Jordan

Ex-Post Evaluation of Japanese Grant Aid Project
"The Project for the Improvement and Expansion of the Water Supply Networks in North/Middle Jordan Valley"

External Evaluator: Noriyo Aoki, IC Net Limited

0. Summary

The project was conducted in the North Shuna region in the Northern Jordan Valley and in some parts of the Middle Jordan Valley to develop water supply networks and introduce water resources management so that safe water can be supplied in an efficient manner.

The project is highly relevant as it is consistent with Jordan's development policy and the priority issues of Japan's assistant policy, as well as the fact that the country has high needs for development. Its effectiveness is also high as the project has achieved targets in most of the major effect indicators, with significant effects obtained, and the findings from the survey of the beneficiaries suggest there are improvements in the water supply conditions. Its efficiency is fair as the project cost was within the plan, although the actual project period was longer than planned. The sustainability of the project's effects is also fair as, despite no major problem having been found in the project in terms of operation and maintenance techniques, there is some concern about the structural and financial conditions.

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

1. Project Description

Project Location

Adasiya Pumping Station

1.1 Background

In Jordan, water is quite a scarce resource, even compared with the neighboring countries. Under its framework development study, the Government of Japan conducted several studies, including the Study for the Project for the Improvement Plan of the Water Supply Networks in the Zarqa Region, and the Study for the Water Resources Management Plan. Based on the findings from these studies, Japan continuously offered Jordan grant aid for projects such as the one on the improvement and expansion of water supply networks. The Capacity Development Project for Non-Revenue Water Reduction was carried out between 2005 and 2011 as a technical cooperation project (phase I and phase II). At present, a grant-aid environmental program for the improvement plan of energy efficiency in the water supply networks is being carried out. These aid undertakings were, and are, mainly intended to upgrade Jordan's water pumps and supply pipes, reducing the non-revenue water rate and saving electricity charges. As described above, the Government of Japan has provided assistances to help Jordan improve its techniques for water supply services and minimize losses in the management of water resources. The project was conducted as part of a series of the assistance measures above.

1.2 Project Outline

The project was conducted in the North Shuna region in the northern part of the Jordan Valley and some parts of the Middle District to develop water supply networks and introduce the water resources management so that safe water can be supplied in an efficient manner to help improve the living conditions of the community people.

Grant Limit/Actual Grant Amount		53 million yen/53 million yen (detailed design) 2,011 million yen/1,978 million yen (main construction work)
Exchange of Notes Date		December 28, 2004 (detailed design) June 30, 2005 (main construction work)
Implementing Agency		Water Authority of Jordan (WAJ)
Project Completion Date		February 20, 2008
Main Contractors	Main construction work	Dai Nippon Construction
	Consulting	Yachiyo Engineering Co., Ltd.
Basic Design Study		July 2004 - December 2004
Related Project		None

2. Outline of the Evaluation Study

2.1 External Evaluator

Noriyo Aoki, IC Net Limited

2.2 Duration of the Evaluation Study

A study was conducted as follows for ex-post evaluation of the project:
Duration of the Study: September 2011 – November 2012
Duration of the Field Study: November 26 – December 12, 2011; April 12 – April 21, 2012

2.3 Constraints during the Evaluation Study

The Northern Governorate Water Administration (NGWA) was originally a government institution operating as a division of the Water Authority of Jordan (WAJ), the implementing agency. Under the commercialization policy of the government, the NGWA was reorganized as the Yarmouk Water Company (YWC) in September 2011. In the same month, YWC started working on management reforms under the guidance of a French consulting firm specializing in water supply services. This ex-post evaluation study was conducted in the midst of the period that YWC was striving to implement structural and financial reforms. As a result, the evaluation study had difficulty in collecting information about the form that the organization had taken before the reforms and in obtaining data concerning the project. The consulting firm had already presented YWC with a clear direction of action that it should take for the reform of its operations, but no agreement has been reached between them. Whether the reform plan that the consulting firm showed the external evaluator will be carried out is still uncertain.

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

3.1 Relevance (Rating: ③[2])

3.1.1 Relevance to the Development Policy of Jordan

Before the project was planned, the Government of Jordan had formulated a three-year plan called the Social and Economic Development Plan 2004-2006. In this plan, the government

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

declared several targets for the water supply services sector, including a reduction in non-revenue water, the control of groundwater pumping, enhanced efficiency of the organization, the development of human resources, improvement in the financial conditions, and reduced dependence on the national treasury. Another target was promotion of the optimal use of water resources that should generate maximum economic returns. As issues to be emphasized, the Water Sector Policy at that time mentioned control of the excessive pumping of circulating groundwater, a reduction in unaccounted-for water and leakages, and the introduction of a supervisory control and data acquisition (SCADA) system[3] from the water supply networks.

On the other hand, it is addressed in the Jordan National Agenda 2006-2015 (a national development plan at the time of the study for ex-post evaluation) that relevant projects will be carried out focusing on the improvement of water supply networks as well as measures to reduce non-revenue water and for water pollution, in order to strive for the vision of effective management of limited water resource while cooperating with other donors.

In Jordan's Water Strategy 2008-2022, the latest water supply policy, the government also declared that it intends to promote the supply of appropriate and safe drinking water, measures to reduce non-revenue water, the effective use of existing water resources, the introduction of know-how from the private sector for improving the financial fundamentals, and the adoption of new technologies for upgrading water supply techniques.

Both the national development and water supply policies that were in effect when the project was planned and this ex-post evaluation study was being conducted referred to the effective use of existing water resources and the supply of safe drinking water. Therefore, the project is consistent with Jordan's development policy.

3.1.2 Relevance to the Development Needs of Jordan

Jordan has adopted a policy of prohibiting the development of new groundwater sources to prevent the excessive pumping of water from wells. Thus the country needs to maintain the pumping capacity of the existing wells and use these water resources in an effective manner.

In 1978, Jordan laid water distribution pipes in the Northern and Middle Districts of the Jordan Valley, and asbestos pipes were used for parts of the networks. As the pipes were dilapidated, a significant amount of leakage was found. Deterioration was also conspicuous in the pumping equipment and reservoirs, which meant that they were unable to supply sufficient water for the increasing number of people living on higher land on the hillsides. The problem of low feed-water pressure in highland residential areas and excessively high pressure in the lowlands was evident.

As a solution to these issues, the water service areas was divided into smaller areas, and the valves installed in the water distribution areas were adjusted. However, ad hoc repairs to the water distribution system have resulted in increasing the complexity of the system. The need has thus arisen for a fundamental upgrading of the water distribution system.

The project enabled the upgrading of the water distribution pipes and involved reconstruction of the water supply networks, and was thus successful in reducing the leakage rate. Deteriorated equipment and facilities were also repaired and the capacity of these was expanded, so that the water supply could be managed more efficiently to satisfy the needs of the users. Highland residential areas were supplied with water at an appropriate pressure, and the problem of excessively high water pressure in the lowlands was solved.

[3] The SCADA system is composed of measuring instruments for remote monitoring (flow meters, water-pressure gauges, and water level indicators), central monitoring devices and data transmission equipment. The system has been installed to monitor the amount and pressure of the water supplied and the existing wells.

These achievements demonstrate the great consistency of the project to the needs of the water service operator and the community people.

3.1.3 Relevance to Japan's ODA Policy

Japan's Country-wise Assistant Policy for Jordan refers to the issue of water supply, especially the need to secure domestic-use and irrigation water, in a section about improvements in meeting basic human needs (BHN), which is a priority issue of the policy. JICA's National Project Implementation Plan for Jordan (FY2005) also stated in the section on improvements in BHN, a priority issue of the plan as well, that JICA should help the country expand its water supply capacity, with the effective and efficient use of water taken into consideration. Specifically, the Plan stated that JICA should offer the country support mainly for the development of water supply networks and cooperation activities for reducing non-revenue water.

In light of the above, as the project is fully consistent with Jordan's development policy and development needs, as well as Japan's assistance policy; therefore, its relevance is high.

3.2 Effectiveness[4] (Rating: ③)

3.2.1 Quantitative Effects

3.2.1.1 Operation Indicators

Table 1 below shows benchmarks of the operation indicators observed before the project started, the targets set for the project, and the actual results measured after the project completion. Reservoirs have been expanded to ensure water reserve capacities as planned, and it achieved larger water supply capacities than planned.

Table 1: Operation Indicators

	Benchmark (2003)		Plan (2010)		Actual (2010)		Comparison Actual/Plan	
	Capacity (m^3)	Supply (m^3/h)	Capacity (m^3)	Supply (m^3/h)	Capacity (m^3)	Supply (m^3/h)	Capacity (m^3)	Supply (m^3/h)
Moa's Reservoir	625	194.2	1,600	194.2	1,600	230.0	100%	118%
Tabaqat Fahil Reservoir	650	165.2	2,500	299.2	2,500	300.0	100%	100%
Kreyma Reservoir	600	41.0	600	61.0	600	100.0	100%	164%[5]

Source: Information provided by the North Shuna Office

3.2.1.2 Effect Indicators

Table 2 below shows the benchmarks of the effect indicators observed before the project started, the targets set for the project, and the actual results measured after the project completion. The leakage rate has been lowered, and the water supply provision to the population and the volume/person/day reached 100.4% and 97.0% respectively. The water pressure also achieved the maximum of the target range of six bar,[6] which enables water to be supplied to the highlands.

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

[5] After the project was completed, a reverse osmosis membrane water treatment plant was constructed near the Kreyma Pumping Station as a build-operate-transfer (BOT) project with WAJ. The plant, capable of processing water with excessively high salinity, enables water resources that had been useless to be supplied to the Kreyma Pumping Station. The percentage includes the capacity that was expanded in the plant (100 m^3/hr.).

[6] At the minimum water pressure of 2.5 bar, water can be supplied directly to the fourth floor of a building. Pressurized at six bar, water can reach the highlands.

Table 2: Effect Indicators

Indicator (unit)	Benchmark (2003)	Plan (2010)	Actual (2010)	Comparison Actual/Plan
Leakage rate (%) (Note 1)	30	20	22	90%
Water supply population (persons) (Note 2)	117,674	137,426	137,992	100.4%
Average water supply volume/person/day (L)	114	129	125[7]	97%
Water pressure	–	2.5*-6 bar	6 bar	100%

Source: Information provided by the North Shuna Office

(Note 1) The benchmark and actual value of the leakage rate are calculated based on the non-revenue water rate[8] derived from the volume of water supplied and the water used by customers in the jurisdictional area of the North Shuna Office on the assumption that half of the proportion of non-revenue water comes from physical leakage ([Non-revenue rate] x 1/2[9]).

(Note 2) This is the total of the water supply population in the jurisdictional areas of the North Shuna Office and the Kinanah Office, as well as in two areas in the Middle District. The basic design assumed a water supply rate of 100 percent, setting the target of the water supply population at the same number as the jurisdictional population. The actual result was derived from customer data and the rate of collection of water charges.[10]

As shown in Table 3, all the three reservoirs satisfy Jordan's water quality standards.

Table 3: Water Quality Standards and the Actual Water Quality of the Reservoirs
(Test Results as of the Evaluation Study)

	Planned water quality (treated water) (Note)	Kreyma Reservoir	Tabaqat Fahil Reservoir	Moa's Reservoir
pH	6.5-8.5	7.99	7.48	7.28
Color	Max. 20-39 in cobalt-platinum scale	< 13	5	2
Taste	Acceptable range	Drinkable	Drinkable	Drinkable
Smell	No smell	No smell	No smell	No smell
Turbidity	5 Jackson turbidity units	< 0.56	0.33	0.3
Evaporation residue	1,200 mg/L	596	598	493
Iron	1.0 mg/L	< 0.035	< 0.035	0
Manganese	0.1 mg/L	< 0.05	< 0.05	0
Copper	1.0 mg/L	≤ 0.05	< 0.05	0
Zinc	4.0 mg/L	< 0.08	< 0.08	0.05
Hardness	500 mg/L	186	412	376
Calcium	200 mg/L	42	109	97
Magnesium	150 mg/L	19	34	32

[7] The actual result failed to reach the target as some of the wells in Wadi Arab that were supposed to be available for the project are actually used to meet demand in another area, Irbid.

[8] The non-revenue water rate was 44 percent in 2010. The national average was 41 percent, and the average of the four northern governorates was 38.28 percent. The non-revenue water rate is defined as the amount of water which is not treated as the charged water amongst the total amount of water supply which is brought by the water supply system. It includes the amount of a physical loss, a loss of illegal connection and a loss due to defects of the meters of water supply, The Basic Design Study Report states that the benchmark as of 2003 was 53 percent, and that the target set for 2010 was 40 percent.

[9] Neither WAJ nor YWC analyzed the components of the non-revenue rate (a finding of the field study) and nor has the North Shuna Office. After consultations with WAJ and YWC, a physical leakage rate which is calculated as the non-revenue rate multiplied by 1/2 was adopted for the evaluation to calculate the physical leakage rate. The coefficient is used for reasons of expediency to compute the physical leakage rate when the instruments required to measure leakage are unavailable.

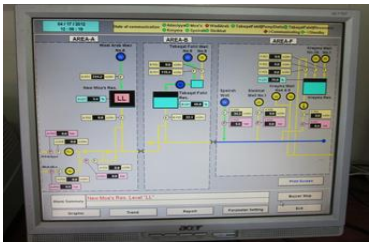
[10] The water tariff collection rate in the North Shuna Office's jurisdictional area was 85 percent in 2011.

	Planned water quality (treated water) (Note)	Kreyma Reservoir	Tabaqat Fahil Reservoir	Moa's Reservoir
Sulfide ion	400 mg/L	9.86	37	23
Chlorine ion	500 mg/L	312	83.4	44
Nitrous acid	2 mg/L	< 0.1	< 0.1	0.019
Nitrate	50 mg/L	16	14	16
Aluminum	0.1 mg/L	< 0.03	< 0.03	0

Source: Data from the Water Quality Laboratory, YWC
(Note) The plan was formulated according to Jordan's water quality standards.

3.2.1.3 Effects of the Soft Component

The soft components of the project were carried out by focusing on the operation of the SCADA system. The staff in the central control room and those at the reservoirs or pumping stations were interviewed separately to examine the current status of SCADA system operation and the related abilities. The staff who was being trained as a candidate for an operator of the system when the soft components were carried out, is now the operator of the system. Three of the four technical workers who received the training now work at the Moa's Reservoir, Kreyma Pumping Station, and Tabaqat Fahil Pumping Station.[11]



Monitor in the SCADA System Control Room

The results of interviews have shown that what they learned in their training concerning the operation of the measuring instruments, operation of the SCADA system, and the maintenance of equipment & instruments still remains useful for their work. Though they also learned about the analysis and the effective use of the data, as well as the detection of abnormal data and the action to be taken regarding water distribution, the collected data is not utilized for water distribution since the data control system was not established[12].

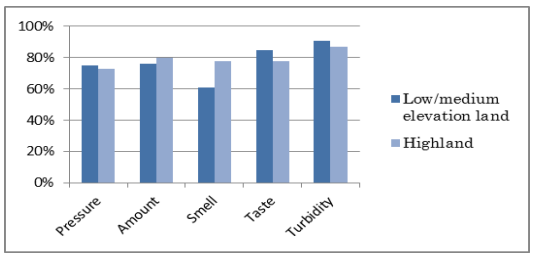
3.2.2 Qualitative Effects

3.2.2.1 Supply-Side Management

Now that water pressure can be adjusted more easily, the frequency of valve adjustment has reduced to one-third of the pre-project level. As information on several water sources and the amount of water held in the reservoirs can be monitored by the North Shuna Office's control room, water supply and distribution can be managed more easily.[13]

3.2.2.2 Evaluation of the Improvements by the Beneficiaries

A survey of the beneficiaries was conducted as a means of quantitative examination of the effects the project had generated.[14] Figure 1 shows the percentage of the respondents who answered "Improved" to questions about improvements in each item based on a comparison of before and after the project.



Source: Results of the beneficiaries survey

Figure 1: Percentage of the respondents who answered "Improved" based on a comparison before and after the project

[11] One of the technical workers was transferred out of the jurisdictional area.
[12] YWC requires no reporting of data (daily, seasonally, or annually), such as the amount of water taken from wells or that supplied from reservoirs which are able to obtained from SCADA system, and the North Shuna Office does not take a record on these data periodically.
[13] Based on information from the workers engaged in maintenance at the North Shuna Office.
[14] The study was conducted using 100 samples collected from the target areas; 45 samples from low/medium elevation land and 55 from the highlands. Households were used as the survey unit as the surveyed areas were residential areas. An average household consisted of 7.2 members. The survey was carried out in November 2011.

To the question about water pressure, 75 percent of the respondents from low/medium elevation area and 73 percent of those from the highlands answered that improvements had been made in comparison with the situation before the project. Asked about water quantity, 76 percent of the respondents from low/medium elevation land areas and 80 percent of the highland respondents said it had increased. Improvements in the smell were recognized by 61 percent of the respondents from low/medium elevation land areas and 78 percent of the highland respondents.[15] Better taste was perceived by 85 percent and 78 percent of the respondents in the low/medium elevation land areas and highlands, respectively. Improvements in turbidity were observed by 91 percent and 87 percent of the respondents in the respective areas.

3.3 Impact

3.3.1 Intended Impacts

3.3.1.1 Improvements in Living Conditions

The survey of beneficiaries conducted as part of this evaluation study shows that 74 percent of all the respondents answered "improved" to the question whether their living conditions had been improved. Among all the respondents, 62 percent answered that the quantity of water had increased, leading to better hygienic conditions. Among respondents living in higher land areas, 42 percent said they had purchased water from mobile tank water suppliers before the project, and all of those former tank water users perceived more convenience compared to before the project. Since tank water is more expensive than tap water, the project allows households who used water from tank suppliers to save an estimated 11.3 Jordan Dinars (JOD) (equiv. approx. 1,296.74 yen) per month.[16]

3.3.1.2 Fair Allocation of the Project Benefits

Beneficially surveys were separately conducted in low/medium elevation lands and the highlands where the water distribution pipes had been laid, and both the residents of low/medium elevation lands and the highlands answered that water supply had been improved. The highlands that had no access to piped water are now supplied with tap water. Other areas that were not supplied with tap water have also gained access to piped water.

3.3.2 Other Impacts

3.3.2.1 Impacts on the Natural Environment

Construction work for the water pipelines caused no damage to the natural environment.[17] Existing asbestos pipes were not removed or crushed but buried under the ground[18] in order to prevent being scattered around. The location of the buried asbestos pipes was plotted on a GIS (Geographic Information System: GIS) map, which was submitted to WAJ. WAJ can identify the location of the asbestos pipes based on the information on buried objects recorded in the GIS map. No land subsidence has been caused by the pumping up of groundwater.[19]

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[15] The smell of the water in the low/medium elevation lands may be caused by, for instance, dirty water seeping under pressure into the connectors between the water pipes when water supply is halted. However, no empirical study has been conducted concerning this hypothesis. (Locally employed experts of the water service)

[16] Water sold from tanks by private-sector suppliers costs 3 JOD per cubic meter. An average household in this region consumes four cubic meters of water every month. As the amount is below the upper limit of tap water available at a monthly basic charge, a household with piped water has only to pay a monthly charge of 0.7 JOD, 11.3 JOD lower than they would have to pay for tank water, or a saving of 1,296.74 yen at the exchange rate as of April 25, 2012 (1JOD = 114.756 yen).

[17] Information provided by parties related to the North Shuna Office

[18] The Ministry of the Environment and WAJ discussed and decided that the existing asbestos pipes should be buried and left underground instead of being removed(Basic Design Study Report).

[19] Confirmed by a local water supply expert employed for the field study.

3.3.2.2 Resettlement and Land Acquisition

No residents were relocated. To acquire the sites for the Tabaqat Fahil Pumping Station and the Adasiya Pumping Station, vacant and arid land of 2,436 square kilometers was purchased.[20] The land was acquired in compliance with Jordanian law[21] without any legal disputes. Landowners agreed to the purchase prices and the other conditions offered.[22]

3.3.2.3 Historical Remains

The project had no impact on any historical remains. As the Tabaqat Fahil Reservoir lies beside the Pella Ruins, which are ancient relics of the Roman and Byzantine era, the detailed design of the reservoir and connecting pipes underwent environment monitoring by the Authority of Archeology. Specifically, the Authority of Archeology gave directions that the reservoir should be constructed at a lower elevation than the existing pumping stations and that the walls should be painted in a color that matched the ruins behind the walls. When the ground was dug to lay the pipes, the Authority of Archeology and WAJ attended the construction site.

3.3.2.4 Considerations for the Residents and Measures to Ensure Smooth Traffic Flows during the Construction Work

During the construction of water distribution pipes, water was sprinkled from water trucks to prevent dust from being stirred up. The Tabaqat Fahil area has a large population; hence, construction work alongside roads was carried out during the night instead of the daytime in order to avoid the traffic disturbance. As a measure to ensure traffic safety on highways where the construction work was being conducted, construction signs and road cones were placed along the roads as early as possible. Traffic controllers, wearing fluorescent vests, were designated to direct traffic around the construction sites,[23] keeping both the traffic and construction safe. Safety management was emphasized, and plans for the workers' safety and health rule were prepared, and the traffic controllers were thoroughly instructed to adhere to those arrangements such as wearing a hard hat, secure footholds, place tools and equipment in a safe place, and take sufficient days off.

3.3.2.5 Impact on Health

There was some concern that the aging asbestos pipes might have a harmful impact on the health of residents. However, this concern was resolved by adopting other safe water distribution pipes such as ductile cast iron pipes[24]. As stated above, construction workers avoided removal of the existing pipes and left them buried underground to prevent the asbestos from being scattered around. Therefore, there were no harmful impacts to construction workers and the local residents.[25]

3.3.2.6 Environmental Monitoring

No environmental monitoring was conducted for any specific issues, other than for the historical ruins.[26]

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[20] The land was purchased for 39.2 JOD per square kilometer and a total of 95,515 JOD was paid. (Information provided by WAJ)

[21] The acquisition of the sites generally proceeds in the following order. Firstly, based on a design plan, a consultant informs WAJ of the land sites needed to be acquired. Then WAJ's Expropriation Department sets a price for the land, and offers the landowners the purchase conditions. If they do not accept the price or any other conditions, WAJ continues negotiating with the owners until they reach an agreement. During the process, some modification may be made in the design, if necessary. Once the owner's consent is obtained, WAJ notifies the consultant to start the construction work. Land sites for the project were acquired according to these general procedures.

[22] Information provided by WAJ

[23] Confirmed with photographs and a report submitted by WAJ and a consulting firm

[24] Ductile cast iron pipes cause no harm to human health and have great resilience, corrosion resistance and other properties required for distribution pipes.

[25] Information provided by WAJ and a consultant

[26] Information provided by WAJ and a consultant

As mentioned above, it should be concluded that the intended impact of improvement in the living conditions and the fair distribution of water between areas has been achieved.

In light of the above, the project has succeeded in generating outcomes that were almost as planned; therefore, it should be concluded that its effectiveness is high.

3.4 Efficiency (Rating: ②)

3.4.1 Project Outputs

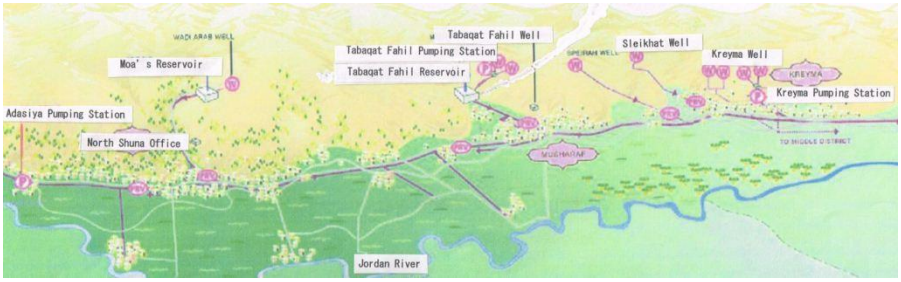
Table 4 and 5 below show the outputs (plan and actual) of Japan and Jordan respectively.

Table 4: Outputs of Japan (Plan and Actual)

Item	Plan	Actual
1. Replacement of the main and branch distribution pipes	1) Northern District: 57,739 m 2) Middle District: 3,580 m Total: 61,319 m	Completed almost as planned[27]
2. Procurement of branch distribution pipes	1) Northern District: 72,778 m 2) Middle District: 875 m Total: 73,653 m	Completed as planned
3. Replacement of pumping stations (Northern District only)	1) Adasiya Pumping Station 56 m^3/h×274 m×2 units 32 m^3/h×74 m×1 unit Pump house: 1 2) Tabaqat Fahil Pumping Station 160 m^3/h×10 m×1 unit 188 m^3/h×64 m×3 units Water tank (380 m^3×1 unit) Pump house: 1 3) Kreyma Pumping Station 163 m^3/h×40 m×2 units Pump house: 1	Completed as planned
4. Reservoir remodeling (Northern District only)	1) Moa's Reservoir 1,600 m^3×1 unit 2) Tabaqat Fahil Reservoir 2,500 m^3×1 unit	Completed as planned
5. Construction of a SCADA system (Northern District only)	1) North Shuna Office (i) Remote monitoring (telemeter panel, personal computers, CRT, printers, software, etc.) 2) Pumping stations, reservoirs and wells (i) Electromagnetic flowmeters, water pressure meters, telemeter panels, and water level indicators	Completed as planned
6. Technical transfer for the SCADA system (soft components)	1) Deliverables (plan) (i) Equipment management manual (ii) Manual for effective use (iii) Evaluation report on the level of understanding of the training participants (iv) Soft components completion report (English) (v) Soft components completion report (Japanese)	Completed as planned

Source: Basic Design Study Report, materials provided by JICA and the responses to questionnaires

[27] According to a CAD drawing provided by YWC, 60,250 meters of pipes have been laid.



Source: Drawn based on the completion drawing in the Basic Design Study Report

Figure 2: Image of the Water Supply Facilities in the Northern Jordan Valley

Table 5: Outputs of Jordan (Plan and Actual)

Plan	Actual
1. Acquisition and creation of sites for reservoirs	Acquisition and creation of sites for the Tabaqat Fahil Reservoir and the Adasiya Pumping Station
2. Construction work for laying the branch distribution pipes	Branch distribution pipes totaling 79,807 meters were laid.
3. Construction work for laying the connecting pipes for individual houses	Connecting pipes totaling 54,250 meters were laid for 7,901 households.
4. Bringing power lines into the facilities	Completed as planned.
5. Bringing telephone lines into the facilities	Completed as planned.
6. Acquisition of water to meet the additional distribution requirements[28]	Completed almost as planned.[29]
7. Securing of technical workers engaged in training and instruction for water purification facilities operation and SCADA system management	Completed as planned.

Source: Basic Design Study Report and interviews with the related parties

3.4.3 Project Inputs

3.4.3.1 Project Cost

The project, prepared with 2,064 million yen as E/N grant limit, was completed with an actual expenditure of 2,031 million yen, or 98 percent of the estimate. The input of the soft component of training was one month (17 person-days of training), with no change from the plan. Regarding the project cost of Jordan side, against its estimated total expenditure[30] of 296 million yen,[31] it actually expended 298.74 million yen.[32] Taking into account changes in the exchange rate between the times of estimation and project implementation, it should be concluded that the actual total expenditure remained within the plan.

[28] It was necessary to obtain water from other regions and secure a sufficient quantity of water to supply the target areas that the project was designed to cover.

[29] Some of the wells that were supposed to be available for the project turned out to be unavailable as they were needed to supply water to another area that became short of water. As a result, the total amount of water available in the regions that the project was designed to cover fell short of the quantity assumed in the plan.This shortfall was covered by installing a reverse osmosis membrane water treatment plant that was constructed near the Kreyma Pumping Station as a BOT project with WAJ, although the plant is not included in the scope of the project.

[30] The Basic Design Study Report

[31] The estimation was made in August 2004, and the exchange rate at that time (the average over the past six months from August 31, 2004) was 110.49 yen to the US dollar and 156.06 yen to the JOD.

[32] The estimation was made in July 2005, and the exchange rate at that time (the average over the past six months from July 31, 2005) was 114.94 yen to the US dollar and 162.99 yen to the JOD.

3.4.3.2 Project Period

The project was originally planned to be completed in 35 months.[33] It actually took 37 months (106 percent of the planned period) for completion[34]. The parts of the project done by Jordan side were completed within the planned period.

To oversee the progress of the project, WAJ formed a project supervisory team with representatives from WAJ, Authority of Archeology and the municipalities, as well as the contractors and consultants. They had regular meetings in the headquarters or on site as needed, to ensure and make adjustment of the progress and the challenges of the work, negotiate and solve the problems, and to establish a scheme for the efficient implementation of the project.[35] When a construction is carried out in Jordan, the Jordanian parties often fail to complete the preparations on schedule, such as for land actuation and the acquisition of approvals or permits, which affects the progress of the main construction work.[36] The completion of the project without delays was due to effectiveness of these supervisory arrangements.

In light of the above, the project cost was within the plan, but the actual project period was longer than planned; therefore, it should be concluded that its efficiency is fair.

3.5 Sustainability (Rating: ②)

3.5.1 Structural Aspects of Operation and Maintenance

NGWA, a branch of WAJ, was reorganized as YWC[37] in September 2011, and the North Shuna Office was also transferred to YWC as its branch. A French water service consulting firm concluded a five-year contract with WAJ for management reform after it had won a competitive bid.[38] Specifically, they are trying to carry out reforms to reduce deficits, save power consumption for the pumps, respond to the increase in the population with the inflow of refugees and migrants, lower the non-revenue water rate, provide better services to customers, and maintain, upgrade and replace facilities and equipment.

The French consulting firm submitted a plan for the organizational reform of YWC[39] to WAJ, but many YWC employees[40] rejected it. At the time this evaluation study was being conducted, the organizational structure remained unchanged from what it had been as the NGWA.

The North Shuna Office is composed of Departments of the Customer, Engineering & Maintenance, and Finance & Administration. It has 79 employees including an engineer[41] and 15 diploma holders. Other than employees that work in the office building, most of the employees are technical workers who maintain the facilities and turn out on tractors and power shovels to

[33] Ex-ante Evaluation

[34] February 2005 - February 2008 (37 months)

[35] Findings from an interview with the then WAJ manager in charge of the project

[36] There is a particular case that a project conducted with another donor for the improvement of a water distribution network in the Northern District, which was completed significantly behind schedule due to delays in the work of the Jordanian implementing agency.

[37] YWC is fully owned by WAJ, and its budget is financed by WAJ. It is not a financially independent entity.

[38] Part of the payment to the contractor is financed by the European Union (EU), which has provided grant aid of €900,000 for financial audit techniques and the dispatch of a chief supervisory officer and administrative engineers. In line with the contract, KfW (Kreditanstalt für Wiederaufbau) has offered an interest-free loan of €4.2 million for investment in facilities in the Northern District. The EU and Germany are working in coordination to provide support for the management reforms.

[39] The French water service consulting firm focused on functions in designing the organizational structure that it proposed, which was composed of IT, Human Resources, Operation and Maintenance, Finance and other Departments. YWC's existing organization is made up of regional branches.

[40] The proposal included the major reform of the organizational structure that YWC had inherited from the former NGWA, and its employees rejected the proposed reform, and started a campaign against it. The Minister of Water and Irrigation intervened, and decided that the existing organization should be maintained.

[41] Engineers, defined differently from Japanese ones, are obliged to have a bachelor's or higher degree.

solve problems, such as water leakages and accidents related to the water supply and distribution pipes.

To date, YWC has not established a scheme to collect, manage, or effectively use information obtained through SCADA concerning, for instance, the trend in changes in the water level of water source wells.

3.5.2 Technical Aspects of Operation and Maintenance[42]

At the time the project was completed, technical workers engaged in operation and maintenance had already obtained the level of technical skill required for routine operation and maintenance. For the project, WAJ staffed the central control room with employees familiar with information technology, and those staff had attended training courses under the project and obtained considerable expertise in the SCADA system.

No specific training or technical guidance has been offered for maintaining or raising technical level other than the training by soft component or the training provided by the constructor during and after the construction work. However, what was taught in these training courses is transmitted and shared among the operation and maintenance workers of the North Shuna Office through their work on the ground.

As for training needs, YWC has examined what kind of training is necessary for each organization and prepared a training plan, which has been sent to WAJ for approval. The present state suggests they need training for developing a scheme to manage, analyze, and effectively use information obtained through SCADA and other data. From the medium- and long-term viewpoint, some technical guidance is needed concerning the removal of dirt in the pumping stations, the adjustment of drainage, and other issues that have no specific impact on present operations but could cause trouble someday.

A management plan for the facilities and equipment and a maintenance and inspection scheme have been established. The frequency and method of daily and regular inspections have also been set out. Maintenance logs are produced and the water pressure and quantity, and chlorine adjustment are recorded.

Pump glands must be kept wet, with a small quantity of water deliberately leaked onto them for the purpose of lubrication maintenance of the main shaft, and so that any air is removed from inside the pumps. However, this technique is not employed at present. If the present condition continues, the pumps will be damaged as the gland packing will heat up and/or its life will be shortened. Technical guidance should be offered.

3.5.3 Financial Aspects of Operation and Maintenance

WAJ and YWC are authorized to manage the financial affairs of the North Shuna Office. The office has no budget that can use for maintenance at its discretion. Every fiscal year, the office notifies YWC of the number of maintenance parts, such as pipes and meters needed to be repaired. It cannot obtain them unless YWC and WAJ give their consent. Judging from answers that Jordanian water supply experts gave when the external evaluator asked in detail about the present state of maintenance, it is hard to say that sufficient expenditures are being made for operation and maintenance for the medium- and long-term needs.

[42] In the project, technical guidance was provided mainly to the North Shuna Office in the Northern District. The external evaluator has no information of maintenance in the Middle District mainly because it is administered by another organization, just as the basic design was.

Water rates were revised in January 2011.[43] Water rates are revised through general procedures; WAJ proposes a revision to the Water Rate Commission of the Ministry of Water and Irrigation, and then puts the proposal to the parliament to ask for its approval. Water rates are set based on the socio-economic conditions of each region, rather than the economics of WAJ. Each regional water service agency is operated on the basis of the water rates set for the region, but generally they would make a loss if they were dependent solely on the water charges. YWC stated that the cost of water supply in the Northern District as a whole[44] is 1.1 JOD per cubic meter.[45] WAJ has a plan to save electricity charges by replacing pumps and fixing distribution pipes to lower the cost of water supply[46]. Table 6 shows YWC's water charges.[47]

Table 6: YWC's Water Tariff Rates (2011: in JOD)

User category	Rate
Households (< 7 m^3)	0.700
Households (< 13 m^3)	0.145/m^3
Households (< 19 m^3)	0.500/m^3
Households (< 25 m^3)	0.940/m^3
Households (< 30 m^3)	0.145/m^3

Source: YWC

WAJ also operates at a loss.[48] Table 7 shows the revenues and expenditures in 2009 and 2010. Revenues increased to nearly 1.4 times the level one year before while expenditures decreased by 14.3 percent. As a result, WAJ's deficit fell at least over these two years.[49]

Table 7: WAJ's Revenues and Expenditures (in JOD)

	2009	2010
Revenues		
Water sales and charges	34,249,747	39,681,779
Equipment rental fees	9,269,000	12,260,000
Sewerage charges	9,246,100	7,116,782
Meter management revenues	3,110,414	2,395,587
Contract household water service connection charges	1,697,496	1,744,546
Other revenues[50]	797,137	682,566

[43] Water charges revised in January 2011 were set to be paid monthly. At the time of the second field survey in April 2012, the system had been changed to pay every three months. The change was revised again in January 2012, as it turned out that the collection rate was higher for payment once every three months than for monthly payments.

[44] Water supply costs are higher than the income from water rates not only in the Northern District, but everywhere in Jordan. The government must bear the cost, as the more water customers consume. Hence, the more people are called on to save water or water supply restrictions are imposed nationwide.

[45] The exchange rate was 108.79 yen to the JOD as of December 31, 2011.

[46] Another donor provided YWC with technical aid to improve its schemes and organizations, including the methods of water cost analysis and price-setting; however, socio-economic aspects are also considered for the actual raise in water rates. A raise in water charges in proportion to the increase in water service costs was strongly opposed by the parliament and citizens, and YWC failed to set the rates proposed by the donor.

[47] The survey of beneficiaries revealed that water rates were seen as high by 66 percent of the beneficiaries, as a little high by nine percent of them and as reasonable by 25 percent of them. Most of the households that had used tank water previously responded that the water rates were reasonable as even the raised water charges were lower than the price of water sold by the tank water suppliers.

[48] To cope with its different water conditions from other countries, Jordan buys or borrows water from Israel and Syria during summer, when demand is high. The Yarmouk River, which has Lake Tiberias as its riverhead, flows 300 meters below sea level, and is 170 kilometers from Amman. The highland metropolis needs to pump up water from the river lying 1,200 meters below it and the electricity charges for running the pumps raise the maintenance costs. WAJ's deficits are made up for by the state budget.

[49] Parties related to WAJ explained that part of the decrease was the result of a 10 percent reduction in the number of employees.

	2009	2010
EBITDA	12,208,126	19,033,670
Other revenues	1,811,210	2,108,512
Foreign exchange losses	0	15,818,037
Total revenues	**72,389,230**	**100,841,479**
Expenditures		
Water purchases	3,313,754	3,821,944
Salaries and wages	20,668,595	19,690,810
Operation and maintenance expenses	21,146,904	20,324.226
Administration expenses	1,032,515	1,010,610
Expenditures for the sewerage business	22,543,533	13,398,752
Depreciation expenses	67,568,402	68,491,052
Uncollected water charges	2,920,107	1,000,000
Expenses before interest and taxes	79,012,706	61,747,622
Financial fees	21,637,189	24,117,242
Foreign exchange losses	9,335,762	0
Total expenditures	**249,179,467**	**213,602,258**
Annual earnings	**-176,790,237**	**-112,760,779**

Source: Data obtained from WAJ's Financial Department

As the reform of YWC started in 2011, financial data on the former NGWA was only available for the time this evaluation study was being carried out. Table 8 shows the revenues and expenditures of NGWA in 2009 and 2010. In both years, NGWA made a loss, and electricity charges accounted for 56 percent of the maintenance expenses. YWC intends to oblige employees to keep the necessary records, such as operation logs for pumps and vehicles, as a way of reducing expenditures, especially power charges and the fuel expenses for vehicles.[51]

Table 8: NGWA's Revenues and Expenditures (in JOD)

	2009	2010
Revenues		
Sales of water to other governorates	12,508,932	13,127,018
Water service customer connection charges	1,435,095	1,555,153
Sewerage charges	1,168,948	1,196,063
Sewerage connection charges	470,656	823,724
Sales of water tanks	481,217	496,954
Sales of water to WAJ	359,465	269,790
Metered customer charges	257,671	246,142
Agricultural water charges	4,356	3,046
Other revenues	2,175,870	94,984
Total revenues	**18,862,210**	**17,812,874**
Expenditures		
Maintenance expenses (Breakdown shown in Table 10)	16,040,301	17,950,738
Personnel expenses	7,669,266	7,773,076
Depreciation expenses	2,921,137	3,437,685
Administration expenses	686,491	779,366
Total expenditures	**27,317,195**	**29,940,865**
Annual earnings	**−8,454,985**	**−12,127,991**

Source: Data obtained from YWC's Financial Department

[50] Including revenues from water supplied to other regions.
[51] Information provided by YWC's Financial Department

Table 9: Breakdown of the Maintenance Expenses (in JOD)

	2009	2010
Electricity charges	8,986,031	10,204,111
Maintenance expenses	2,776,535	2,672,168
Purchase of water from private wells	1,370,417	1,476,486
Fuel expenses	1,304,785	1,423,509
Compensation	313,224	1,037,801
Transport expenses	503,938	654,256
Expenditure on chemicals	277,761	227,179
Machine and vehicle expenses	462,597	203,509
Purchase of water from WAJ	45,013	51,719
Total maintenance expenses	16,040,301	17,950,738

Source: Data obtained from YWC's Financial Department

3.5.4 Current Status of Operation and Maintenance

Local experts on water supply stated that there are some issues in the operation and maintenance of the facilities and equipment, but in general the local offices perform maintenance themselves as far as they can, and no specific problems found in the appearance or performance inspections. They also said that a sufficient quantity of parts is supplied for maintenance,[52] but actually slight improvements are still needed in the maintenance work. For instance, as local offices have difficulty in procuring some types of spare parts, such as the larger sizes of valves for the distribution pipes, it may not be possible to stop water leakages until such parts are obtained,[53] and the water supply may cut off in the meantime in the affected area.

The Tabaqat Fahil Pumping Station was constructed in a low site to preserve the appearance of the historic ruins. The pumping station was hit by unprecedented torrential rain[54] in May 2008 during the defects liability period, and its pumping facilities were inundated. To control the rainwater, the pumping station was surrounded by U-shaped trenches capable of draining off 50 millimeters per hour, and the pump room had an automatic drainage pump with a water gauge installed on the floor. However, when the floodwaters began coming into the station, operators urgently turned off the power to shut down the main pump,[55] causing the drainage pump to stop working as well. The consultant, after discussions with WAJ, made the necessary repairs to the machines and electrical equipment and replaced the broken parts. After the incident, the constructor and consultant built protective walls to prevent the inflow of rainwater. Specifically, the Japanese consultant constructed 60 centimeters in height cut-off walls (breast walls) outside the U-shaped trenches surrounding the pump station. WAJ also built earthen banks.

In addition, the following facts were observed.

- No water leakage had occurred in the pumping stations, except some pumps at the Tabaqat Fahil Pumping Station. At Tabaqat Fahil Pumping Station, the leaked water was being pumped out, but some water was observed gathering in cable pits or gutters formed like U-shaped trenches that were used to lay the wires from the control panel to the pumps[56].

[52] Information provided by a maintenance manager at the North Shuna Office

[53] The North Shuna Office says that the Irbid Branch is almost 80 kilometers away, and that it takes more than one day and a half to contact the branch and acquire the necessary parts.

[54] It was such torrential rain, even by local standards, that the meteorological data could not be measured. (Information provided by WAJ)

[55] It is insisted that this action was also necessary to prevent workers from receiving electric shocks.

[56] The Inspection Report has already pointed out this situation.

- At the Tabaqat Fahil Pumping Station and the Kreyma Pumping Station, some equipment was rusted and stained with calcium carbonate contained in the groundwater[57].
- After the project was completed, a reverse osmosis membrane water treatment plant was constructed near the Kreyma Pumping Station, and a new pump was added to the Station. However, information on the new pump was not added to the SCADA system due to systemic restrictions of the program used.[58]
- The SCADA system is designed on the assumption that reservoirs maintain a certain amount of water, and when the water declines below a certain level, the system gives a warning. Therefore, the warning switch was kept off when the SCADA system was in use.
- Some of the communication cables for the SCADA system were stolen and new cables had been installed. However, they were later stolen again and had been abandoned without repair. The cable system is set to be restored with some safety monitoring arrangements, when SCADA systems are introduced throughout the Northern District with the aid of the Spanish government.[59]

In light of the above, there was no major problem found in the maintenance techniques for the project, but some issues remain in its structural and financial conditions, thus the sustainability of the project effect is fair.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

The project is highly relevant as it is consistent with Jordan's development policy and the priority issues of Japan's assistant policy, as well as the fact that the country has high needs for development. Its effectiveness is also high as the project has achieved targets in most of the major effect indicators, with significant effects obtained, and the findings from the survey of the beneficiaries suggest there are improvements in the water supply conditions. Its efficiency is fair as the project cost was within the plan, although the actual project period was longer than planned. The sustainability of the project's effects is also fair as, despite no major problem having been found in the project in terms of operation and maintenance techniques, there is some concern about the structural and financial conditions.

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

4.2 Recommendations

4.2.1 YWC

Organizational scheme:

The North Shuna Office has no stock of some important spare parts in its warehouse, and needs to contact YWC's Irbid Branch to acquire them. A scheme should be set up to allow local offices to manage spare parts themselves.

The North Shuna Office has no document produced to record the monthly water distribution or water reserves, and has no way to monitor long-term trends in seasonal changes in the

[57] In relation to this point, the Inspection Report has already pointed out as the same as note 55.

[58] There was no one besides the original programmer who was able to modify or expand the SCADA system program. (Information provided by the consultant)

[59] According to the information provided by a member of YWC's Strategic Planning Office, a decision has been made to introduce SCADA systems in the four northern governorates with the aid of the Spanish government. At the time the second field survey was being conducted, the plan had already been approved by WAJ, and it was before the Jordanian parliament for its approval. Once approved, the systems will come into operation in 2012. Control rooms will be installed in the four governorates and a central control room will be set up in the YWC headquarters in Irbid. With the introduction of the new SCADA systems, the North Shuna Office's system will also be connected to the central control room at YWC. A plan has been prepared to lay new cables to replace the stolen ones and install surveillance cameras around them to prevent theft.

groundwater level. YWC has not established a data management scheme to analyze information obtained from the SCADA system and use it for control, forecasting, or estimation of water supplies. A scheme to manage the data should be developed.

Financial scheme:

YWC and WAJ retain all information and authority concerning financial affairs. Power to make decisions concerning the supply of parts and the repair of tools for maintenance should be transferred to local offices.

Technical management scheme:

At the time of the defects study, some problems had already been pointed out, such as the need for adjustment of the pump gland leakage in the pumping stations, painting of the pumps, repair of the cable pits with water leakage at the Tabaqat Fahil Pumping Station, and the removal of rust on the pumps and stains from calcium carbonate contained in the groundwater. However, no improvement was observed in the field study. So far no supervisory or maintenance system has been established for the inspection and maintenance of these basic details. YWC's prevention and maintenance team visits the work sites to give guidance to people working on the ground. To ensure that this guidance work effectively and the maintenance work is conducted according to the actual conditions at the sites, YWC should set up an internal system to supervise and monitor its maintenance.

4.2.2 North Shuna Office

Technical transfer within the organization:

As reform is set to start at YWC, it should make sure that the techniques and expertise of the maintenance work for the project is transferred to the employees in the North Shuna Office in order to minimize the negative consequences of the redeployment of personnel or any other changes.

Emergency response drills:

As the possibility cannot be ignored that unexpectedly heavy rain such as that experienced in Tabaqat Fahil may cause similar trouble, crisis management arrangements should be established by, for instance, giving operators and other parties concerned regular drills to prepare for unexpected incidents, so that they will keep crisis management in mind in their daily work.

4.2.3 Recommendations for JICA

None in particular.

4.3 Lessons Learned

It was appropriate that the implementing agency assigned employees familiar with information technology to the North Shuna Office when the SCADA system was introduced. This arrangement was carried out based on a suggestion given by the Japanese side to WAJ. Before the project started, the North Shuna Office had no personal computers, and the Japanese side concluded that this office should be staffed with a worker qualified to control the SCADA system, and made a suggestion to this effect. As seen in this case, the SCADA system can only be introduced after the necessary personnel are assigned since they make a great difference to the operation and maintenance once the system comes into service.