 24,688 m^3 (November 17, 2017), 29,749 m^3 (April 24, 2018) and 35,521 m^3 (April 23, 2019).

Note 6) Service ratio (%) = number of people receiving water from each Waterworks/population within each Waterworks' service area. At the time of planning, figures were for 10 communes, but the actual figure is the service ratio for 17 communes. For reference, service ratios for the original 10 communes were 55.45% (2017), 60.79% (2018) and 68.99% (2019).

Note 7) Non-revenue water rates are shown as reference figures.

The actual figures of each indicator set at the time of planning have increased year after year since the project was completed for both Kampong Cham and Battambang. Looking at the actual figures in 2019, "Served populations" are 53,243 people and 136,990 people in Kampong Cham and Battambang respectively, and the target achievement rates are 91% and 108%, respectively. "Daily average water supply volumes" are 11,606 m^3 and 24,946 m^3 for Kampong Cham and Battambang respectively, and the target achievement rates are 86% and 91%, respectively. "Service ratios" are 61.11% and 56.79% for Kampong Cham and Battambang, respectively, and the target achievement rates are 72% and 67%, respectively, and "number of service connections" are 12,382 and 27,398 for Kampong Cham and Battambang, respectively, and the target achievement rates are 101% and 108%, respectively.

The target achievement rates of "Service ratio" are lower than the achievement rates of other indicators because water supply areas of both Kampong Cham and Battambang are expanding. (As shown in note 1 and note 4 of Table 5, water supply area of Kampong Cham has expanded from 4 communes to 8 communes and that of Battambang has expanded from 10 communes to 17 communes.) In other words, service ratios declined because population within each water supply area by the Waterworks which is the denominator has increased. According to the project consultant, expansion of the water supply area was not considered when setting the target figures for service ratio. For reference, the actual service ratio in 2019 for the original 4 communes in Kampong Cham is 97.83%, which is 115% of the target, and the actual service ratio in 2019 for the original 10 communes in Battambang is 68.99%, which is 81% of the target.

With regard to "Number of service connections," it can be said that water supply connection work for each house at both Waterworks is progressing as expected, as both Kampong Cham and Battambang have achieved their targets.

While "Number of service connections" has achieved the target, "Daily average water supply volumes" for both Kampong Cham and Battambang are slightly below the targets.

This is because people in Kampong Cham consumed less water than expected per each household. According to Kampong Cham Waterworks, there are households which use water from other sources (well water, rainwater, etc.) to save water bills during the rainy season. As regards Battambang, it is thought that production capacity is almost full. According to Battambang Waterworks, although there are intake facilities developed by the ADB in 2007 in addition to the intake facilities constructed under this project, it is said that further production would be difficult due to the decrease in pumping capacity because of deterioration of the ADB facilities. In addition to this, the decrease in pumping capacity in the dry season due to the decrease in the water volume of the Sangke River as the water source is also causing difficulty to produce more. In fact, it has been pointed out that demand volume may exceed water supply volume within 2020. In response to this, Battambang Waterworks is expecting to secure new water sources from the multipurpose dam that is being developed with the support of the Korea Export-Import Bank. Battambang Waterworks is also expecting early construction and completion of water treatment facilities and other facilities by the ADB project[8] that is currently underway.

Regarding non-revenue water rates shown as reference figures, the actual figures for both Kampong Cham and Battambang are decreasing, and they are 6.00% and 8.07%, respectively, in 2019. This indicates that their operational status of water supply business is very excellent.

3.3.1.2 Qualitative Effects (Other Effects)

As qualitative effects of the project, “Improvement of insufficient water volume and pressure from taps” and “Provision of stable water supply” were expected.

(1) Kampong Cham

According to Kampong Cham Waterworks, water pressure was low (water supply pressure was less than 1 bar[9]) and water volume was not sufficient before the project, but at the time of the ex-post evaluation, water pressure for the additional 4 communes is 1 bar to 2.5 bar, and for the original 4 communes is 3 bar to 5 bar. In addition, before the project, it was not a 24-hour water supply, and stable water supply was not possible, however after the project, 24-hour water supply is realized in a stable manner.

Furthermore, as a result of conducting interview survey with 11 local residents[10] during

[8] Provincial Water Supply and Sanitation Project (scheduled for 2018 – 2023). Water supply capacity of 50,000 m^3/day and expansion of water pipes of 120 km are planned. According to the MIH and the ADB, consultants were selected in December 2019 and consulting services have initiated.

[9] The power to push water up to a height of 10 m.

[10] The interviewees consisted of 4 men (2 in 40s, 1 in 50s, and 1 in 60s) and 7 women (2 in 30s, 1 in 40s, 3 in 60s, and 1 in 70s). Interviews were conducted to the following 4 categories of residents.

the project site inspection, it was confirmed that water volume and water pressure are sufficient after the project, and the insufficient conditions before the project were resolved. It was also confirmed that stable water supply has realized 24 hours a day, 365 days a year. When asked why the unconnected residents do not connect, one respondent said that because she is using well water and rainwater. She also pointed out that while water tariff of the Waterworks is reasonable, the initial cost required for connection is high (connection fees: 292,400 Riel (about USD 73), deposit: 37,800 Riel (about USD 9), and thus she has not connected. The other respondent is a vegetable farmer who does not have a stable monthly income and cannot pay monthly water tariff to the Waterworks. Therefore, she mentioned that she is using a family-owned well water in the neighborhood, which is expensive, but can delay payment until she can earn income during the harvest season.

(2) Battambang

According to Battambang Waterworks, water volume and water pressure were not sufficient before the project, but at the time of the ex-post evaluation, the water pressure became 2 bar. In addition, before the project, it was not a 24-hour water supply, and stable water supply was not possible, but after the project, 24-hour water supply was realized in a stable manner.

Furthermore, as a result of conducting interview survey with 12 local residents[11] during the project site inspection, it was confirmed that water volume and water pressure are sufficient after the project, and the insufficient conditions before the project were resolved. It was also confirmed that stable water supply has realized 24 hours a day, 365 days a year. When asked why the unconnected residents do not connect, one respondent said that she is using well water in the garden, and the wells are still operating without problems, thus she has not connected to the water pipe. In addition, 1 resident pointed out that she is not connected because the initial cost at the time of connection is high. Another resident

- Residents who have been connected to the water pipe before the project and can compare the differences before and after the project. (2 people: 1 man in his 60s and 1 man in his 40s.)
- Residents who have newly connected to the water pipe after the project. (2 people: 1 woman in her 30s and 1 woman in her 60s.)
- Target residents of the connection support system for the poor. (5 people: 1 man in 40s, 1 man in 50s, 1 woman in 40s, 1 woman in 60s and 1 woman in 70s.)
- Residents who are unconnected. (2 people: 1 woman in her 30s and 1 woman in her 60s.)

[11] The interviewees consisted of 4 men (1 in 40s, 1 in 50s, and 2 in 60s) and 8 women (1 in 30s, 1 in 40s, 3 in 50s, and 3 in 60s). As same as Kampong Cham, interviews were conducted to the following 4 categories of residents.

- Residents who have been connected to the water pipe before the project and can compare the differences before and after the project. (2 people: 1 man in his 60s and 1 woman in her 50s.)
- Residents who have newly connected to the water pipe after the project. (4 people: 1 man in his 40s, 1 man in his 60s, 1 woman in her 30s and 1 women in her 60s.)
- Target residents of the connection support system for the poor. (3 people: 1 man in his 50s and 2 women in their 50s.)
- Residents who are unconnected. (3 people: 1 woman in her 40s and 2 women in their 60s.)

responded that she was absent for a long time at the time of construction of water pipe and did not know the procedures for connecting to the water pipe.

From the above, it is considered that the indicators of quantitative and qualitative effects set at the time of planning have mostly achieved.

3.3.2 Impacts

3.3.2.1 Intended Impacts

As impacts of this project, state of generation of "Improvement of hygiene condition" and "Facilitation of female employment and children's school attendance" were evaluated.

(1) Improvement of Hygiene Condition

According to both Kampong Cham Waterworks and Battambang Waterworks, residents are taking more showers and doing more laundries because of the clean tap water supplied by the project. In addition, it was pointed out that public schools are also connected to tap water after the project, and 1) hand-washing areas are established with school budget and hand-washing environment has improved (if it were still using well water, surrounding areas would be all wet and unsanitary) and 2) because toilets became clean, more children use them at school without putting up (originally, toilet water was from rivers and wells and was unsanitary, so many children used to put up with toilets).

In addition, results of interviews with local residents[12] indicated that hygiene condition of residents has improved after the project. In addition to the above pointed out by the Waterworks (increase in the number of showers and washing), there were also responses that residents can now properly wash vegetables when cooking and thus they are using more water. Residents also pointed out that they can use tap water at ease since it is clean and thus, they are drinking the water without boiling. On the other hand, no residents pointed out changes in their physical conditions regarding incidence of water-borne diseases such as diarrhea, typhoid fever, and dysentery before and after the project.

(2) Facilitation of Female Employment and Children's School Attendance

As a result of interviews with local residents,[13] it was confirmed that employment of women and children's school attendance have been promoted after the project. Specifically, there were following responses. "By connecting to water supply and saving time to fetch water, women can go to the market to sell crops, and children can go to school for a whole day (rather than half a day) as well as to cram schools. (Before connecting to water supply,

[12] The interviewees are the same residents listed in footnotes 10 and 11.
[13] Same as the above.

they could only go to school for almost always half a day when there was a school.)," "As fetching water became unnecessary, the resident can now do more housework and child-raising.," "Before connecting to water supply, a resident was worried about safety because her children also went to the river to fetch water, but after connecting to water supply, she can take care of children and do field work by using the saved time for fetching water.," "After connecting to water supply, the resident's life became more convenient, and can devote time to work at the shop as well as do more housework."

From the above, it is considered that impact indicators have been largely achieved.

3.3.2.2 Other Positive and Negative Impacts

(1) Impacts on the Natural Environment

This project does not fall under a large-scale project in water supply sector stipulated in the *JICA Guidelines for Confirmation of Environmental and Social Considerations* (promulgated in April 2010), and undesirable effects on environment were judged not to be serious. In addition, the project does not fall in the area of sensitive characteristics and sensitive areas. Therefore, the project was classified as Category B. According to the MIH, an Initial Environmental Impact Assessment (IEIA) has been prepared and submitted to the Ministry of the Environment and the IEIA was approved by the Ministry of the Environment in 2013. Both Kampong Cham and Battambang Waterworks have explained to the local residents prior to project construction and explained that environmental burden during construction would be avoided as much as possible.

According to both Kampong Cham and Battambang Waterworks, and the project consultants, environmental monitoring during the project implementation has been carried out based on the environmental monitoring plan, and monitoring of air, water quality, waste, noise, and vibration has been carried out once a month, and bad odors once a week. No major problems such as exceeding the standard have been reported. In addition, according to both Waterworks, as environmental mitigation measures, consideration was made during construction based on the environmental management plan such as avoiding construction at night (Construction hours were 7–11:30 am and 1–5 pm. Noise-free construction was until 10 pm.), and the material transportation trucks were used after cleaning tires with water before using them, and their load capacity was also properly complied with. Furthermore, after water services are in place, sludge produced by the water treatment process has been dried and then buried in the lagoon within each Waterworks' premises to manage it. As a result, no negative impacts on natural environment have been reported and no complaints have been pointed out from local residents. From the interviews with both

Waterworks and local residents, as well as from the results of site survey, no major problem with respect to natural environment has been identified.

(2) Resettlement and Land Acquisition

According to both Kampong Cham and Battambang Waterworks, land acquisition and resettlement did not take place.

(3) Other Impacts

At the time of planning, "Cooperation with other donors" and "Promotion of water supply connection of poor households" were expected as other impacts of the project. The state of generation of these impacts is as follows.

1) Cooperation with Other Donors

In Kampong Cham, coordination with the ADB project[14] (2004–2006) and the UN-HABITAT project[15] (2011–2013) and in Battambang, coordination with the ADB project[16] (2003–2007) has taken place, generating synergetic effects.

In Kampong Cham, the ADB and the UN-HABITAT projects conducted water supply development using well water as the water source. On the other hand, this project did not use well water, but the Mekong River as the water source to expand the service area. In Battambang, this project aimed to respond to increased demand in light of deterioration of facilities developed by the ADB project and the increase of population. It should be noted that each donor has conducted the project based on the support of previous donors and there was no overlap of support. Different types of water pipes were used by different donors, but they had compatible specifications. In addition, in the soft component (capacity building such as operation and maintenance of water distribution facilities, production management, etc.) of the project, comprehensive support was provided, taking into account previous donor support and projects conducted by both Kampong Cham and Battambang Waterworks themselves.

2) Promotion of Water Supply Connection of Poor Households

It was confirmed that both Kampong Cham and Battambang Waterworks are promoting water supply connection of poor households. Tables 6 and 7 show trends in the number of new connections for the poor households for each Waterworks.

[14] The ADB supported the improvement of water treatment system for wells and the development of water pipes for 20 km along the main road.
[15] The UN-HABITAT developed water pipes in the form of expanding the ADB project. It also provided support for the introduction of preferential treatment as a measure to promote water supply connection for the poor.
[16] The ADB supported the development of water intake facilities and water treatment plants in the Sangke River.

Table 6: Number of New Connections to the Poor Households for Kampong Cham Waterworks

	ID Poor 1	ID Poor 2
2017	98	135
2018	27	72
2019	3	7
Total	128	214

Source: Results from questionnaire survey of Kampong Cham Waterworks

Note 1) The evaluation criteria for poverty categories 1 and 2 are based on (1) house material (palm leaf, galvanized iron, wood), and (2) the source of income. The staff of the Waterworks actually visits the house and makes a decision in consultation with the target person. The village chief makes approval at the end.

Note 2) The number of new connections is decreasing year by year, as explained above, because the Waterworks is developing water distribution pipes while considering commercial feasibility, and thus it seems to take time to connect to each house. Also, the number of connections is smaller than that of Battambang Waterworks, because of the difference in population size.

Table 7: Number of New Connections to the Poor Households for Battambang Waterworks

	Number of connections of ID Poor
2016	1,600
2017	2,068
2018	1,678
2019	1,728
Total	7,074

Source: Results from questionnaire survey of Battambang Waterworks

Note 1) There is no category under ID poor. Regarding judgment of the poor, as with Kampong Cham Waterworks, the staff of Battambang Waterworks actually visits the house and makes a decision in consultation with the target person. The village chief makes approval at the end.

Kampong Cham Waterworks has introduced preferential treatment for the poor for the exemption from connection fee payment or reduction of burden as a measure to promote water supply connection to poor households.[17] This is because the revolving

[17] Regarding the initial cost required for water supply connection, the preferential treatment for the poor in Kampong Cham is as follows. (There is no change according to length of intake pipe and diameter of water pipe. Because the poor people use less water, water pipe diameter is the smallest figure of 15 mm.)

- Connection fee (with preferential treatment): Free for those who are in poverty category 1. Targets of Category 2 will be charged 57,000 Riel (approximately USD 14), but interest-free and installment payments are possible.
- Deposit (same rate as other users, but interest-free and installment payments are possible): 37,800 Riel

fund[18] introduced by the UN-HABITAT in its past support (Urban Poverty Reduction Project) has been successful, and the fund is still functioning. Both Kampong Cham and Battambang Waterworks allow the poor to make payments of initial costs (connection fee and deposit) without interest and with installments. In addition, in Kampong Cham, resident information meetings to explain to local residents are held 8–10 times a year to promote water supply connection regardless of the poor. As mentioned in "3.3.1.2 Qualitative Effects (Other Effects)," there are still residents who are using water from other water sources (well water, rainwater, etc.), and some residents do not feel the need to pay the initial cost and water bill to connect to water supply. For this reason, Kampong Cham Waterworks disseminates the importance of use of safe and hygienic tap water to unconnected families and carries out enlightened activities.

ID Poor of poor residents and water supply contracts with Kampong Cham Waterworks

Tables 8 and 9 show the water connection fees and deposits in ordinary cases. The same fee system is used for Kampong Cham and Battambang. According to both Waterworks, connection fee is charged only for the cost of construction, and no profit is generated.

(approximately USD 9) for both poverty categories 1 and 2.
In Battambang, connection fee and deposit required for water supply connection are charged the same amount as other users to the poor, but the poor can make interest-free and installment payments.

- Connection fee: 292,400 Riel (approximately USD 73).
- Deposit: 37,800 Riel (approximately USD 9).

[18] The UN-HABITAT has set up a revolving fund to provide urban poor to access to clean water supply at affordable prices. Specifically, funds to support the community infrastructure of the urban poor are operated as revolving fund, and the repayment funds are used to supplement water supply connection costs for the poor in Kampong Cham. In Battambang, support from the UN-HABITAT is not provided, and there is no preferential treatment like the case of Kampong Cham.

Table 8: Water Connection Fee (Kampong Cham and Battambang)

Unit: Riel

Length of water intake pipe from the main pipe to each household (m)	Diameter of water pipe (mm)				
	15	20	25	30	40
0–10	292,400	533,820	633,600	1,091,100	1,548,600
11–20	350,000	579,100	678,600	1,161,900	1,645,200
21–30	421,600	624,500	723,600	1,232,700	1,741,800
31–40	499,400	669,800	769,200	1,304,100	1,839,000
41–50	576,700	714,700	814,200	1,374,900	1,935,600

Source: Information provided by Kampong Cham Waterworks (MIH Ministerial Decree 140/2016) and information provided by Battambang Waterworks (MIH Ministerial Decree 258/2017)

Table 9: Deposit (Same Fee System for Both Waterworks)

Unit: Riel

	Diameter of water pipe (mm)				
	15	20	25	30	40
Fee	37,800	118,100	165,400	318,900	472,500

Source: Information provided by Kampong Cham Waterworks (MIH Ministerial Decree 140/2016) and information provided by Battambang Waterworks (MIH Ministerial Decree 258/2017)

This project has mostly achieved its objectives. Therefore, effectiveness and impacts of the project are high.

3.4 Sustainability (Rating: ③)

3.4.1 Institutional/Organizational Aspect of Operation and Maintenance

The operation and maintenance of the project after completion is undertaken by Kampong Cham Waterworks and Battambang Waterworks under the supervision of the MIH and the Department of Industry and Handicraft (hereinafter referred to as “DIH”), which is the branch organizations of Kampong Cham Province and Battambang Province.

At the time of the ex-post evaluation, there are 51 staff members in Kampong Cham Waterworks, and headed by the Director, personnel are assigned to Business Section, Production Section, Network Section, Accounting Section and Personnel Section. There are 102 staff members in Battambang Waterworks, and headed by the Director, personnel are assigned to Business Section, Production and Supply Section, Network and Service Section, Planning/Accounting/Finance Section and Management/Personnel Section. Table 10 shows

the technical sections in charge of operation and maintenance of the project, work contents, and the number of staff assigned. It is considered that the number of staff is adequately secured when taking into account the scale of facilities of each Waterworks.

Table 10: Technical Sections in Charge of Operation and Maintenance of the Project, Work Contents and the Number of Staff

Kampong Cham Waterworks (Number of staff members)	Battambang Waterworks (Number of staff members)	Work Contents
Business Section (18)	Business Section (31)	Responsible for sales to individual customers, water supply connection and management of individual households, meter reading and billing for each house, meter maintenance, etc.
Production Section (20)	Production and Supply Section (22)	Responsible for on-site management/monitoring work 24 hours a day, such as operation management of water intake pump facilities and water treatment facilities, and water quality testing, and responsible for identifying and responding to problems before they occur.
Network Section (7)	Network and Service Section (26)	Responsible for leakage inspection and repair of main water distribution pipes, connection of new water pipes, renewal and maintenance of old water pipes, etc. (Various efforts are being made to reduce non-revenue water rate.)

Source: Results from questionnaire survey of Kampong Cham Waterworks and Battambang Waterworks

The MIH, the DIH, Kampong Cham Waterworks and Battambang Waterworks are constantly in communication and close collaboration system is in place. (Each Waterworks reports to the MIH and the DIH every month, and the reporting sessions are held every six months at the MIH.) In addition, decision-making process and authority are clear and no problems have been observed. As regards securing budget for operation and maintenance as well as recruitment of staff, each Waterworks makes application to the MIH through the DIH and then budget allocation and personnel recruitment are carried out after approval from the MIH.

As mentioned before in “3.3.1.1 Quantitative Effects (Operation and Effect Indicators),” non-revenue water rates of both Waterworks are decreasing, and the actual figures in 2019 are

6.00% for Kampong Cham Waterworks and 8.07% for Battambang Waterworks, and they are maintaining very excellent operating conditions. In order to reduce non-revenue water rate, both Waterworks: 1) established a 24-hour hotline for customers and set up a system which can respond in a timely manner when problems occur, including night time, 2) conduct periodical water leak monitoring, and established a system to prevent problems, 3) replace old water pipes, 4) strengthen capacity of staff in charge of operation and maintenance (carry out various trainings within each Waterworks to accumulate knowledge and experiences so as to respond promptly in the field), and 5) procure and use equipment with good quality and longer service life, and aiming for further operational improvement.

From the above, no particular problem has been identified regarding the institutional/organizational aspect of operation and maintenance of the project.

3.4.2 Technical Aspect of Operation and Maintenance

There is no qualification for waterworks operators in Cambodia, and at both Waterworks, there is no qualification holders for the operation and maintenance staff in the field (electrical machinery, machinery, engineering, IT, etc.) with the exception of one civil engineer, who is the Production Section Manager of the Kampong Cham Waterworks. However, staff in charge of operation and maintenance of both Waterworks have accumulated necessary experiences and knowledge through the soft component of this project, training by the JICA technical cooperation projects, “The Project on Capacity Building for Urban Water Supply System in Cambodia (Phase 2, 3)” (see Box 1), as well as guidance through on-the-job-training. Thus, they are at a sufficient level to carry out daily operation and maintenance work.

In the soft component of the project, training and technology transfer regarding operation and maintenance of water treatment plant, operation and maintenance of water distribution facilities, and production management were carried out by the project consultant, Kitakyushu City Water and Sewer Bureau. In addition to Kitakyushu City staff, PPWSA staff members participated in the training as instructors.[19] Participants of the training were all technical staff in charge of operation and maintenance in both Kampong Cham and Battambang Waterworks,

[19] PPWSA has strengthened its capacity through receiving technology transfer from Kitakyushu City Water and Sewer Bureau related to water supply business operation and maintenance, and now PPWSA staff is in a position to provide technical guidance to local waterworks as trainers. In short, PPWSA is rolling out its own success stories to local public waterworks. During the time when the former PPWSA Director Ek Sonn Chan, who realized the reconstruction of water supply business through PPWSA reform, was the head of the MIH (2014‐2016), support for local public waterworks was bolstered. Technology transfer by PPWSA is considered that these efforts are still being passed down. At the time, Ek Sonn Chan called that training as “Provincial Tour” and visited local public waterworks with the staff of the MIH, PPWSA and Kitakyushu City to diagnose their management and operation and maintenance situation and to instruct immediate action. He gave guidance and supervised them to achieve tangible results. (“Provincial Tour” was conducted as part of JICA technical cooperation project, “The Project for Capacity Building for Water Supply System (Phase 3),”) As a result, local public waterworks have improved their management and strengthened their capacities, which have also contributed significantly to strengthen the foundation of operation and maintenance of this project.

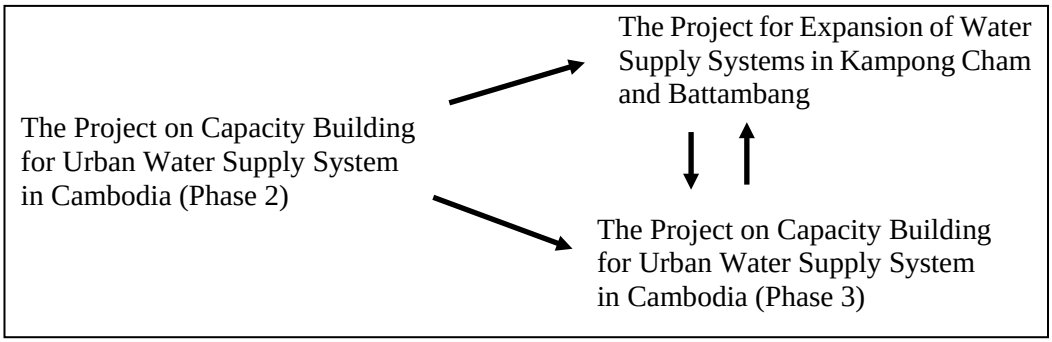
and they received lectures and hands-on training. Trainings were conducted in Khmer, and some of the handouts were in English and some in Khmer, and there were no language problems. In addition, some lectures were given by the staff of PPWSA, as the staff of Kitakyushu City explained, and the staff of PPWSA made interpretation. Trainings were conducted after clarifying the definitions of technical terms and various indicators in advance and confirming that there was no discrepancies in recognition between the parties concerned. According to the MIH and both Waterworks, the staff of Kitakyushu City may have had a two-way learning – transferring technology to the staff of Waterworks and learning the context of water supply business in local cities of Cambodia.

Regarding the content of the training, according to the trainees in Kampong Cham Waterworks, they were able to fully understand since the trainings were consistent with the needs in the field and the level of staff, and that they continue to utilize that knowledge in their daily work. According to the trainees in Battambang Waterworks, some staff pointed out that although the trainings were very useful, the level was high and that they could not fully understand without basic knowledge, especially with regard to electrical machinery and machinery related matters. At the time of the ex-post evaluation, none of the trainees from both Waterworks have resigned. Contents of the trainings have also been shared to and utilized by other staff and newly hired staff after the project. In addition, the operation manuals prepared under the soft component are always available in the field for both Waterworks and are referred to and utilized in their daily operations. Battambang Waterworks revises and updates the operation manuals according to the actual situation in the field.

[BOX 1: Effective Coordination with JICA Technical Cooperation Projects]

This project has effectively collaborated with the JICA technical cooperation project, "The Project on Capacity Building for Urban Water Supply System in Cambodia (Phase 2, 3)," and provided consistent technology transfer to the staff in the field in charge of operation and maintenance of both Waterworks.

In the technical cooperation projects, trainings were conducted for 8 public waterworks,[20] including both Waterworks. The Phase 2 (2007–2011) project provided support to strengthen operation and maintenance capacity of water facilities, and the phase 3 (2012–2017) project provided support to strengthen operation and management capacities of water utilities. This project was implemented based on the lessons learned and recommendations obtained in the Phase 2 project, and the soft component of this project was followed up in the Phase 3 project. In other words, close information exchange between this project and the technical cooperation projects took place, and effective collaboration was realized. Kitakyushu City staff participated in all of these projects as experts and were handed over among those staff who participated in each project and consistent guidance was provided. According to the trainees from both Waterworks, this project was implemented after the Phase 2 project, and follow-up and after care were provided in the soft component of this project, which has enabled to deepen their understanding and gave them confidence.



Through the field survey, it was confirmed that all staff of both Waterworks are striving to improve efficiency of their daily work in order to enhance daily access to safe water for residents, improve water services, and reduce non-revenue water rate as well as to respond promptly when problems occur. They are working enthusiastically with pride.

[20] Waterworks in Siem Reap, Battambang, Kampot, Kampong Cham, Sihanoukville, Kompong Thom, Pursat and Svay Rieng. In Phase 1 project (2003-2006), support for strengthening operation and maintenance capacity of water supply facilities was provided for PPWSA.

From the above, staff members in charge of operation and maintenance have accumulated achievements and results based on the knowledge and technology acquired through the support so far and have sufficient technical capacity to carry out usual operation and maintenance work. Thus, there seems to be no particular problem.

3.4.3 Financial Aspect of Operation and Maintenance

As regards operation and maintenance costs of the project, the necessary amounts are estimated by both Kampong Cham and Battambang Waterworks, and the budget request will be made to the MIH via the DIH of each supervising province where it is scrutinized. Then, after the approval by the MIH, the budget will be allocated to both Waterworks. Tables 11 and 12 show the budget (requested amount), actual allocation and actual expenditure of operation and maintenance costs of each Waterworks. In both Waterworks, it is difficult to divide only the operation and maintenance cost of this project and show the amount, so the operation and maintenance cost of each Waterworks including this project is shown. Necessary operation and maintenance costs have been secured, and no problems have been observed at the time of the ex-post evaluation.

Table 11: Operation and Maintenance Cost for Kampong Cham Waterworks

(Unit: million Riel)

	2016	2017	2018	2019
Budget (requested amount)	271.1	326.7	337.9	498.9
Actual allocation	271.1	326.7	337.9	498.9
Actual expenditure	237.6	320.4	263.9	459.3

Source: Results from questionnaire survey of Kampong Cham Waterworks

Note 1) Personnel costs are not included in the operation and maintenance costs.

Note 2) Actual expenditure is less than the actual allocation due to good maintenance of facilities and equipment – replacement of spare parts, etc. has become unnecessary at the time indicated at the initial plan, and the costs were saved accordingly.

Table 12: Operation and Maintenance Cost for Battambang Waterworks

(Unit: million Riel)

	2016	2017	2018	2019
Budget (requested amount)	836.9	1,231.5	2,060.3	1,758.8
Actual allocation	753.9	1,071.0	2,036.2	1,685.6
Actual expenditure	746.3	722.3	1,982.3	919.2

Source: Results from questionnaire survey of Battambang Waterworks

Note 1) Personnel costs are not included in the operation and maintenance costs.

Note 2) The budget for 2018 has increased significantly due to the renewal of old water pipes. The budget for the following 2019 has decreased in light of the progress of the renewal work.
Note 3) The actual expenditure in 2019 is far below the actual allocation due to delays (time lag) in procurement procedures.

Tables 13 and 14 show the water tariff revenue of each Waterworks. When comparing the actual operation and maintenance costs in Tables 11 and 12 above, the costs are fully covered by the water tariff revenue.

Table 13: Water Tariff Revenue of Kampong Cham Waterworks

(Unit: million Riel)

2016	2017	2018	2019
3,275.9	4,467.7	4,745.6	5,362.3

Source: Results from questionnaire survey of Kampong Cham Waterworks

Table 14: Water Tariff Revenue of Battambang Waterworks

(Unit: million Riel)

2016	2017	2018	2019
7,926.3	10,236.7	11,763.5	16,889.3

Source: Results from questionnaire survey of Battambang Waterworks

According to both Kampong Cham and Battambang Waterworks, water tariff collection rate is almost 100%. Water tariff payment is made at the counter set on the 1st floor of each Waterworks building, and bank transfer is also possible for public institutions. When asked the Waterworks about the reasons why there was almost no uncollectable water tariff, following explanation was made: (1) Water tariff is affordable (many households make payment within the range of 10,000 to 20,000 Riel (about USD 2.5 to USD 5) per month), (2) residents are highly conscious (behind that, there is a stable supply of sanitary water 24 hours a day, 365 days a year, and the residents are satisfied with the water services), (3) water tariff collection system has been established (in case of payment delay, Waterworks staff will visit the target resident 3 times. If there is no payment for three months or more, water supply will be suspended.)

Tables 15 and 16 show the water tariff system of each Waterworks. Water tariffs are stipulated in the Ministerial Decrees, and the tariff has been revised in 2016 by Kampong Cham Waterworks and in 2017 by Battambang Waterworks. In this project, the necessity of appropriate tariff setting was addressed, and the revision of actual tariffs is said to be a

pervasive effect of "The Project for Capacity Building for Water Supply System (Phase 3),"[21] Both Waterworks have introduced a block system for the poor, and the category with the least usage is the tariff for the poor. For Kampong Cham Waterworks, public institutions are to pay a flat rate of 1,600 Riel per 1 m^3. Tariffs are to be revised once every five years by the MIH Ministerial Decrees, and according to the MIH, there are plans to change the tariff system to three categories – household, business, and public intuition – in the future. (However, tariff level will continue to be set differently for each Waterworks.) In order for each Waterworks to continue to run a profit, tariff increase is planned in the future. As a result of interview survey with local residents[22] on tariff level at the time of site inspection, responses were that the tariff level is relevant and reasonable, including for the poor, and there is no problem even if there is a slight increase of tariff in the future.

Table 15: Water Tariff (Kampong Cham Waterworks)

(Unit: Riel)

Category	Usage (m^3)	2016	2017	2018	2019	2020
Households (including Commercial)	0–6	900	900	900	900	900
	7–15	1,250	1,250	1,250	1,250	1,250
	16–	1,600	1,600	1,600	1,600	1,600
Public Institutions	Flat rate	1,600	1,600	1,600	1,600	1,600

Source: Information provided by Kampong Cham Waterworks (MIH Ministerial Decree 140/2016)

Table 16: Water Tariff (Battambang Waterworks)

(Unit: Riel)

Category	Usage (m^3)	2017	2018	2019	2020	2021
Classification only according to the usage	0–3	1,200	1,200	1,200	1,200	1,200
	4–	1,500	1,500	1,500	1,500	1,500

Source: Information provided by Battambang Waterworks (MIH Ministerial Decree 258/2017)

From the above, no particular problem has been identified regarding the financial aspect of operation and maintenance.

[21] Information from the terminal evaluation of "The Project for Capacity Building for Water Supply System (Phase 3)," Revision of water tariff contains the awareness of a following virtuous cycle, "improvement of water services ➔ increase of residents' willingness to pay and possibility of political agreement ➔ realization of tariff increase ➔ enhancement of sustainability of water utility management."

[22] The interviewees are the same residents described in footnotes 10 and 11.

3.4.4 Status of Operation and Maintenance

It was confirmed that both Waterworks have been operating water facilities/equipment in good condition and have been appropriately operating and maintaining them, including those facilities constructed and equipment procured by the project. At the time of the ex-post evaluation, there were no particular problems with the facilities and equipment of Kampong Cham Waterworks. Battambang Waterworks has some problems and malfunction, and Battambang Waterworks and the MIH are currently considering measures to cope with the situation. Specifically, (1) the underground distribution pipe is partially damaged, and (2) the distribution flow monitoring system[23] is not working, and water volume data is not displayed on the monitor in the central monitoring room. Regarding (1), the underground distribution pipe under the road in front of a house was damaged and not operating due to the loosening of the ground caused by erosion of the Sangke River. The residents are not affected since water is supplied to the water supply area with other water distribution pipes. (2) is a software issue, which Battambang Waterworks is contacting the local vendor to resolve the problem. According to Battambang Waterworks, erosion problems of the Sangke River were surveyed at the time of planning the project, but no particular indication was pointed out regarding the effect to the site, and thus, it can be considered that the problem occurred unexpectedly.

Based on the maintenance and inspection guidelines, both Waterworks carry out daily patrols and inspections and regular maintenance (weekly, monthly, every three months, every six months, every year, etc.) of facilities and equipment and record them, which will be utilized for the preparation for large-scale repair in the future.

Spare parts are stored in the warehouse of each Waterworks, and the inventory lists are updated. Most spare parts can be procured in Cambodia, and they have been procured in a timely manner, and no problems have been observed.

From the above, there are some problems in the operation and maintenance status at the time of the ex-post evaluation, but as a whole, there is no problem because facilities are properly operated and maintained.

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.

[23] The distribution flow monitoring system was introduced for the purpose of grasping distribution volume and managing flow volume data in a centralized manner. Specifically, electromagnetic flow meters and local stations are installed at 2 locations in total – the crossing point of the Sangke River and the outlet point of the treatment plant. Flow data are sent to the central monitoring room in the administration building of the Battambang Waterworks for monitoring.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

This project expanded water supply facilities in Kampong Cham City and Battambang City to improve access to safe water for residents of both Cities. This project, which aims to improve water supply capacity, is consistent with Cambodia's development policy, development needs and Japan's assistance policy at the time of planning and the ex-post evaluation. Therefore, the relevance of the project is high. In terms of project implementation, both the project cost and project period were within the plan. Therefore, efficiency of the project is high. As for project effects, quantitative indicators set at the time of planning are mostly achieved. As for qualitative effects, it was confirmed from the interviews with local residents that improvement of insufficient water volume and pressure from taps have realized and stable water supply has achieved. Regarding impacts, it can be considered that the project has contributed to the improvement of hygiene situation, promotion of employment of women and facilitation of school attendance of children, based on the interviews with local residents. In addition, this project has effectively collaborated with other donors' support and contributed to the promotion of water connections for poor households. Therefore, this project has mostly achieved its objectives and thus, effectiveness and impacts of the project are high. No negative impacts on natural environment and resettlement have been reported. Regarding operation and maintenance, 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 highly satisfactory.

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

<u>Importance of taking early measures to cope with facility problems due to the erosion of the Sangke River and the software problems in Battambang</u>

Regarding the distribution pipes constructed by the project, the underground distribution pipe under the road in front of a house was partially damaged due to the loosening of the ground caused by erosion of the Sangke River in Battambang. In this regard, it is important that the MIH takes the initiative and coordinates/collaborates with the Ministry of Public Works and Transport (MPWT), which has jurisdiction over revetment works of the Sangke River and its branch organization, the Department of Public Works and Transport (DPWT) as well as with the Ministry of Water Resources and Meteorology (MOWRAM) and its branch organization, the Department of Water Resources and Meteorology (DOWRAM) as soon as possible, and takes actions against the erosion problems. In addition, regarding the software

problem, the distribution flow monitoring system is not working. Therefore, it is important that Battambang Waterworks, in coordination with the MIH and the DIH takes actions to repair and restore the system as soon as possible.

4.2.2 Recommendations to JICA

None.

4.3 Lessons Learned

Enhancement of project effects through cooperation with other donors, JICA technical cooperation and efforts in Cambodia to reform the water supply sector

This project provided comprehensive support, building on top of the ADB and the UN-HABITAT projects, which were implemented in the past, expanded water supply areas, and promoted connection of poor households utilizing these projects. In addition, capacity building for operation and maintenance work and production management provided through the soft component of the project was consistent with the series of capacity building support implemented by JICA's long-term technical cooperation, and the implementation of the project took place in appropriate timing and sequence. Furthermore, in good coordination with JICA's technical cooperation, PPWSA carried out technology transfer to local public waterworks. As a result of such a series of support and efforts, both Kampong Cham and Battambang Waterworks have solidified appropriate management bases for water supply business, reduced non-revenue water, and carried out appropriate operation and maintenance, and thus have realized improvement of access to safe water. Therefore, when implementing similar projects in the future, cooperation with other donors in the same sector as well as provision of coherent assistance with JICA's other technical cooperation and reform initiatives of the recipient country would be considered effective.

Program approach that utilizes various actors is effective

Sustainability of the effects produced by this project is high because of the effective cooperation (program approach) between this project (Grant Aid) and the long-term technical cooperation. As described in Box 1, JICA has been aiming to realize synergetic effects by collaborating multiple projects across the framework of individual projects and strategically providing support as one cooperation program. With the participation of Kitakyushu City, which has a long history of cooperation and is familiar with the local situation, in this series of support, JICA was able to strengthen consistent program management. Therefore, program approach that utilizes various actors is effective as a strategic cooperation approach.

[BOX 2: Kitakyushu City's Contribution to Cambodia's Water Supply Sector]

Regarding contribution of Kitakyushu City to this project and in Cambodia, following remarks were made by the Director of Kampong Cham Waterworks, the project consultants (Nihon Suido Consultants Co., Ltd.), and Kitakyushu City.

<Remarks by the Director of Kampong Cham Waterworks>

Kitakyushu City's support for Kampong Cham Waterworks through JICA projects has become 15 years. After completion of the ADB project (2004–2006), water treatment and water supply functions have improved, but there were various issues regarding operation and maintenance of facilities and equipment and the financial aspects of water supply business. Under such circumstances, Kitakyushu City provided support through JICA's technical cooperation project, "The Project on Capacity Building for Urban Water Supply System in Cambodia (Phase 2, 3)" to promote technology transfer and capacity building. In parallel with this, this grant project was also implemented, and JICA comprehensively provided support including the soft component, which Kitakyushu City has undertaken, utilizing the water supply and distribution infrastructures developed by the ADB. Kitakyushu City's contribution was also substantial in the "Provincial Tour" (see footnote 19), which was implemented as part of "The Project on Capacity Building for Urban Water Supply System in Cambodia (Phase 3)." The Tour was conducted to reconfirm how Kitakyushu City's knowledge of water supply business operation was being used in the field. In this way, as a result of Kitakyushu City's constant involvement and continuous and consistent support, non-revenue water rates of Kampong Cham Waterworks were reduced from 50% (2006) to 6% (2019). In addition, financial situation was strengthened, and deficit was resolved in 2010. Since then, Kampong Cham Waterworks has been running a profit. Up to now, the experiences of Kitakyushu City have been utilized in Cambodia through lectures and practical training, but the experiences and knowledge of the City do not always match the actual situation of Cambodia, and PPWSA complemented that part well – development to provincial areas has been carried out based on PPWSA's own growth experiences. Specifically, training was provided tailored to the situation of facilities and equipment in Cambodia and the skill levels of the staff based on the inputs and advice from PPWSA. Since Cambodia does not have modern facilities and equipment like Japan, trainings were carried out according to the actual conditions of Cambodia. Also, since there were few engineers with specialized knowledge in Cambodia, practical trainings were conducted according to their capacities. The staff of Kitakyushu City are good coaches, good friends, and good leaders, and they have provided support while building a very good

relationship with the staff of Kampong Cham Waterworks. We are very grateful to them.

<Remarks by the project consultants (Nihon Suido Consultants Co., Ltd.>

Long-standing cooperation of Kitakyushu City Water and Sewer Bureau in Cambodia has also become extremely important when implementing projects by the consultants. As a Japanese water utility, in addition to being familiar with the water business in the field, it has a deep understanding of project implementation capacity of the Cambodian side and has become a voice for them. For example, at the design stage, considering the operation and maintenance, Kitakyushu City was able to improve quality of design by providing useful inputs to the consultants while taking into consideration the intentions of the Cambodian side. In this respect, it can be said that Kitakyushu City has greatly helped the communication between the consultants and the counterpart organizations.

Cooperation and advice of Kitakyushu City Water and Sewerage Bureau is convincing because it has experiences and know-how in cooperation related to water supply business in Cambodia, backed by many years of experience and achievements. In addition to this, great strength of Kitakyushu City is that for many years, the staff have been staying in the field without interruptions and they understand the background of project implementation as well as they are able to respond flexibly when issues arise. Through such long-standing cooperation over 20 years, maintaining close relationships at the individual level is also considered that it contributes to sustainability of bilateral cooperation. The Cambodian counterparts who have received trainings before are now involved in decision making as a manager class personnel.

In this respect, Kitakyushu City has a special presence in the water supply business in Cambodia, and it can be considered that this is one model of a long-term technical cooperation by a Japanese water utility.

<Remarks by Kitakyushu City>

Kitakyushu City has been deeply involved with Cambodia as a water utility, including human relations, trust relationships, and network building, and has made international contributions firmly including technology transfer. In the past, Kitakyushu City has made various efforts to deal with problems such as drought and water leakages. It is a unique contribution of a water utility to be able to provide specific advice and recommendations to the Cambodian side, based on the experience and knowledge gained from its own history of water supply business management. The advantages of Kitakyushu City's participation in the ODA projects include following points. (1) International sense of the staff in charge can be fostered, (2) In Kitakyushu City, maintenance work is the main activity, and the number of staff involved in expansion projects is decreasing. However, there are many expansion projects overseas, and

it is possible to develop human resources through OJT that cannot be carried out in Japan, and (3) The Water and Sewer Bureau can diversify its work. On the other hand, challenges are that securing human resources is difficult. Since ODA projects have a long-time span of 5 to 10 years, and there are personnel changes during the period, it is difficult to secure and assign substitute staff who can adapt to overseas projects. In addition, as an organization, it is not always possible to have overseas projects stably. Thus, there are many challenges in securing human resources under such situations. On the other hand, in Kitakyushu City, as a future city of SDGs set by the Cabinet, Kitakyushu City is committed to contributing to 6 (water and sanitation), 8 (growth and employment), 9 (innovation), and 17 (means of implementation) among the 17 goals of SDGs, through overseas water business. Kitakyushu City believes that contributions to Cambodia with achievements and results so far can be greatly appealed as the City and considers that this will lead to the civic pride of the citizens.

Hashemite Kingdom of Jordan

FY2019 Ex-Post Evaluation of Japanese Grant Aid Project

"Project for Energy Conservation through Upgrading Water Supply Network in the Hashemite Kingdom of Jordan"

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

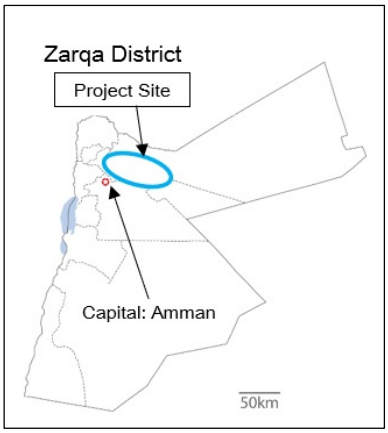
0. Summary

This project procured equipment, installed pumping and water distribution facilities, and provided technical assistance in the areas of operation and maintenance of the pumping facilities and operation of the water distribution system. The aim of the project was to improve operational efficiency of the pumping facilities as well as, with energy-saving measures, to stabilize and improve the water distribution systems at three pumping stations, Azraq, Hallabat and Zarqa in Zarqa District, located northeast of the capital city of Jordan, Amman. With respect to the development policy, documents developed by the Jordanian government such as *National Agenda 2006-2015* and *Water for Life: Jordan's Water Strategy 2008-2022*, list the water sector, climate change measures, supply of safe drinking water and sustainable water resource utilization as important issues. In addition, since the per capita water supply was limited for all of Jordan, including Zarqa District, there was a need for water resource development, the expansion of water distribution networks and the renewal of pumping stations. Furthermore, the project is in line with Japan's ODA policy. Therefore, its relevance is high. With regard to efficiency, the project outputs and costs were generally as planned. However, the project period exceeded the initial plan as it took longer to select and identify a contractor for the work to be carried out on the Jordanian side. Furthermore, it was decided to utilize the remaining budget for additional works such as installation of water pipes and management of reservoir sediments. Therefore, overall the efficiency is fair. As for quantitative effect indicators, "operational efficiency of the pumps" and "reduction in electricity consumption," the targets have been achieved through the implementation of this project. Whilst the target was met for "reduction in electricity costs," it is worth noting that the electricity price rose within Jordan. Additionally, it was confirmed through the qualitative interview survey that the project had contributed to reducing energy consumption (electricity costs), improving technical skills of the operation and management staff of the pumping facilities, establishing a stable water supply and improving water distribution, all with a reduced environmental load. Considering the above, the project's effectiveness and impact are considered to be high. There are no particular concerns regarding the institutional, technical or financial aspects of Miyahuna, the company responsible for the operation and management of the

pumping stations developed by this project. There are no issues concerning the operation and management of the other facilities and equipment. Therefore, sustainability of the project's effects is high.

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

1. Project Description



Project Location

Pumping Station Developed by This Project
(Zarqa Pumping Station)

1.1 Background

Jordan belongs to a desert area and evapotranspiration is high throughout the country. Before this project began, it was expected that securing drinking water would be difficult. Water used for domestic purposes was also limited, and effective and fair utilization of water resources was an important issue. In Zarqa District, per capita water supply was extremely low at approximately 140 L/day. The district's water supply facilities frequently had problems and the water distribution capacity was deteriorating due to issues such as aging of the pumps and inappropriate maintenance. Additionally, Jordan relied almost entirely on thermal power generation, and it was concerned that operating these aged inefficient pumps would not only increase electricity consumption but also increase greenhouse gas emissions. For this reason, there was an urgent need to realize efficient operation of pumps by replacing the existing pumping facilities and improving maintenance.

1.2 Project Outline

The objective of this project is to stabilize water distribution and to improve water supplies with more efficient pumping facilities and an energy-saving water distribution system by procuring equipment and installing pumping and water distribution facilities and by providing

technical assistance in the areas of operation and maintenance of the pumping facilities and the water distribution system at three pumping stations, Azraq, Hallabat and Zarqa, thereby contributing to the reduction in greenhouse gas emissions (a climate change mitigation measure).

Grant Limit / Actual Grant Amount	1,132 million yen / 1,109 million yen
Exchange of Notes Date /Grant Agreement Date	February 2010 / February 2010 (initial plan), October 2013 (revised[1])
Executing Agency	Water Authority of Jordan (hereinafter referred to as "WAJ")
Project Completion	February 2014
Main Contractors	Kubota Corporation (Japan), Emar Jordan Building Materials (Jordan), Dai Nippon Construction (Japan)
Main Consultant	Kyowa Engineering Consultants Co., Ltd.
Procurement Agency	Japan International Cooperation System
Preparatory Survey	February – November 2009 (preparatory survey)
Related Projects	[Japanese Grant Aid Projects] ・ Project for Improvement of Water Supply System for the Zarqa District (The notes were exchanged in 2003 for stage 1 and in 2004 for stage 2.) ・ Project for Improvement of the Water Supply for the Zarqa District (Phase 2) (The notes were exchanged in 2006, 2007 and 2008.)

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: September 2019 – November 2020

Duration of the Field Study: 3 – 18 January 2020

[1] This refers to a revised grant period after it was decided that Lot 3 (laying of water transmission pipes, reservoir sediment measures and improvement) would be implemented using the remaining budget.

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

3.1 Relevance (Rating: ③[3])

3.1.1 Consistency with the Development Plan of Jordan

At the time of the project planning, the government of Jordan had developed a comprehensive national strategy, *National Agenda 2006-2015*, which placed importance on the water sector and climate change measures. The government had also developed the *Strategic Plan 2007-2012* for the water sector entities, which listed reducing the gap between water supply and demand, as well as addressing the issue of non-revenue water, as urgent matters. The plan aimed to balance a reduction in greenhouse gas emissions and economic growth.

At the time of the ex-post evaluation, the government of Jordan has developed the *National Water Strategy 2016-2025*, aiming to strengthen the roles of water entities in the water and sewage service provision sector and to achieve efficient water supply operations by utilizing the private sector and others. In addition, the government has developed the *Water Sector Capital Investment Plan 2016-2025*, which aims to manage insufficient water in an efficient, effective and sustainable manner. Furthermore, the government has developed *Water for Life: Jordan's Water Strategy 2008-2022*, which sets goals for the supply of safe drinking water, sustainable water resource utilization, and climate change responses and adaptations. It identifies the following problems: exploitation of water beyond restoration capacity of the water resources, drying up of the freshwater resources,[4] rapid growth of the population including disaster victims, refugees and returnees, and aging of water distribution networks. To counter these issues, the document lists the following: supply of appropriate and safe drinking water, measures to reduce non-revenue water, effective utilization of existing water resources, introduction of the private sector's expertise to improve financial aspects, and expansion of water supply capacity by utilizing new technologies.

Based on the above, a stable supply of drinking water, the development of water resources, and climate change measures continue to be viewed as important in Jordan at the time of the ex-post evaluation. The project is in line with the development policies in place at the time of its planning as well as those in place at the time of its ex-post evaluation.

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

[3] ③: High, ②: Fair, ①: Low

[4] Jordan's renewable water resources (it refers to a maximum level of water resources that is theoretically available, also called water resource potential) is 129 m^3/year (source: Jordanian government data, 2014) which is less than 30% of the "severe scarcity" threshold of 500 m^3/year set by the UN. Jordan is categorized as one of the most water-scarce countries in the world.

3.1.2 Consistency with the Development Needs of Jordan

Before this project began, per capita water supply was extremely low at approximately 140 L/day in Zarqa District. The water supply facilities of this district had frequent problems, with the water distribution capacity deteriorating due to aging pumps, inappropriate maintenance, etc. There was a concern that these old pumps and their inefficient operations would not only increase electricity consumption but also greenhouse gas emissions. At Azraq pumping station, which was targeted by this project, all seven pumps were old. Only two of the pumps were operational and the rest were either broken or almost ready for disposal, having problems with power panels and/or electric motors. At Hallabat pumping station, four pumps were old, with traces of overhauls and deteriorated basic parts; most of the gate valves and check valves were almost non-operational, requiring urgent repairs. At Zarqa pumping station, the pumping facility was extremely old, and there was a serious problem with its operation and maintenance since some equipment had been replaced and installed as temporary measures.

At the time of the ex-post evaluation, per capita water supply of Jordan is 120 L/day in the capital Amman and Zarqa District, 100 L/day in other regional cities and 80L/day in rural areas.[5] The water supply in Zarqa District is limited compared to before the project. This is due to the population increase and influx of refugees from the neighboring Syria since 2011, together with limited water resources. As a result, the imbalance between water demand and supply has become serious. WAJ, the executive agency for this project, has been expanding water supply services, developing water distribution networks and promoting non-revenue water measures all over the country. As a result of these measures, the water supply has increased. Jordan's total population is approximately 10.66 million (source: Jordanian statistic agency (DOC), 2020 data), of which approximately 0.66 million[6] are Syrian refugees (source: The source of this figure is the United Nations High Commissioner for Refugees (UNHCR), 2018 data). This is considered to be one of the reasons of the increase in the water demand.[7] Furthermore, the total population of Jordan in 2000 (20 years ago) was approximately 4.86 million (source: DOC), which means by the time of the ex-post evaluation, the population had doubled. Thus, the population increase, together with the influx of Syrian refugees, has caused the high demand for water. For this reason, the need for water supply infrastructure, including development and repairs of pumping facilities, is

[5] Source is WAJ 2019 data.
[6] Source: https://www.unhcr.org/news/latest/2018/2/5a81bd504/unhcrs-grandi-hails-jordans-job-scheme-syrian-refugees.html (accessed on 5 August 2020)
[7] Although it is difficult to obtain accurate data on Syrian refugees, we used the information provided by UNHCR. Since the influx began, the number of Syrian refugees is thought to be on the decrease. However, it can be said that they continue to account for a large proportion.

chronically high. Based on the strategies above, WAJ has placed the importance on water resource development and management, expansion/improvement of water distribution networks and pipes, and promotion of private sector involvement. It is considering projects for new water resource development, including a water desalination project (in Aqaba).

Based on the above, per capita water supply per day is limited in Jordan including Zarqa District at the time of the ex-post evaluation, and there remains a need for water resource development and expansion of water distribution networks. Therefore, it can be said that the project is consistent with the development needs at the time of planning and at the time of the ex-post evaluation.

3.1.3 Consistency with Japan's ODA Policy

Japan's ODA Charter approved by the cabinet in August 2003 listed four priority issues: (1) poverty reduction, (2) sustainable growth, (3) addressing global issues, (4) peacebuilding. With respect to issue (3), the policy says that in the light of "global issues such as global warming and other environmental problems, infectious diseases, population, food, energy, natural disasters, terrorism, drugs, and international organized crime, further efforts must be given immediately and in a coordinated manner by the international community." This project aims to reduce greenhouse gas emissions by reducing the energy consumption for water distribution, assisting Jordan in its efforts to stabilize water distribution and improve water supply. Thus, it can be judged that this project is in line with the mentioned assistance policy. Based on the above, the project is in line with Japan's ODA policy.

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

3.2 Efficiency (Rating: ②)

3.2.1 Project Outputs

This project procured equipment, installed pumping and water distribution facilities, and provided technical assistance in the areas of operation and maintenance of the pumping facilities and operation of the water distribution system. This was done with a view to improving the efficiency of the pumping operations at three stations, Azraq, Hallabat and Zarqa. A detailed design was carried out after the project began. After the plan change, the procurement and

installation of the equipment listed in Table 1 were proposed as planned outputs and were implemented.

Table 1: Planned and Actual Outputs of this Project

At the time of Planning (2009)	At the time of the ex-post evaluation (2019-2020)
[Planned Outputs from the Japanese Side] 1) Civil engineering works and equipment to be procured ・Procurement and installation of pumping facilities at Azraq, Hallabat and Zarqa pumping stations (12 pumps) ・Procurement of valves and related materials for Khaw pumping station (four sets) ・Procurement and installation of water flow meters (eight sets) ・Procurement of water transmission pipes (4.1 km) ・Procurement of gate and air valves (220 and 15 pieces, respectively) 2) Consulting services / capacity building program (soft component) ・Detailed design, construction management ・Technical guidance on operation and maintenance of pumps for personnel operating pumping stations ・Technical guidance on operation management for personnel managing water distribution systems	[Actual Outputs from the Japanese Side] 1) Civil engineering works and procured equipment: <u>As planned</u> 2) Consulting services / capacity building program (soft component): <u>As planned</u>
【Inputs from the Jordanian Side】 ・Installation of other equipment and construction of facilities	【Actual Inputs from the Jordanian Side】 ・Installation of other equipment and construction of facilities: <u>As planned (details: installation/repair of transformers and water transmission pipes at Azraq, Hallabat and Zarqa pumping stations, installation of transmission pipelines, installation of chambers for water flow meters and valves, installation of valves and air valves in water distribution networks)</u>

Source: Documents provided by JICA, answers to the questionnaire

Photo 1: Pumping Facility at Hallabat Pumping Station

Photo 2: Control System at Azraq Pumping Station

3.2.2 Project Inputs

3.2.2.1 Project Cost

The total cost of this project was planned to be approximately 12.78 million yen (approximately 11.32 million yen from the Japanese side and approximately 1.46 million yen from the Jordanian side). The actual cost was approximately 12.4 million yen (of which 11.09 million yen came from the Japanese side and approximately 1.31 million yen came from the Jordanian side). These figures were within the plan (approximately 97% of the planned cost).

3.2.2.2 Project Period

The scheduled project period was from February 2010 to November 2012 (34 months). The actual period was from February 2010 to November 2015 (70 months), which was extended from the scheduled period (approximately 206% of the planned time).[8] Table 2 indicates the initially planned and actual project periods. The reasons for the delay are as follows. 1) Under this project, Lot 1 "materials and equipment for water transmission pumps" and Lot 2 "materials and equipment for water distribution networks" were initially planned and completed in January 2014. As the initial plan was expected to be completed by November 2012, the actual delay was one year and a few months. The main reason for this was that it took longer to select and identify a contractor for the work to be carried out by the Jordanian side. This in turn affected the project period of the work by the Japanese side (e.g., procurement of equipment). 2) As stated above, while Lot 1 and Lot 2 were the initial plan under this project, it was discovered during the project

[8] According to *JICA's External Ex-post Evaluation Reference*, the timing of the project's completion is defined as "at the time of the handing over." The project's beginning refers to the month/year in which grant agreement was signed, while the project's completion refers to the completion of Lot 3 (at the time of the handing over).

implementation that there would be some left-over budget. The utilization of the remaining budget was considered. As a result, the installation of water pipes as well as reservoir sediment measures and improvement were implemented. This was considered as Lot 3, which began in June 2013 while Lot 2 was under implementation. Lot 3 was completed in November 2015.[9]

Table 2: Initially Planned and Actual Project Periods

	Initial Plan	Actual
The overall project	February 2010 – November 2012 (34 months)	February 2010 – November 2015 (70 months)
Lot 1: Materials and equipment for water transmission pumps		
Detailed Design – Bidding – Contractor Signing	5.5 months	3.0 months (detailed design) 5.0 months (bidding – contractor signing)
Procurement of Equipment – Inauguration	26.5 months	35.0 months
Lot 2: Materials and equipment for water distribution networks		
Detailed Design – Bidding – Contractor Signing	3.5 months	2.0 months (detailed design) 5.0 months (bidding – contractor signing)
Procurement of Equipment – Inauguration	2.0 months	5.0 months
Lot 3: Installation of pipes and reservoir sediment measures and improvement		
Preparatory survey	-	9.0 months
Bidding – Contractor Signing	-	5.0 months
Construction – Inauguration	-	11.0 months
(Project period for the Jordanian side)	-	(February 2011 – February 2014)

Source: Documents provided by JICA (initial plan), Project Completion Report, answers to the questionnaire and interviews with WAJ (actual).

As discussed above, the outputs and cost of this project were almost as planned. The project period was longer than in the initial plan due to the fact that it took longer to select/identify the contractor for the work to be carried out by the Jordanian side. A decision was made to utilize the remaining budget for the installation of water transmission pipes and reservoir sediment measures and improvement. Therefore, although the project cost was within the plan, the project period exceeded the plan. Thus, efficiency of the project is fair.

[9] This additional work was done because the contractor found a problem in the pump shaft end during the inspection after the operation began at Azraq pumping station. The part inside the pump had a friction problem. It was suspected that sand that was contained in the transmitted water had caused the internal clogging. When the consultant and the contractor carried out a field status survey, it turned out that sand had accumulated in the reservoir and that a small amount of sand was flowing into the transmission pump. As a result, WAJ requested JICA's assistance in addressing the sediment issue. The Japanese side decided that this would be implemented as Lot 3.

3.3 Effectiveness and Impacts[10] (Rating: ③)

3.3.1 Effectiveness

3.3.1.1 Quantitative Effects

1) Operation Indicators

The quantitative effect indicators for operational efficiency of each pumping station at Azraq, Hallabat and Zarqa (baseline, target and actual) are shown in Table 3. The implementation was generally as per the initial plan. As for the unit electricity consumption at Azraq pumping station, the actual consumption was 1.48 kWh/m^3, better than the target of 1.58 kWh/m^3. The main contributing factor is that in 2016, after this project was completed, WAJ upgraded its electric power system of wells from 11kV to 33kV with its own fund.

Table 3: Quantitative Effect Indicators for Operational Efficiency of Each Pumping Station (Baseline, Target and Actual)

Indicator (Operational Efficiency of the Pumps)	Baseline (FY2009)		Target (FY2015) [Three years after project's completion]		Actual [Three years after completion: 2018]	
	Operation efficiency (Unit: %)	Unit electricity consumption (Unit: kWh/m^3)	Operation efficiency (Unit: %)	Unit electricity consumption (Unit: kWh/m^3)	Operation efficiency (Unit: %)	Unit electricity consumption (Unit: kWh/m^3)
Azraq pumping station	57	1.88	68	1.58	68	1.48
Hallabat pumping station (water destination: Khaw reservoir)	57	0.62	68	0.52	68	0.50
Hallabat pumping station (water destination: Hallabat village)	34	1.20	65	0.63	65	0.63
Zarqa pumping station	50	0.78	68	0.40	68	0.40

Source: JICA document (baseline, target), answers to the questionnaire (actual)

Table 4 shows outcome indicators that measure relationships between this project and electricity consumption as well as electricity charges. The actual "reduction in electricity consumption" was as per the target. Considering the fact that operational efficiency has improved with the introduction of the pumping facilities by this project, it can be judged that the annual electricity consumption was reduced by more than 8,687,000 kWh/year. The performance

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

exceeded the target because electricity consumption at Azraq and Hallabat pumping stations improved (from 1.58 to 1.48 kWh/m^3 and from 0.52 to 0.50 kWh/m^3, respectively) as shown in Table 3.

It is possible to conclude that "reduction in electricity cost" outperformed the target. This is because there is a difference in the power rate before this project began (2009) and at the time of the ex-post evaluation (end of 2019). As will be elaborated in 3.4.3 Financial Aspects of Operation and Maintenance under "Sustainability" electricity rates have been revised multiple times and have been on the rise for the past 10 years (since this project began up until the time of the ex-post evaluation). The unit electricity charge is 0.115 JD at the time of the ex-post evaluation (end of 2019), whereas it was 0.043 JD before in 2009. Before this project began, it was expected that 8,687,000 kWh × 0.043 JD would equal a reduction in electricity costs of 374,000 JD. However, more than 8,687,000 kWh[11] × 0.115 JD equaling more than 999,000 JD annually is being achieved at the time of the ex-post evaluation. In other words, the reduction exceeded the target due to an external factor - a change in power rates. Electricity cost reduction scenarios with and without this project will be analyzed in 3.4.3 Financial Aspects of Operation and Maintenance under "Sustainability" taking into consideration the changes in water supply volumes and power rates.

Table 4: Outcome Indicators of Electricity Consumption and Costs

Indicator	Baseline (2009)	Target/year [Three years after project's completion]	Actual/year [At the time of the ex-post evaluation: 2019]
Reduction in electricity consumption (Unit: thousand kWh/year)	-	8,687	8,687 or more
Reduction in electricity cost (Unit: thousand JD)	-	374	999 or more

Source: JICA document (baseline and targets), answers to the questionnaire (actual)

[11] One can say it will be "more than" 8,687,000 kWh because the electricity consumption at Azraq and Hallabat pumping stations have improved as shown in Table 3 (Azraq: from 1.58 to 1.48 kWh/m^3, Hallabat: from 0.52 to 0.50 kWh/m^3). However, since it is difficult to obtain concrete numbers, it will be written as "more than."

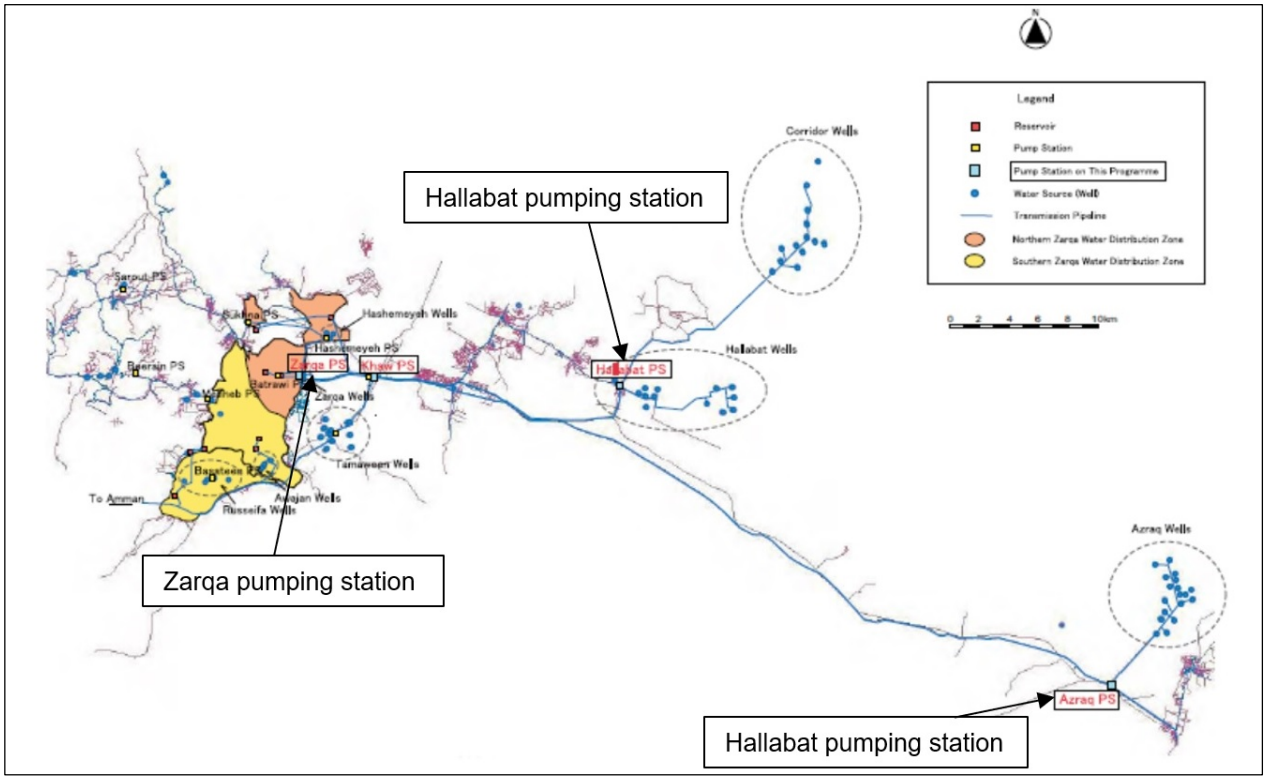

Figure 1: Locations of Project Sites[12]

3.3.1.2 Qualitative Effects (Other Effects)

Reduction in Energy Consumption on Water Distribution, Improvement in Technical Skills of WAJ's Operation and Maintenance Personnel with Realization of Stable Water Distribution, Stabilization of Water Distribution and Water Supply

As part of the field survey of this evaluation, interviews were carried out with employees of Miyahuna (the company responsible for the operation and management of the pumping stations developed by this project), and with headquarters staff of WAJ, an executing agency of this project.[13] Comments obtained through these interviews were as follows:

・ "Electricity consumption is large for operating pumping facilities. The power rate increased every year, and it is preferable to reduce electricity consumption and make the operation of the pumps more efficient. If this project wasn't implemented and we kept operating using the old existing pumping facilities, there is no doubt that electricity costs would have been high. While water demand increases throughout the nation, stable water transmission from the pumping

[12] It was taken from the map created by the main consultant.

[13] Group interviews and key informant interviews were conducted with 11 people: three people from each of the Azraq, Hallabat and Zarqa pumping stations and two WAJ headquarters staff members. The interviewees were selected based on the criterion that they had knowledge of the situation regarding the pumping stations and facilities before as well as after the implementation of this project.

stations is especially critical, and payment of electricity bills is a bottleneck for the organization management. Electricity costs account for about 60 to 70% of our entire operation and maintenance costs in recent years. The pumping facilities introduced by this project have achieved economized operations (as compared to the past), and we think it has led to a reduction in energy consumption." (Comments from WAJ headquarters staff, Miyahuna employees)

・ "The operation has become stable after replacing the pumping facilities. There have been no problems; the status of the operation is good. Made-in-Japan facilities are to be trusted. The water transmission from the pumping stations is stable, so are the water distributions from the reservoirs to downtown areas and the water supply to each household. While the water demand has been on the rise due to the population increase (with the increased influx of Syrian refugees), we consider the facilities of this project as one of the foundations for stable supply." (A comment from a Miyahuna employee)

・ "Miyahuna has a long history working on water supply projects. Most of its employees have been working at the firm for many years. We learned about the efficient operation of pumping facilities and periodic maintenance duties from Japanese contractors (through the capacity building/soft component training) during the implementation of this project. As an example, it enables us to judge the appropriate timing of oil changes and grease coating by listening to the sound of the pump's motor. We think that our knowledge and skills of operating and maintaining the pumps have improved through this project." (A comment from a Miyahuna employee)

Based on the comments above, it can be deduced that this project is contributing to a reduction in energy consumption, to improved technical skills of operation and maintenance staff, to a stable water supply, and to improved water distribution.

3.3.2 Impacts

3.3.2.1 Intended Impacts

Contribution to Reduction in Greenhouse Gas Emissions (climate change mitigation measure)

Table 5 shows the target and actual figures for a reduction in greenhouse gas emissions.

Table 5: Indicator of Effects from Reduction in Greenhouse Gas Emissions

Baseline (2009)	Target	Actual (2019)
-	5,386 tons CO_2/year	5,386 or more tons CO_2/year

Source: JICA document (target), answers to the questionnaire as well as results from interviews with WAJ and Miyahuna (actual)
Note: A specific year was not set for the target before this project began.

It is thought that the target has been achieved at the time of the ex-post evaluation. As explained in 3.3.1.1 Quantitative Effects, the “reduction in electricity consumption” was as planned. Calculating the actual reduction at the time of the ex-post evaluation using the calculation basis before this project began (8,687,000 kWh/year × 0.62kg - O_2/kWh), it is possible to say that the actual reduction was at least 8,687,000 kWh/year × 0.62kg - CO_2/kWh, which equals at least 5,386 tons CO_2/year. As a result of the interviews[14] with WAJ headquarters and Miyahuna staff on the reduction in energy consumption and climate change measures, the following comments were obtained. “We do not know if the greenhouse gas emissions and climate change impacts are related to this project, however, considering that this project has reduced electricity costs, we may be able to say that the project is contributing to the reduction in energy consumption (WAJ headquarters staff).” “Made-in-Japan pumping facilities are trustworthy. Since the operation efficiency is high, we think the environmental load surrounding this project has generally been decreasing (Miyahuna staff).” It is difficult to refer to the reduction in greenhouse gas emissions as directly correlated to this project due to many external factors. However, considering the comments above, it can be inferred that the project is contributing to reducing an environmental load by cutting down on electricity consumption.

3.3.2.2 Other Positive and Negative Impacts

1) Impacts on the Natural Environment

This project did not require any socio-environmental formalities because the replacement of the pumping facilities was the main project component. EIA was not implemented either.

It has been confirmed through the questionnaire, field visits, as well as interviews with WAJ and Miyahuna that there was no negative impact on the natural environment (e.g., air pollution, vibration, noise, ecosystem, etc.) during the project implementation or after the project’s completion. No negative impacts were observed during the field survey, which included visually checking the natural environment around each pumping station.

WAJ is responsible for the environmental monitoring related to the project’s facilities. However, periodic monitoring has not been conducted as there has been no negative environmental impact of any significance. If an environmental issue arises near any of the pumping stations, the

[14] As was the case for interviews mentioned in 3.3.1.2 Qualitative Effects, group interviews and key informant interviews were conducted with 11 people: three people from each of the Azraq, Hallabat and Zarqa pumping stations and two WAJ headquarters staff members. The interviewees were selected based on the criterion that they had knowledge of the situation regarding the pumping stations and facilities before as well as after the implementation of this project.

procedure will be that WAJ should consult the relevant department of Zarqa District and the Ministry of Environment and address the issue accordingly.

2) Resettlement and Land Acquisition

It has been confirmed through the questionnaire as well as interviews with WAJ and Miyahuna that there was no resettlement or land acquisition since replacement of the existing pumping facilities and water transmission pipes were the main component of this project.

<Conclusion on Effectiveness and Impacts>

With respect to quantitative effect indicators ("operational efficiency of the pumps" and "reduction in electricity cost"), the actual achievements are as targeted. While the actual figure exceeded the target in terms of "reduction in electricity costs," it is largely due to the increase in power rates. Considering the reduction in energy consumption (electricity costs), improved skills of the operation and maintenance staff at the pumping facilities, contribution to stable water supplies and distributions, and contribution towards the reduction in environmental load, this project has achieved its objectives. Therefore, effectiveness and impacts of the project are high.

3.4 Sustainability (Rating: ③)

3.4.1 Institutional/Organizational Aspects of Operation and Maintenance

The executing agency of this project is WAJ. Miyahuna's local staff is commissioned by WAJ to carry out and take charge of the operation and maintenance of the pumping facilities and water transmission pipes. Miyahuna is a semi-governmental company under the Ministry of Water and Irrigation, to which WAJ reports. It is also an entity affiliated with WAJ. Since 2015, this company has been carrying out operation and maintenance duties in Zarqa District, where this project's pumping stations are located. In reality, WAJ's Zarqa branch office, which had been operating and maintaining water supply works in Zarqa District until 2014, underwent restructuring and transferred its function to Miyahuna together with many of its employees. According to WAJ headquarters and Miyahuna, the organizational transfer and handover went smoothly.

Miyahuna has 205 employees (as of December 2019) for the operation and maintenance of the pumping stations, water transmission and distribution pipes, and well facilities. According to the site managers of the pumping stations, the number of staff is sufficient, and they do not foresee problems arising from staff shortages. In addition, Miyahuna reports to WAJ headquarters

periodically.[15] Moreover, headquarters visit Miyahuna regularly to check the implementation status of operation and maintenance. No significant problems were observed in the supervision system.

Therefore, it can be assumed that there are no significant problems with the organizational aspect of the operation and maintenance at the time of the ex-post evaluation.

3.4.2 Technical Aspects of Operation and Maintenance

According to Miyahuna, its staff working at Azraq, Hallabat and Zarqa pumping stations have 10 to 20 years of working experience. As mentioned above, WAJ's Zarqa branch office staff who had been responsible for the operation and maintenance until 2014 was transferred to Miyahuna and continued its work. Site visits and staff interviews confirmed that there were no particular technical or capacity problems. It was also observed that experienced personnel were assigned to appropriate jobs in appropriate places.

Miyahuna conducts regular training for its staff. Training is held at the headquarters (in the capital Amman) on different topics, such as how to use pipe leakage inspection equipment, financial plan development, management skills, computer skills and the operation of pumping facilities. Additionally, on-the-job training is given to newly recruited staff as appropriate.

As discussed in 3.3.1.2 Qualitative Effects under "Effectiveness" staff at each pumping station can now adhere to periodic maintenance requirements through the capacity building / soft component training conducted as part of this project. They are now able to judge the appropriate timing of oil changes and grease coating by listening to the sound of the pump's motor. It is evident that the knowledge and technical skills of operating and maintaining pumps have improved.

Based on the above, it can be concluded that there are no particular problems in the technical aspect of the operation and maintenance of this project.

3.4.3 Financial Aspects of Operation and Maintenance

Miyahuna allocates a budget for the operation and maintenance of the facilities and equipment developed by this project. Table 6 shows Miyahuna's operation and maintenance expenses for the entire Zarqa District, which includes the operation and maintenance expenses of Azraq, Hallabat and Zarqa pumping stations.

[15] They report every month or every three months depending on the content of the work.

Table 6: Miyahuna's Operation and Maintenance Expenses for Zarqa District
(Last three years) *Note 1

(Unit: thousand JD)

	2016	2017	2018	2019 *Note 2
1) General maintenance costs	179	93	78	Data not available
2) Vehicle maintenance costs	166	133	200	Data not available
3) Water distribution networks and pumping stations maintenance costs	1,417 *Note 3	1,097	1,069	Data not available
4) Electricity costs	N/A	9,358	12,149	11,113
5) Sewage facilities maintenance costs *Note 4	8,682	10,556	11,167	11,254

Source: Miyahuna
Note 1: These data include the operation and maintenance costs of Azraq, Hallabat and Zarqa pumping stations.
Note 2: Data until the end of November 2019 (provisional numbers)
Note 3: A large budget was allocated to the maintenance of water distribution networks and pumping stations for 2016 due to periodic maintenance work to be conducted every few years (large-scale works such as equipment replacement, overhaul). For this reason, the expenses for 2016 were greater than for 2017 and 2018. If a large budget is needed, the allocation is done accordingly.
Note 4: Although it is not related to this project, the numbers are shown here because the sewage maintenance costs, just like electricity costs, account for a large portion of Miyahuna's expenses.

According to WAJ and Miyahuna, with regard to the required works, sufficient budgets were allocated to general maintenance costs, vehicle maintenance costs, and the maintenance costs for water distribution networks and pumping stations. The interviews with the operation and maintenance staff of each pumping station also confirmed that the budgets were neither too large nor too small and that the facilities and equipment were in use. The operational status of the pumping facilities developed by this project remained good after the project's completion, and apparently, no major budgets were allocated to repairs or replacements. Miyahuna confirms that they would allocate a sufficient budget if there was a problem/breakage. Miyahuna also commented, "While costs of electricity needed for operating pumping stations are high and the influx of Syrian refugees is a big factor, the volume of water supplied has been increasing every year, and so has the revenue. We have no problem allocating budgets for operation and maintenance. Operating pumping facilities is a lifeline for Jordan. Its budget cannot be cut.[16]"

As a reference, Table 7 shows recent gross revenues and gross expenses (2017) of major water

[16] WAJ has not provided Miyahuna with any subsidy or fund since the separation. As WAJ is aware of the importance of the facilities and equipment developed by this project, it is inferred that WAJ will provide some form of assistance if Miyahuna becomes unable to operate or secure sufficient funds. For this reason, the understanding and importance of spending operation and maintenance budgets is considered to be high.

supply entities that operate in Jordan. Miyahuna operates the largest water supply businesses with the largest operating profit (gross revenue minus gross expenses). Considering this point, it can be concluded that there are no problems with the financial aspect of the operation and maintenance.[17]

(Reference) Table 7: Gross Revenues and Gross Expenses of Major Water Supply Entities Operating in Jordan (2017[18])

(Unit: thousand JD)

	WAJ Headquarters	Miyahuna	YWC	AWC	4 GWAs	Total
Gross Revenue	57,988	174,293	38,705	18,486	20,221	309,693
Gross Expense	54,488	167,300	62,917	14,993	36,259	335,957
Difference	3,500	6,993	-24,212	3,493	-16,038	-26,264

Source: WAJ documents

Note: YWC stands for Yarmouk Water Company, AWC for Aqaba Water Company, while 4GWAs refers to water supply entities of the four main districts.

Electricity costs account for a large proportion of expenditure. Since they continue to rise, an increase in electricity costs is considered to be a burden. According to WAJ and Miyahuna, current electricity costs account for about 60 to 70% of the operation and maintenance costs of the entire water supply operations. The electricity bills for the pumping facilities and equipment bills for this project have been paid without delay, and there have been no problems in terms of electricity supply. Nevertheless, it is a factor that is oppressing the water supply operations, and it continues to be an issue that requires close attention.

[17] If Miyahuna is unable to pay electricity bills or allocate sufficient budgets for maintenance work, it can be concluded that there are issues and concerns about the financial aspect. However, there are no delays or problems with their payment at the time of the ex-post evaluation, which is one of the reasons why this judgment was made.

[18] Only 2017 data could be obtained during this survey.

Box. The electricity consumption/rates/payments of the pumping stations in this project

Here we will examine the relationship between this project and electricity consumption/rates/payments of the pumping stations. Table 8 shows the changes in electricity consumption of Azraq pumping station, the power rates, and the electricity payments made by Miyahuna. (1) While electricity consumption fluctuates from month to month, the replacement of pumping facilities was carried out in this project in 2012. As a result, the operation became more efficient and electricity consumption decreased (from July 2011: 3,505,915 kWh to July 2013: 2,390,805 kWh). However, water demand increased sharply (mainly because of the influx of Syrian refugees since 2012), while operational hours of pumping facilities at Azraq station increased. As a result, water production also increased. According to Miyahuna, every pumping facility faced a production increase of 10 to 20% over the period 2012 to 2017. As the operational hours of the pumping facilities increased, the electricity consumption also increased (from July 2013: 2,390,805 kWh to June 2017: 2,827,750 kWh). (2) The power rate at the time of the ex-post evaluation (end of 2019) is 0.115JD per kWh. This means the rate has almost tripled over 10 years, with repeated increases in recent years.[19]

Based on (1) and (2) above, we can compare and verify the scenarios with or without this project. Applying the power rate at the time of the ex-post evaluation (0.115 JD / kWh) to the electricity consumption of July 2011, i.e., just before the introduction of pumping facilities by this project, we get 403,180 JD (i.e., 3,505,915 kWh × 0.115 JD). (3) According to Miyahuna, the actual electricity payment for July 2011 was 150,754.35 JD. This means the difference between this amount and 403,180 JD is approximately 250,000 JD (i.e., 403,180 to 150,754 JD). Although it is a retroactive perspective, the difference is not small. Therefore, if this project had not been implemented, with power rates being on the increase, it would have put further stress on the company's finances. With the pumping facilities of this project (introduction of newest equipment), highly efficient and stable operations became possible. The electricity payment by the operation and maintenance entity or energy consumption is reduced. Therefore, it can be said that this project is contributing to the "reduction in energy consumption," which was discussed in 3.3.1.2 Qualitative Effects.

[19] There are multiple factors behind the power rate changes. To cite a few, there were problems with procuring LNG used for thermal power generation, the oil price increased (the price was three to four times more than the level before the project commenced), etc.

(Reference) Table 8: Changes in Electricity Consumption at Azraq Pumping Station, Domestic Power Rate, Electricity Payment by Miyahuna

	Sep 2009	July 2011	July 2013	June 2017	March 2018
(1) Electricity Consumption (Unit: kWh)	2,639,747	3,505,915	2,390,805	2,827,750	2,759,400
(2) Domestic Power Rate (Unit: JD / kWh)	0.041	0.043	0.066	0.094	0.094 (As of the end of 2019, 0.115 JD)
(3) Electricity Payments by Miyahuna (Unit: JD) *(1) x (2)	108,229.63	150,754.35	157,793.13	265,808.50	259,383.60

Source: Miyahuna

Remark: Data were available only from Azraq pumping station. Data were not recorded at Hallabat and Zarqa pumping stations before the completion of this project.[20]

3.4.4 Status of Operation and Maintenance

At the time of the ex-post evaluation, there are no problems in terms of the operational status of Azraq, Hallabat, and Zarqa pumping stations nor the water transmission pipes developed by this project. There have been no problems or need for repairs in the period before the ex-post evaluation. According to Miyahuna, the system is in place to respond immediately to any breakage or damage should the need arise. Daily/monthly/annual inspections are conducted depending on the type of facility or equipment.

Currently, there are no problems with the status of storing and procuring spare parts. The field visits and interviews confirmed that the storage status and quantity stored was satisfactory at each pumping station at the time of the ex-post evaluation. For the pumping facilities in particular, procurement system from Japan is in place in case there is a necessity to replace the parts because of the breakages. The staff of each pumping station works in three shifts around the clock. A system is in place so that staff can come in at all times in case of an emergency.

Based on the 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.

[20] The reason is thought to be that records were not smoothly handed over at the time of the organizational transfer in 2015.

Photo 3: Pumping Facility at Zarqa Pumping Station

Photo 4: Safety Measure Board (At Each Pumping Station)

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

This project procured equipment, installed pumping and water distribution facilities, and provided technical assistance in the areas of operation and maintenance of the pumping facilities and operation of the water distribution system. The aim of the project was to improve operational efficiency of the pumping facilities as well as, with energy-saving measures, to stabilize and improve the water distribution systems at three pumping stations, Azraq, Hallabat and Zarqa in Zarqa District, located northeast of the capital city of Jordan, Amman. With respect to the development policy, documents developed by the Jordanian government such as *National Agenda 2006-2015* and *Water for Life: Jordan's Water Strategy 2008-2022*, list the water sector, climate change measures, supply of safe drinking water and sustainable water resource utilization as important issues. In addition, since the per capita water supply was limited for all of Jordan, including Zarqa District, there was a need for water resource development, the expansion of water distribution networks and the renewal of pumping stations. Furthermore, the project is in line with Japan's ODA policy. Therefore, its relevance is high. With regard to efficiency, the project outputs and costs were generally as planned. However, the project period exceeded the initial plan as it took longer to select and identify a contractor for the work to be carried out on the Jordanian side. Furthermore, it was decided to utilize the remaining budget for additional works such as installation of water pipes and management of reservoir sediments. Therefore, overall the efficiency is fair. As for quantitative effect indicators, "operational efficiency of the pumps" and "reduction in electricity consumption," the targets have been achieved through the implementation of this project. Whilst the target was met for "reduction in electricity costs," it is worth noting that the electricity price rose within Jordan. Additionally, it was confirmed through

the qualitative interview survey that the project had contributed to reducing energy consumption (electricity costs), improving technical skills of the operation and management staff of the pumping facilities, establishing a stable water supply and improving water distribution, all with a reduced environmental load. Considering the above, the project's effectiveness and impact are considered to be high. There are no particular concerns regarding the institutional, technical or financial aspects of Miyahuna, the company responsible for the operation and management of the pumping stations developed by this project. There are no issues concerning the operation and management of the other facilities and equipment. Therefore, sustainability of the project's 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

The power rate increases are significant in Jordan. At the time of the ex-post evaluation, electricity costs account for around 60 to 70% of WAJ's total expenses. This is significant for water supply operations, including the operation of the facilities targeted by this project. As there is no guarantee that the rate will not rise in the future, it is preferable that WAJ deepen cooperation with relevant government agencies, thereby preparing for the burden of such expenses.

4.2.2 Recommendations to JICA

None

4.3 Lessons Learned

Necessity to provide solid training when renewing facility/equipment

During the implementation of this project, generous training was given on the operations of facilities and equipment to be introduced. All operation and maintenance staff received training not only on efficient operation methods for the pumping facilities but also on preventative maintenance, such as a technique to determine the right timing for the maintenance. This has better prepared them for future maintenance. It has also helped them develop a habit of accurately monitoring the equipment/instruments, enabling them to carry out operations and maintenance work properly. The capacity building of the operation and of the maintenance staff was completed before the introduction of the pumping facilities, which enabled them to operate water distribution management around the clock. For future projects of a similar nature, it is preferable that JICA

and executing agencies explore ways to realize sustainable maintenance by taking appropriate measures at the right time, such as conducting training at the same time as the introduction of facility/equipment.