Ex-Post Project Evaluation 2014: Package I-3

(Tunisia, Egypt, Lebanon)

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Republic of Tunisia

Ex-Post Evaluation of Japanese ODA Loan

"Photovoltaic Rural Electrification and Water Supply Project"

External Evaluator: Machi Kaneko, Earth & Human Corporation

0. Summary

This project has aimed to improve livelihood in rural communities and promote development in the livestock industry in Tunisia by installing equipment such as solar photovoltaic systems, thereby contributing to the improvement of overall living standards in target areas.[1]

At the time of the project appraisal and ex-post evaluation there was a change in political power in Tunisia due to the Jasmine Revolution in 2011 and the shift to democratization took about four years to complete. The new government, formed in February 2015, has indicated its plan to address social and regional inequalities. At both the time of the project appraisal and ex-post evaluation, electrification of remote rural communities through solar energy and supplying of water were regarded as important developmental needs that would contribute to reducing regional inequalities in Tunisia. In addition, this project is consistent with Japan's ODA policy at the time of the project appraisal. Therefore, this project has been deemed highly relevant due to its consistency with Tunisia's Development Plan, development needs, and Japan's ODA policy.

This project consisted of two parts: (1) rural electrification by installing decentralized Solar Home Systems (SHS) at each household in remote rural communities, and (2) water supply by installing desalination equipment and solar photovoltaic systems at wells in southern rural communities. Implemented as planned, the rural electrification portion of the project contributed to electrifying 500 households in remote rural communities. SHS installed in this project are expected to aid in improving the lives of people in target households for years to come. In contrast, the water supply portion of this project, which comprised a larger portion of the project's total budget than the rural electrification portion, was not implemented during the loan period. For this reason, operation and effect indicators fell far short of the set targets as outputs for the water supply portion of the project, which accounted for numerous project targets, could not be observed in the ex-post evaluation. Comprehensively considering the above, the project has achieved limited effectiveness compared to its plan. Therefore the effectiveness and impact of the project are low.

Although the project cost was within the plan, the project period far exceeded the plan.

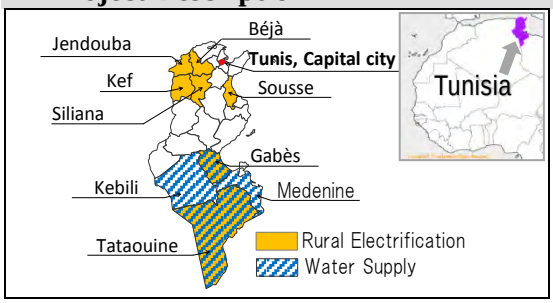
[1] The targeted region for water supply portion of the project was southern Tunisia, which relies heavily on groundwater as a water source. The plan set out to promote livestock raising by providing assistance intended to ensure drinking water (human and livestock use) to be used in the livestock trade which nomadic people of this region are engaged in.

Therefore, efficiency of the project is fair. Primary reasons for delay in the project include a significant delay in the bidding procedure of selecting consultants related to the water supply portion of the project, and in addition, considerable time was needed for coordination between relevant ministries debating the administrative structure for operation and maintenance of desalination equipment, hence, resolution could not be reached even when the loan disbursement deadline was closed.

In terms of sustainability, under the supervision of the National Agency for Energy Conservation (ANME), the SHS installed in the rural electrification portion of the project were operated and maintained with the mutual cooperation of ANME local offices, fitting contractors, and beneficiary households. No major problems have been observed in the institutional, technical and financial aspects of the operation and maintenance system. Therefore sustainability of the project effects is high.

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

1. Project Description



Project locations

Solar panels installed in the project (Siliana Governorate)

1.1 Background

Based on government-led five-year plans, the Tunisian government has aimed to improve household electrification rates since the 1980s. By the end of the Eighth Five-Year Development Plan (1992-1996), almost 100% of urban areas achieved electrification. Even nationwide, household electrification rates have steadily improved; in 1994 the average nationwide electrification rate was 86.8% but reached 96% by 2002, and the Tenth Five-Year Development Plan (2002-2006) set forth a goal to raise the average nationwide electrification rate to 97.7% by 2006.

However, because the Tunisian government has set upper limits on investment cost for electrification through development of the distribution network, rural communities, which are located far from existing distribution networks, exceed the upper limit and thus have had no distribution lines constructed. This has resulted in non-electrified settlements scattered across the remote rural regions and is a factor that causes regional inequalities

in living conditions between urban and rural areas.

Meanwhile rural communities in southern Tunisia, which receive extremely little rainfall of 100 to 200 mm annually, are dependent on the groundwater water resources. In order to secure drinking water (for humans and livestock) for the livestock raising, which is one of the major livelihoods in the region, electric power is needed to operate desalination equipment to convert saline well water to fresh water, and also needed to power pumps to pump water from deep wells. However, it is impossible to supply power through the existing distribution network since livestock wells are scattered in pastures located far from cities. It is for this reason most wells have a diesel generator set up. For diesel power, however, fuel must be transported for tens to hundreds of kilometers along unpaved roads and then stored. Maintenance has also become a huge burden due to the frequency of generator breakdowns, which occur because equipment operates in such a harsh natural environment.

Under these circumstances, this project has been planned to install independent power sources that utilize solar energy in non-electrified remote rural communities, and at water-wells in southern rural areas.

1.2 Project Outline

The objective of this project is to improve living standards in rural communities and promote development in the livestock industry in Tunisia by installing solar photovoltaic systems as alternative sources of energy, thereby contributing to the improvement of livelihood in target areas.

Loan Approved Amount / Disbursed Amount	1731 million yen / 257 million yen
Exchange of Notes Date / Loan Agreement Signing Date	June 2005 / June 2005
Terms and Conditions	Interest Rate: 0.4% Repayment Period: 40 years (of which, Grace Period is 10 years) Main Contracts: Tied (Special Terms for Economic Partnerships (STEP))
Borrower / Executing Agency(ies)	Government of the Republic of Tunisia / National Agency for Energy Conservation
Final Disbursement Date	December 2012
Main Consultant	Nihon Techno Co., Ltd. (Japan) / ALCOR (Tunisia) (joint venture)
Related Studies (Feasibility Studies, etc.)	Special Assistance for Project Formation (SAPROF) "Republic of Tunisia Photovoltaic Power Generation Project" (JICA, November 2004)

2. Outline of the Evaluation Study

2.1 External Evaluator

Machi Kaneko, Earth and Human Corporation

2.2 Duration of Evaluation Study

This ex-post evaluation study was carried out in the following schedule.

Duration of the Study: August 2014 - November 2015

Duration of Field Study: January 29 - February 27, 2015, and May 27 - June 16, 2015

2.3 Constraints during the Evaluation Study

For reasons related to safety measures in Tunisia, field studies were not performed in any parts of Kef and Jendouba Governorates, or in certain parts of Gafsa, Kebili, Medenine, and Tataouine Governorates.

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

3.1 Relevance (Rating: ③[3])

3.1.1 Relevance to the Development Plan of Tunisia

National Development Plan

At the time of the project appraisal, the Tunisian government was promoting an economic policy intended to improve international competitiveness, address inequalities between regions, and improve productivity in the private sector through its Tenth Five-Year Plan (2002-2006), the country's national policy for socioeconomic development. The use of solar power and other renewable energy was encouraged in this plan, and in May 2003 a "presidential decree" was promulgated which encouraged the use of renewable energy, established relevant laws, and promoted public awareness in citizens. Emphasis has also been placed on rural electrification using solar energy as well as rural development and through the development of water supply facilities.

Democratization of Tunisia took about four years from the Jasmine Revolution which broke out in January 2011. At the time of the ex-post evaluation, this democratization process was complete and a new political power was finally established in February 2015. Although a national development plan has not been developed since the revolution, the new government plans to begin deliberations in Parliament for a 2016–2020 national Five-Year Plan that would start in January of 2016. One of the central themes in the plan development process is continued effort towards addressing social and regional inequalities. Consequently, based on the new government's policy, preparations to draw

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

[3] ③: High, ② Fair, ① Low

up sector development plans and regional development plans have been progressing concurrently.

Renewable Energy-Related Policies

At the time of the project appraisal, the Tunisian Electricity and Gas Company (hereinafter "STEG"), which is under the umbrella of the Ministry of Industry, Energy and Small and Middle Enterprises, had received the Tenth Five-Year Plan and was working towards electrification through the expansion of the power distribution network. Meanwhile for electrification of remote rural areas, which are difficult to connect to the power grid, a plan to use solar energy was being promoted under the National Agency for Energy Conservation (hereinafter "ANME"), who also operates under the same umbrella. Specifically, in order to achieve 100% electrification nationwide by 2010, a goal was set to cover about 97% percent of the population through the power distribution network, and install renewable energy-powered generation equipment as independent power sources for the remaining 3%.

At the time of the ex-post evaluation, it was confirmed that even after the revolution, nationwide dialog continued among the energy sector and working groups of relevant ministries centered on the Ministry of Industry, Energy and Mines. This is because the renewable energy sector continues to be an important issue in Tunisia. Recommendations made through this work have been adopted, such as the need for long-term vision, decentralization of energy policies, and the gradual elimination of energy related subsidies in order to reduce the financial burden on the government, and by June 2014 the "Strategie Nationale de Maîtrise de l'Energie" (National Energy Management Strategy)[4] was announced, which set forth the goal of 30% of power deriving from renewable energy by the year 2030. Implementing the same strategy, the energy transfer fund "Fonds de Transition Energétique" (hereinafter "FTE")[5] established through the 2014 Budget Act, designating ANME to act as the operating entity of the fund. In addition, energy transfer legislation (NO.12 1105-2015) was adopted in May 2015, which is positioned as a collection of several operations related to energy transfer.

The decentralization of energy policies will continue in the future, while rural electrification plans will be handled within the framework of governorate development plans. FTE will not only be utilized as an assistance system to facilitate SHS installation, but will also implement the PROSOL program ("Promotion du Solaire en Tunisie"),

[4] Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) provided support for the Strategie Nationale de Maîtrise de l'Energie.

[5] Fonds de Transition Energétique (FTE) : An energy efficiency action plan for the years 2015 to 2020 is formulated with the estimated budget for this period at 663 million TD (Tunisian Dinar). According to ANME, FTE capital participation places emphasis on investment from the private sector and ANME is positioned as the operating entity of the fund.

which links STEG and ANME together in order to promote individual purchases of solar water heaters. As shown in Table 1 below, behind this promotion trend is the fact that the nationwide electrification rate in 2014 was already 99.8% with even rural areas reaching 99.4%, and so in order to expand electrification and the use of renewable energy past this, and under a continuing reduction of financial burden on the government, the Tunisian government decided that plans should be implemented based on actual conditions in each governorate.

Table 1 Nationwide Average Electrification Rates

Units: %

Year / Region	2004	2005	2010	2012	2013	2014
Nationwide	99.0	99.3	99.5	99.6	99.7	99.8
Urban areas	99.7	99.7	99.8	99.8	99.8	99.9
Rural areas	97.3	98.2	98.9	99.1	99.2	99.4

Source: Documents provided by ANME

Rural Water Supply in Southern Rural Areas

At the time of the project appraisal, efforts to improve livelihood of residents engaged in the agriculture and livestock trades and supply of water to remote areas, as well as other efforts were underway in response to the Tenth socioeconomic Five-Year Plan.

At the time of the ex-post evaluation, we confirmed that research of water resource strategies was underway based on the long-term vision to develop water resources and in preparation for the 2030 goal. The strategy research found that although the population growth rate of Tunisia is only expected to grow within 1% from 2010 to 2030, GNP is expected to double, and thus an increase in drinking, agricultural, and industrial water demand is forecast as a result. According to the same research, Tunisia's water resources (surface water and groundwater) are presumed to be 4,760 Mm^3/year and not expected to increase to 2030. Accordingly, additional costs are also expected to be incurred to improve water quality. Groundwater is heavily relied on particularly in southern Tunisia due to the scarce amount of surface water, and given that most of the groundwater is high in salinity, it has been indicated that there will be a need to respond to increased demand by desalinating the groundwater.

Political power changed between the time of appraisal and the ex-post evaluation. And although an environment of uncertainty has continued due to a lack of formal national policies, the democratization process, which took about four years from the Jasmine Revolution, is complete and a new government was established in February 2015. This

new government plans to announce a national Five-Year Plan by the latter half of 2015 and has indicated policy to address social and regional inequalities. With respect to this project's goal of improving the living standards of remote rural communities, the government is considered to have been aligned with this aim both during the appraisal period and ex-post evaluation period.

3.1.2 Relevance to the Development Needs of Tunisia

Solar power

At the time of the project appraisal, Tunisia's national average electrification rate grew to 96% (2003). However, because the Tunisian government set an upper limit (3000 TD per household) on investment cost for electrification through power distribution network development, rural communities, which are located far from existing distribution networks, exceed the upper limit and thus have had no distribution lines constructed. This has resulted in non-electrified settlements scattered across the remote rural regions and is a factor that causes regional inequalities in living conditions between urban and rural areas.

On the other hand, Tunisia has one of the world's highest number of sunshine hours (2,500 hrs annually in the North; 3,200 hrs annually in the South), and since solar power is easier to operate and maintain than other renewable energies such as wind power, ANME has been engaged in installing decentralized Solar Home Systems (hereinafter "SHS") at non-electrified households since the first half of the 1990s.

At the time of the ex-post evaluation, the length of sunshine hours in Tunisia was recognized as having potential to generate solar powered energy while development progressed on large-scale solar powered facilities mainly utilizing European companies. SHS installed by ANME, which targeted non-electrified households in remote communities until around 2011, also contributed to raising electrification rates in rural areas. Although ANME-led SHS installation has finished now, the introduction of the new subsidy system (FTE) operated through ANME continues to assist with some costs of purchasing and installing SHS with private sector work.

An SHS set up through this project at a home in the mountainous region of Siliana

Rural Water Supply in Southern Regions

The southern region receives extremely little rainfall of 100 to 200 mm annually. At the time of the project appraisal water resources depended on groundwater, yet the water from most wells is saline. For this reason, electric power is needed to operate water

pumps and desalination equipment[6] installed at wells in order to secure drinking water (for humans and livestock) in the livestock industry, which is one of the major livelihoods in the region. However, because these wells are located in remote pastures not covered by the power distribution network, diesel generators have been used as power sources. The operation and maintenance of these, including transporting and storing fuel, are great burdens on residents.

At the time of the ex-post evaluation, the per capita renewable freshwater resources of Tunisia were 433 m^3 per person per year (2011)[7], which is roughly half the amount it was in 1972. Reasons for this include an increased population as well as the impact of a variety of factors such as climate change in recent years. Although severe water shortage is a common challenge shared across Africa, the water shortage in Tunisia is a pressing problem. Especially in the southern region, there is little choice but to continue relying on groundwater, since, despite the vast land area, there is scarce surface water. This groundwater, however, consists of just 0.3% freshwater, while salt water makes up the vast majority. For this reason, in order to supply water in the southern region there is a need to increase the use of high salinity concentration saltwater or seawater, or to reuse drainage water.

In addition, in southern regions, where there is little rainfall and limited livestock feed crops, goat production is thriving and nearly half of all of Tunisia's goats are raised there. Goats and sheep are a valuable source of income for farmers in the southern region, thus drinking water for grazing periods are regarded as an ongoing high need. It should be noted that in the field study we observed cases of high salinity groundwater and freshwater being mixed for use as drinking water for the livestock.

At the time of the project appraisal, electrification of remote rural communities through solar energy and supplying of water were considered to be meaningful development needs that would contribute to reducing regional inequalities.

At the time of the ex-post evaluation, expansion of the power distribution network by STEG combined with the installation of SHS at non-electrified households by ANME had achieved a nationwide electrification rate of 99.8% in 2014 with a 99.4% electrification rate in rural areas. Some non-electrified households still remain, however, and many are located in remote areas, thus the private sector-led system which utilizes FTE to subsidize a portion of expenses to purchase and install SHS continues on an ongoing basis. Due to

[6] Many of the wells in the southern region have salinity. Typically, salinity concentration is 3.0 g/l, though some wells have a higher salinity of 7 to 9 g/l.

[7] According to Falkenmark water stress indicator standards, countries or regions with per capita annual water volume of 1700 m^3 or less are designated "water stress," 1000 m^3 or less are "water scarcity," and 500 m^3 or less are "absolute scarcity."

these conditions it is regarded that development will continue.

With regard to water supply, there is extremely high need to desalinate high salinity water due to the limited availability of freshwater in southern Tunisia. Needs are expected to further increase in the future due to the anticipated increase in water demand in years to come.

3.1.3 Relevance to Japan's ODA policy

At the time of the project appraisal, the Japan Bank for International Cooperation (JBIC)'s Medium-Term Strategy for Overseas Economic Cooperation Operations (2002 to 2004, policy in force at the time) set forth the following policies concerning assistance: to provide assistance intended to promote economic growth by establishing economic and social infrastructure that serves as "infrastructure development for economic growth"; to proactively support the introduction of renewable energy as part of a "response to global issues"; and to support "strengthening of measures to reduce poverty" through electrification of rural communities.

Further, in order to support efforts to improve Tunisia's environment, the 2002 Tunisia Assistance Plan set out a policy to promote cooperation in line with government policies in Tunisia in such areas as effective utilization of groundwater resources and the introduction of renewable energy. Implementation of this project conforms to such policies.

Seeing that it has been judged appropriate to make use of Japanese technology, which held the top spot in the solar cell market worldwide at the time of appraisal, a requirement to use Japanese technology (STEP: Special Terms for Economic Partnership) for solar photovoltaic systems has been applied in this project.

Based on the above, the implementation of this project is considered to be relevant with Japan's ODA policy.

3.1.4 Relevance of the Project Plan and Approach

As mentioned in upcoming sections that discuss efficiency, effectiveness and impact, the water supply portion of the project was not undertaken and thus could not realize its anticipated outputs. Causes for this included prolonged coordination between relevant ministries primarily concerning the revenue source and administrative structure to operate and maintain equipment after project completion. Based on this, it is conceivable that the water supply portion of the project may have had project design problems at the planning stage, particularly in terms of addressing the administrative structure to oversee operation and maintenance as well as verification of costs. It should be noted that, although this matter is not reflected in the relevance rating as there were also outside factors that

contributed to water supply work not being undertaken, it will be appended as an issue at the planning stage.

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

3.2 Efficiency (Rating: ②)

3.2.1 Project Outputs

Plans in this project involved (1) a rural electrification portion: to electrify 500 households in remote rural communities, and (2) a water supply portion: to install solar photovoltaic systems and other equipment at 63 wells in southern rural communities. However, only the rural electrification portion was implemented according to the initial plan. Work was not undertaken on the water supply portion of the project despite creating a detailed design. Table 2 below shows the scope of this project.

Table 2 Scope of this Project

Classification	Plan	Actual
1) Rural Electrification Portion	【Project Site】 All of Tunisia, Target beneficiaries: 500 households in remote rural communities (non-electrified homes) 【Equipment】 Photovoltaic modules (100W × 500 units), regulators, batteries, fluorescent lamps	【Project Site】 Northern Tunisia (Siliana, Béjà, Jendouba, Kef) Central Tunisia (Sousse), Southern Tunisia (Gabès, Tataouine), Target beneficiaries: 500 households in remote rural communities (non-electrified homes) 【Equipment】 Photovoltaic modules (108W × 500 units), regulators, batteries, fluorescent lamps
2) Water Supply Portion	【Project Site】 4 Southern Governorates (Tataouine, Kebili, Medenine, Gabès), Deep public wells in pasture land (63 locations) 【Equipment】 Install solar photovoltaic systems at approximately 60 wells (photovoltaic modules, regulators, batteries, etc.), water pumps, desalination equipment, etc.	There are no outputs for this portion of the project as no work has been undertaken.

Classification	Plan	Actual
3) Consulting Services	Consulting services for the water portion Breakdown: Bidding assistance Construction supervision Operation and maintenance (O&M) assistance Social impact research Environmental monitoring assistance	Partial consulting services for the water portion Breakdown: Some tendering assistance (implementation/preliminary review of tenders/creation of tender documents, etc., for " Study of Operation and Maintenance Methods for Solar Water Pumping Systems and Solar photovoltaic Systems for desalination ")

(1) Rural Electrification Portion

As shown in Table 3 below, in the rural electrification portion of this project SHS were installed in all 500 households in all targeted seven governorates. The selection criterion for all 500 households was to be located in a remote rural community that is difficult to connect to the power distribution network. According to ANME, as the project was in the final stage of SHS installation work, which began in the 1990s, the homes selected were those bypassed in previous work, especially homes in remote areas.

Table 3 Breakdown of 500 Targeted Households in Electrification Portion of the Project

Units: Households

Region	North				Central	South		Total
Governorate	Siliana	Béjà	Jendouba	Kef	Sousse	Gabès	Tataouine	
SHS Units Installed	110	38	7	25	20	150	150	500

Source: Documents provided by ANME

(2) Water Supply Portion

Although a detailed design was created for the water supply portion of this project, the work was never carried out. It should be noted that although ANME was the implementing agency in this project, after completion of the water supply portion of the project the Agricultural Regional Development Office (CRDA), which is the local office of the Ministry of Agriculture, Water Resources and Fisheries (hereinafter "Ministry of Agriculture"), was responsible for operation and maintenance of water pumps installed at wells, desalination equipment, and solar photovoltaic systems attached to all equipment.

The reasons for work in this portion of the project not being carried out are complex; however, for the most part it was due to the following reasons: a long time was taken for the process of selecting consultants; consultant efforts were discontinued in January 2011

due to the Jasmine Revolution; and great deal of time was taken to coordinate views within the Tunisian government regarding the administrative structure for operation and maintenance of desalination and other equipment.

Consultant Selection

Table 4 below summarizes the consultant selection process for the water supply portion of the project from the selection procedure to project completion. Despite beginning the consultant selection process in October 2005, it took over four years (1489 days) until the order was given to begin work in November 2009. In the initial plan, consultant contracts were to be entered by November 2007, construction to take place between December 2007 and March 2010, and the project to be concluded by June 2011. According to a Survey Report (2010) outsourced by the JICA Tunisia office, the factors listed below are cited as factors for the delay. The first bid ended in failure due to Tunisia's procurement system, while the subsequent procurement process also was unable to proceed smoothly.

- The first bid was declared unsatisfactory by the Senior Procurement Committee[8] due to the lack of bidding companies (only three applicants).
- It took over nine months to select the consultant for the second round.
- It took over nine months to examine paperwork. Of this, ANME took four months to conduct technical review and JICA approval took two months.
- It took over 17 months of contract negotiations between ANME and the selected consultant.

Table 4 Planned and Actual Each Process in the Water Supply Portion (from consultant contracting to project completion)

	Plan	Actual
Start of consultant selection process	October 2005	October 2005
Creation of selection documents by ANME		657 days
Procedural formalities by Senior Procurement Committee		340 days
Approval by JICA		235 days
Briefing by selected consultant		171 days
Other procedural delays by ANME		86 days
Total days		1489 days
Conclusion of consultant contract	November 2007	November 2009
D/D Implementation	December 2007 － March 2010	November 2009 － Not started
Tendering process		
Construction work		
Project completion	June 2011	Not started

Source: Documents provided by ANME and JICA

[8] Senior Procurement Committee: An organization which supervises public competitive bidding in Tunisia

Jasmine Revolution

Although the consultant began work in December 2009, work was interrupted due to worsening public safety caused by the Jasmine Revolution which broke out in January 2011.

Prolonged Coordination of Views between Relevant Ministries in Tunisia Concerning the Administrative Structure for Operation and Maintenance of Desalination Equipment

As summarized in Table 5 below, after receiving study results from the consultant, the Tunisian government took considerable time to coordinate between relevant ministries concerning the administrative structure for operation and maintenance of the equipment, as well as for deliberation over revenue sources, which led to a prolonged time period without a forthcoming solution. As a result, ANME was requested by the relevant ministries to postpone evaluation of project bids for the water supply portion of the project and rethink the plan. After this, ANME submitted to JICA a scope change proposal that greatly reduced the number of desalination units to install. JICA, however, determined that the administrative structure and budget for operation and maintenance of the equipment were insufficient, and in addition, Japanese companies'[9] level of interest in bidding would be extremely low due to both civil unrest in southern regions and reduced scale of the project. As a result JICA notified the Tunisian side that the loan would be closed as per the original loan deadline.

[9] Due to being a STEP project, participants in this project are limited to Japanese companies.

Table 5 Chronicle of Events in the Water Supply Portion of the Project - From Reconsideration of the Administrative Structure for Operating Solar Water Pumping and Desalination Systems to Project Conclusion

Time Period	Chronicle of Events
December 2009 to October 2011	The consultant began work in December 2009. Later, civil unrest broke out due to the Jasmine Revolution in January 2011 and work was suspended for approximately six months.
November 2011 to June 2012	In November 2011 ANME submitted a written report entitled "Study of Operation and Maintenance Methods for Solar Water Pumping Systems and Solar photovoltaic Systems for desalination," which was prepared by the consultant, to the National Piloting Committee (Comité National du Pilotage). Whereupon debate concerning the administrative structure responsible for operation and maintenance, income sources, etc., deteriorated into a state of discord within the Tunisian government. This resulted in a delay of the bidding process of the water portion of the project. Of particular note, the points below were identified as problems based on findings in this study. (1) Increased cost of desalinated water and of the administration, operation and maintenance for the equipment: Depending on user population and geographic conditions, the production cost of desalinated water, including investment and operation cost, was calculated at 11 TD/m^3 to 52 TD/m^3. Meanwhile, the cost of water delivered by tanker lorries in the designated project region was, again depending on user population geographic conditions, 6 TD/m^3 to 12 TD/m^3. For this reason the desalination cost in remote areas with a low user population (at 52 TD/m^3) greatly exceeds the cost of water delivered by tanker lorry (at 12 TD/m^3). (2) The administrative system for maintaining facilities and its revenue sources: Since there is no agricultural development cooperative for beneficiaries (GDA) in the desert region of southern Tunisia, which is populated mainly by nomadic people, assistance for establishing a GDA is required. In addition, as it is difficult to cover expenses and facility maintenance with the material and human resources of nomadic people, the Ministry of Agriculture needs to prepare revenue sources to do so at the same time as CRDA provides assistance to set up the GDA. In response to the above issues, committee members expressed cautious and diverse opinions regarding implementation of the water supply portion of the project as originally planned, and ANME had no choice but to postpone the bidding process for an extended period until the committee could declare a solution to the issues.
June 2012 to December 2012	ANME raised two issues for debate in an inter-ministerial meeting on June 12, 2012: (1) Project scope changes. (Initially the plan was to install desalination equipment at 45 of the 63 wells, which changed to only 2 wells in densely user-populated areas); (2) a summary of changes to the loan agreement in order to extend the loan disbursement deadline. According to the Ministry of Agriculture, the ministry had agreed to bear the cost to set up a GDA at each well resulting from changes in the project scope, as well as the cost for operation and maintenance. As a result, ANME was to negotiate with the Japanese side regarding the changes. Meanwhile, amid the approaching the loan disbursement deadline of December 15, 2012, JICA confirmed with ANME several times on the progress of Tunisian government debates concerning the operation and maintenance of desalination equipment. After this, JICA considered the scope change proposal submitted by the Tunisian side. As a result, based on the above-mentioned reasons it was determined that there was a high risk that the bidding process would not be completed, and thus JICA notified the Tunisian side that the loan would be closed as per the original loan deadline, specifically noting: ・ The project scope was significantly reduced as a result of scope changes due to issues in settling the operation and maintenance system matters, etc. ・ It is expected that Japanese companies will be concerned about safety after the revolution since the target sites (wells) are dispersed around the southern region. ・ Almost no Japanese companies expressed interest in tendering bids. Tunisian government agreed following this.

Source: Documents provided by ANME and JICA

Based on the above, although unforeseen events occurred due to the Jasmine Revolution for the water supply portion of the project, it has been determined that reasons for work not being undertaken in the project were extensive delays in the procurement process of the consultant; considerable time taken to coordinate between relevant ministries concerning the administrative structure for operation and maintenance of desalination equipment; and failure to reach a resolution until just before the loan disbursement deadline.

3.2.2 Project Inputs

3.2.2.1 Project Cost

No inputs were implemented in the water supply portion of the project. For this reason, evaluation of project expenses will only cover portions of the project excluding water supply.

As shown in Table 6 below, total cost of the project excluding the water supply portion was planned to be 725 million yen. Of this 329 million yen comprises the ODA loan covered amount. In the "Actual" column total project cost was 274 million yen (excluding the water supply portion). Of this 257 million yen comprises the ODA loan covered amount, which is 38% of the planned amount (also excluding the water supply portion). For this reason it is deemed that project costs were kept within the plan.

Table 6 Planned and Actual Total Project Cost

Units: Millions of yen

	Plan		Actual	
	Overall	ODA Loan	Overall	ODA Loan
Rural Electrification	309	289	142	142
Water Supply	1,402	1,312		
Consulting Services	130	130	115	115
Land costs	0	0		
Administrative costs	54	0		
Tax and duties	142	0	17	0
Total	2,037	1,731	274	257

Note: Exchange rate at the time of the project appraisal, 1 Tunisian Dinar (TD) =86.2 yen
Exchange rate during actual implementation: 1 Tunisian Dinar (TD) =85.4 yen

3.2.2.2 Project Period

The actual project period was 116 months (159% of the planned period) from June 2005 (L/A signing) to January 2015 (ex-post evaluation), which exceeded significantly than the planned period of 73 months from June 2005 (L/A signing) to June 2011 (Ex-post Evaluation).

With regard to the fact that the rural electrification portion of the project was

implemented as planned, while the water supply portion was not, as mentioned in section (2) of 3.2.1 Project Outputs, the primary reasons for project delay included a significant delay in the procurement process for selecting consultants for the water supply portion of the project, and in addition, considerable time was needed for coordination between relevant ministries over the administrative structure to operate and maintain desalination equipment, hence, resolution could not be reached even when the loan disbursement deadline was closed. This resulted in no work on the water supply portion of the project being undertaken, and this situation continued past the time of the ex-post evaluation.

3.2.3 Internal Rates of Return (reference only)

Due to difficulty in monetizing and quantifying benefits, the Financial Internal Rate of Return (FIRR) was not calculated.

Due to opinions given from ANME that there are strong social welfare connotations when a project such as this conducts SHS installation targeting residents in non-electrified remote regions, the Economic Internal Rate of Return (EIRR) was not calculated. Recalculation was also not performed due to a lack of a clear calculation basis at the time of the project appraisal.

Based on the above, although project cost was within the plan, the project period significantly exceeded the plan. Therefore, efficiency of the project is fair.

3.3 Effectiveness (Rating: ①)[10]

3.3.1 Quantitative Effects (Operation and effect indicators)

This project was broadly comprised of (1) a rural electrification portion: to electrify 500 households in remote rural communities, and (2) a water supply portion: to install solar photovoltaic systems and desalination equipment at 63 wells in southern rural communities. Of these, the water supply portion of the project accounted for the largest portion of the overall project cost. Nevertheless, as mentioned in 3.2 Efficiency, the rural electrification portion was implemented according to plan while the water supply portion of the project was not undertaken during the loan period. Because of this, outputs for the project's goals could not be observed for the water supply portion, which accounted for a great deal of project goals. This resulted in a failure to realize project outcomes and impacts.

Consequently, it was possible to check the actual values for (1) Maximum Power Output and (2) Household Electrification Rates, which comprise the rural electrification of operation and effect indicators set at the time the project appraisal. For the water

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

supply portion, however, (3) Well Usage (residents, livestock) and (4) Volume of Groundwater Pumped could not be observed since this portion of the project was not implemented.

The achievement status of each indicator is shown below.

(1) Maximum Power Output

Table 7 shows targeted and actual maximum power outputs. Compared with the project's overall target value of 630 kW, the actual value in 2014 was 54 kW, falling dramatically short of the target. The reason for falling short of the target was that the water supply portion of the project was not implemented. In contrast, in the rural electrification portion of the project SHS were installed at 500 households in remote rural communities as per the initial plan. And because all households made use of the SHS, the actual maximum power output was 54 kW against the target of 50 kW, meeting its set target.

Table 7 Maximum Power Output in the Project

Units: kW

Indicator	Baseline 2004 Assessment year	Target 2014 3 Years After Completion	Actual 2014 3 Years After Completion
Maximum power (theoretical value)	0	630	54
[BREAKDOWN] Rural Electrification		50	54
Water Supply		580	0

Source: Target values from documents provided by JICA / Actual values from documents provided by ANME

(2) Household Electrification Rate in Rural Areas

Table 8 shows targeted and actual household electrification rate in rural areas. Compared with the target of 100%, the actual value for FY 2014 was 99.4%. This is considered to have generally achieved the target. As mentioned in the section on Relevance, the primary factors responsible for improving rural electrification rates were the advancement of electrification measures, which were accomplished by STEG's expansion of the power distribution network, and ANME's installation of SHS and other independent power sources (power that does not rely on STEG's distribution network).

Table 8 Household Electrification Rate in Rural Areas

Units: %

Indicator	Baseline (2004)	Target (2014)	Actual (2014)
Household Electrification Rate in Rural Areas (Rural Electrification Portion)	97.3 [1)]	100	99.4

Source: Target values from documents provided by JICA / Actual values from documents provided by ANME

Note 1: Although the Baseline Year (2004) "Household Electrification Rate in Rural Areas" is 0% in the preliminary evaluation table, the reference value of 97.3% was used as this was the rural household electrification rate in Tunisia in 2004.

It is worth noting that although SHS installed in this project are helpful for using electrical appliances such as TVs, radios, and mobile phones, many households that had SHS installed actually still wished to be connected to the STEG power distribution network due to the low 100 W power output capacity of these systems.

During the most recent inspection tour, instances were seen, particularly in northern settlements, where homes were able to connect to STEG in response to strong requests from residents to local authorities. By effectively using power from both SHS and STEG, these households were able to save on electricity bills from STEG. According to ANME, however, generally when an SHS-installed home connects to STEG's power grid, the SHS is to be moved to a non-electrified household. Nevertheless, based on the current energy policies and utilization at households, it is believed that there is a need to officially approve continued use in cases where the SHS is being used effectively. It should be noted that a local official from ANME has suggested that there is a need for a system that allows a household that no longer needs an SHS to voluntarily transfer ownership (O&M handled by ANME) to a home that needs the system.

SHS installed in this project.
Top: Solar panels installed on the roof of a home.
Middle: Fluorescent lighting in the home.
Bottom: TV in the home (owner purchased).

Considering the prospect of an increasing number of future cases where an SHS–installed household is connected to STEG's power grid, it is considered necessary to create a system that suits present conditions.

(3) Well Usage (Drinking Water for Residents and Livestock)

Table 9 below shows targeted and actual well usage. The initial plan set out to install solar photovoltaic systems, water pumps, desalination equipment, etc., at 63 deep public wells in Tataouine, Kebili, Medenine, and Gabès Governorates. However, the effectiveness of these indicators was not demonstrated since the water supply portion of the project was not implemented.

Note that primary factors for this part of the project not being carried out are detailed in 3.2 Efficiency.

Table 9 Utilization of Wells in the Project

Indicator	Baseline (2004)	Target (2014)	Actual (2014)
Number of people using wells (Water Supply Portion)	4,980 people	7,850 people	Not implemented
Number of livestock using wells (Water Supply Portion)	355, 100 animals	667,000 animals	Not implemented

Source: Target values from documents provided by JICA / Actual values from documents provided by ANME

(4) Volume of Groundwater Pumped

Table 10 below shows targeted and actual volume of pumped groundwater. For the same reason as (4) above, the effectiveness of these indicators was not demonstrated since the water supply portion of the project was not implemented.

Table 10 Volume of Groundwater Pumped in the Project

Units: m^3/month

Indicator	Baseline (2004)	Target (2014)	Actual (2014)
Volume of Groundwater Pumped (Water Supply)	36,000	67,500	Not implemented

Based on the above, each operational and effectiveness indicator set in this project fell significantly short of its target due to the water supply portion of the project not being implemented. The rural electrification portion of the project, however, was implemented as planned and for the most part reached its targets. Thus it was instrumental in the electrification of 500 households in remote rural communities. Due to the above reasons, in the next section, 3.4 Project Impacts, only impacts demonstrated by the rural electrification of the project were analyzed.

3.3.2 Qualitative Effects

As qualitative effects of this project, the following benefits were expected: an improvement in living standards by promoting development of the livestock industry and enhancing local infrastructure for residents through electrification; an improvement in living standards for the poor; and a reduction in regional inequalities. These will be inspected in further detail in the Project Impacts section based on the assumption that they should be treated as impacts of this project.

3.4 Impacts

3.4.1 Intended Impacts

In terms of impacts of the project, it was primarily expected that it would improve living standards for local residents and contribute to reducing regional inequalities through electrification. As mentioned in the previous section on Effectiveness, however, due to not implementing the water supply portion of the project, which accounted for 64% of the total project cost, project outcomes and impacts were not realized.

In contrast, the rural electrification portion of the project, which accounted for 15% of total project cost, was found to demonstrate impacts as initially hoped for households where solar photovoltaic systems were installed. Shown below in Tables 10 to 13 are the results of the beneficiary study[11] of the rural electrification portion of the project.

Current Electrification Status

As seen in Table 11 below, approximately 80% of households that had an SHS installed in the project were located far from the STEG power distribution network, and thus responded that it would have been unlikely that they could be connected to the power distribution network, even in the future. For this reason, many of the targeted households in the project use the SHS as their principal source of power. Hence, this project is considered to have improved living conditions and reduced regional inequalities through electrification.

[11] Local consultants were utilized to conduct a Beneficiary Survey on 79 households that had SHS installed through this project (8 in Siliana, 23 in Tataouine, 48 in Gabès). Note that significant time was required to visit the SHS-installed households due to being in locations difficult to access by car, such as mountainous regions and desert areas. As a result, although the initial target was to visit 100 households to collect questionnaires, valid responses were collected from 79 households.

Table 11 Connection Status to the STEG Power Distribution Network in Households that had SHS Installed in the Project.

Unit: Households

Item	Households	(%)
1.Already connected to the existing grid	3	(4 %)
2. Plan to connect to the existing grid in the future	10	(13 %)
3. Believe it difficult to be connected to the existing grid even in the future because it is too far	64	(81 %)
4. Don't know	2	(2 %)
Total	79	(100 %)

Source: Beneficiary study

Changes in Lives Associated with Power Use

In Table 12 below, residents were asked questions about how their lives changed after the SHS was installed. In response to the question "(a) Did your daily energy use increase or decrease after SHS installation?" 80% of people responded that energy use increased. According to site visits and interviews, previously power could only be used temporarily by running diesel generators and such, but SHS installation carried out in this project has made it possible to use lights at night, watch/listen to TV or radio, charge mobile phones, and other such everyday uses.

At an SHS-installed home in Gabès, a woman weaves a rug in a room with fluorescent light and a TV

In response to the next question, "(b) Did use of electricity to make handicrafts or other goods increase your cash income?" 23% of people responded that cash income increased. However, realization of this benefit is limited since only certain areas in the southern region are involved in making handicrafts and the women involved in this work are advancing in age.

In response to "(c) Did use of electricity increase daily study time for your children?" 42% of people responded that study time increased. While being a somewhat low figure, interviewed children were delighted to be able to do their homework, read, draw pictures, and play at night indoors.

A fluorescent light is installed in the kitchen of an SHS-installed home in Tataouine

In response to "(d) Did use of energy increase time to spend with your family?" 90% of people responded that it did increase family time. Light provided through installation of SHS is deemed to have contributed to improving quality of life by helping provide family time for people living in rural communities.

Table 12 Changes in Lives Brought About by SHS

Units: Households

	(a) Did your daily energy use increase or decrease after SHS installation?		(b) Did use of electricity to make handicrafts or other goods increase or decrease your cash income?		(c) Did use of electricity increase or decrease daily study time for your children?		(d) Did use of energy increase or decrease time to spend with your family?	
1. Increased	63	(80%)	18	(23%)	33	(42%)	71	(90%)
2. No noticeable change	16	(20%)	55	(70%)	41	(52%)	6	(8%)
3. Decreased	0	(0%)	5	(6%)	4	(5%)	1	(1%)
4. Don't know	0	(0%)	1	(1%)	1	(1%)	1	(1%)
Total	79	(100%)	79	(100%)	79	(100%)	79	(100%)

Source: Beneficiary Study

Life improvement and Women's Housekeeping Chores

According to Table 13, over 90% of SHS-installed households feel that energy use has improved their lives. Also, as shown in Table 14, in response to the question "Did use of energy decrease the burden of household chores?" over 60% of people responded that it reduced the burden. It is worth noting that several homes had fluorescent lights installed in their kitchen which made it possible to cook indoors at night, and during site visits many people commented on how it was now possible to cook safely indoors.

Based on the above facts, SHS has provided positive benefits in the lives of people living in rural communities and is deemed to have made a contribution to improving their lives.

Table 13 "Do you feel that energy use has improved your life?"

Units: Households

Item	Households	(%)
1. Feel that it has improved	72	(91%)
2. No noticeable change	5	(6%)
3. Do not feel that it has improved	0	(0%)
4. Don't know	2	(3%)
Total	79	(100%)

Table 14 "Did use of energy decrease the burden of household chores?"

Units: Households

Item	Households	(%)
1. Decreased	50	(63%)
2. No noticeable change	22	(28%)
3. Increased	3	(4%)
4. Don't know	4	(5%)
Total	79	(100%)

Source: Beneficiary study

Based on the above, SHS installed through this project are expected to continue being used at installed homes in the future and will be useful in improving people's lives.

3.4.2 Other Impacts

(1) Impact on the Natural Environment

According to ANME, there have been no impacts on the natural environment. In addition, no negative impacts were observed during the site visit.

(2) Land Acquisition and Resettlement

No resettlement or land acquisition occurred since the rural electrification portion of this project installed equipment on roofs or inside homes.

Based on the above, although the rural electrification portion of this project demonstrated improvements to people's lives through electrification, due to not implementing the water supply portion of the project, which accounted for 64% of the total project cost, project outcomes such as improvement to the lives of residents in southern regions and development of the livestock industry were not realized. Likewise, project impacts such as contribution to the betterment of livelihood in targeted regions also were not realized.

In light of the above, benefits of implementing this project were limited in comparison with its plan. This project has not achieved its objectives. Therefore effectiveness and impact of the project are low.

3.5 Sustainability (Rating: ③)

Evaluation of sustainability will only cover the rural electrification portion of this project in which outputs can be confirmed.

3.5.1 Institutional Aspects of Operation and Maintenance

ANME employed 187 staff at the end of 2014, and this has remained unchanged since the time of appraisal. Hence, no particular problems are seen concerning staffing levels. ANME's Gabès Office has jurisdiction over southern governorates of Gabès, Tataouine, and Sousse targeted in this project, while ANME's Kef Office has jurisdiction over northern governorates of Siliana, Kef, Jendouba, and Béjà targeted in this project. Both offices deployed experienced technicians for the operation and maintenance of SHS and it was found that the local operation and maintenance system was appropriate.

Since the time of appraisal, there have also been no changes in the system that SHS-installed households to request repair persons under. There have been a few instances of repairs and no problems have been observed at this point in time. However, since it is expected that the frequency of repairs will increase as equipment degrades over time, it is important that ANME shares contact numbers of repair persons and other

pertinent information again.

Based on the above, no problems have been observed in the administrative system for operation and maintenance.

3.5.2 Technical Aspects of Operation and Maintenance

Primarily technicians from ANME's Gabès and Kef offices managed operation and maintenance at sites and work was carried out appropriately. Likewise, no particular problems were observed in skill levels or the number of technicians.

Interviews conducted with beneficiaries while visiting SHS-installed households indicated that ANME technicians had visited three times[12] after SHS installation to inspect operation of the equipment. Installed households have also been performing daily inspections while verifying with the manual distributed at the time of installation. ANME technicians have also offered advice when requested by beneficiaries. Through a field study at the time of the ex-post evaluation it was determined that ANME technicians are well aware of the location of installed households, which are dotted across a vast target area, and they also communicate appropriately with beneficiaries.

Instruction manual distributed to homes with SHS-installed (Arabic)

Also note that inspections and repairs conducted by ANME technicians and repair persons were carried out according to the manual, and no outstanding technical problems or issues were observed with regard to operation and maintenance system for SHS.

Based on the above, no problems have been observed in the technical aspects of the operation and maintenance system.

3.5.3 Financial Aspects of Operation and Maintenance

Table 15 below shows changes in ANME government subsidies. Although there was some decline the year following the Jasmine Revolution (2012), from 2013 onward subsidies maintained 6,000,000 TD levels. It has been determined that there are no problems with the financial situation.

[12] Breakdown of the three time inspection is as follows: provisional acceptance (within 1 to 6 months); preventive maintenance visits (within nine months); final acceptance (within one year).

Table 15 Government Subsidies to ANME

Units: 1,000 TD

	2008	2009	2010	2011	2012	2013	2014
Subsidy amount	5,253	5,109	5,562	5,138	4,443	6,120	6,000

Source: Documents provided by ANME

Beneficiaries are only responsible for the cost of parts when an SHS is repaired (equivalent to 30% of the entire repair cost). Costs are 100 TD for a battery, 50 TD for regulator, 35 TD for lamination repair, and 50 TD for the adapter. According to ANME, they have been able to cover repair costs within the budget each year without problem.

SHS projects through ANME ended with this project. Currently, the subsidy program available to households who want to install solar power generation is continued through the FTE energy transfer fund. That being said, operation and maintenance costs for the SHS project will continue to be borne by ANME, and the budget will be secured in such a way that required expenses can be covered.

Based on the above, no problems have been observed in the financial aspects of operation and maintenance.

3.5.4 Current Status of Operation and Maintenance

Table 16 below shows results of the beneficiary study. Of the 79 modules installed at households, only 1 Japanese-made solar module required repair. In addition, only one household reported a one-time breakdown. The installed SHS are regarded as having a generally favorable operation and maintenance system.

Table 16 SHS Operating Status and Frequency of Breakdowns

Units: Households

	Photovoltaic module (made in Japan)		Regulator		Battery	
Operating Status						
1. Operating	77	(97%)	70	(89%)	74	(94%)
2. Needs repair	1	(1%)	3	(4%)	4	(5%)
3. Unanswered	1	(1%)	6	(8%)	1	(1%)
Total	79	(100%)	79	(100%)	79	(100%)
Number of breakdowns since installation						
1 Time	1		5		11	
2 Times	0		2		3	

Source: Beneficiary study

Routine inspection is also been conducted satisfactorily. At the same time, in some cases repair costs were saved for batteries, regulators, and other accessory hardware by performing early maintenance. Also note that some residents (especially the elderly) do not sufficiently understand how to deal with SHS breakdowns, wiring extensions, etc., and so it is necessary that ANME local technicians make visits to provide advice in order to support the continued long-term use of SHS.

In light of the above, no problems have been observed in the current status of operation and maintenance system of the project.

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

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

The objective of this project was to improve livelihood in rural communities and promote development in the livestock industry in Tunisia by installing equipment such as solar photovoltaic systems, thereby contributing to the improvement of overall living standards in target areas.

At the time of the project appraisal and ex-post evaluation there was a change in political power in Tunisia due to the 2011 Jasmine Revolution and the shift to democratization took about four years to complete. The new government, formed in February 2015, has indicated its plan to address social and regional inequalities. At both the time of the project appraisal and ex-post evaluation, electrification of remote rural communities through solar energy and supplying of water were regarded as important developmental needs that would contribute to reducing regional inequalities in Tunisia. In addition, this project is consistent with Japan's ODA policy at the time of the project appraisal. In light of this, this project has been deemed highly relevant due to its consistency with Tunisia's Development Plan, development needs, and Japan's ODA policy.

This project consisted of two parts: (1) rural electrification by installing SHS at each household in remote rural communities, and (2) water supply by installing desalination equipment or solar photovoltaic systems at wells in southern rural communities. Implemented as planned, the rural electrification portion of the project contributed to electrifying 500 households in remote rural communities. SHS installed in this project are expected to aid in improving the lives of people in target households for years to come. In contrast, the water supply portion of this project, which comprised a larger portion of the

project's total budget than the rural electrification portion, was not undertaken during the loan period. For this reason, operation and effect indicators fell far short of the set targets as outputs for the water supply portion of the project, which accounted for numerous project targets, could not be observed in the ex-post evaluation. Comprehensively considering the above, the project has achieved limited effectiveness compared to its plan. Therefore the effectiveness and impact of the project are low.

Although project cost was within the plan, the project period significantly exceeded the plan. Therefore efficiency of the project is fair. Primary reasons for delay in the project include a significant delay in the procurement process of selecting consultants related to the water supply portion of the project, and in addition, considerable time was needed for coordination between relevant ministries debating the administrative structure for operation and maintenance of desalination equipment, hence, resolution could not be reached even when the loan disbursement deadline was closed.

In terms of sustainability, under the supervision of ANME, SHS installed in the rural electrification portion of the project were operated and maintained with the mutual cooperation of ANME local offices, fitting contractors, and beneficiary households. Therefore no systematic, technical, or financial problems were observed and sustainability of rural electrification portion of the project is high.

In light of the above, however, evaluation of the project overall is low.

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

ANME had set a general rule wherein, when an SHS-installed home connects to STEG's power distribution system, the SHS is to be moved to a non-electrified household. However, at the time of the ex-post evaluation, the Tunisian government was recommending parallel usage of STEG's power distribution system with solar power in order to promote energy efficiency. This is thought to be a possible catalyst for confusion in the field. For this reason, it is important that, based on the current energy policies, ANME review the provisions to be applied when an SHS-installed household connects to STEG's power distribution system, and then clearly announce the revised provision to SHS-installed households and local authorities. It is believed that this will both eliminate confusion in the field and lead to more efficient use of energy.

4.2.2 Recommendations to JICA

Even now, there is an urgent need to utilize the high-salinity water in southern Tunisia as a water supply, and such needs are expected to further increase due to increased water demand in the years to come. For this reason, with regard to addressing the water supply

portion of the project which was not undertaken, the consultant recommends deliberating this matter with the Tunisian side, including such matters as assistance methods.

4.3 Lessons Learned

Formulation of highly feasible project design that includes countermeasures against delay factors

This project required the participation of not only an execution agency to oversee operation and maintenance of the facilities, but also multiple government ministries. Further, due to the target area being located in a remote desert region and the anticipated beneficiaries were nomadic people, it is assumed that the project had high degree of difficulty as a STEP project. Although from the time of appraisal, possible delay factors were recognized among project stakeholders and efforts were made to mitigate and eliminate them, in the end, and also in light of external factors compounding issues, only so much could be done.

While it is difficult to eliminate every factor of delay at the planning stage, it is important to incorporate a resolution mechanism into the project's design that will accurately identify and analyze risks of delay when formulating a project with similar factors. In doing so, it is of paramount importance to hold thorough discussions with the executing agency and relevant ministries, so as to place due consideration on ensuring that the design of the project is highly feasible for all parties involved.

Comparison of the Original and Actual Scope of the Project

Item	Plan	Actual
1.Project Outputs	1) Rural Electrification Portion Installation of solar photovoltaic systems (photovoltaic modules, (100 W x 500 units), regulators, batteries, etc.) and fluorescent lights in non-electrified households (500 homes) in remote rural communities. 2) Water Supply Portion Installation of solar photovoltaic systems (photovoltaic modules, regulators, batteries, etc.), water pumps, and desalination equipment at deep public wells (63 locations) in pasture lands of four southern governorates (Tataouine, Kebili, Medenine, and Gabès governorates) 3) Consulting Services Comprehensive consulting services for the water supply	1) Rural Electrification Portion According to plan 2) Water Supply Portion There are no outputs for this portion of the project as no work has been undertaken. 3) Consulting Services Although some consulting services were conducted, due to the reason listed in 2) above, work was not implemented.
2. Project Period	June 2005 - June 2011 (73 months)	June 2005 - January 2015 (116 months)
3. Project Cost Amount paid in Foreign currency Amount paid in Local currency Total Japanese ODA loan portion Exchange rate	 1,426 million yen 611 million yen (7,088,000 TD) 2,037 million yen 1,731 million yen 1 TD＝86.2 yen (As of November 2004)	 213 million yen 61 million yen (720,000 TD) 274 million yen 257 million yen 1 TD=85.4 yen (Average between August 2008 and December 2012)

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Republic of Tunisia

Ex-Post Evaluation of Japanese ODA Loan

"Water Resource Management Project"

External Evaluator: Machi KANEKO, Earth and Human Corporation

0. Summary

This project has aimed to improve agricultural productivity, increase livestock numbers and farmers' income, and consequently contribute to the conservation of water resources and prevention of soil erosion, etc. by constructing hill dams[1] and irrigation facilities in the north-central region of Tunisia, where precipitation was relatively high.

Tunisia formed a new government in February 2015 after completing a four-year transition process toward democracy since the Jasmine Revolution in 2011 and is currently in the process of formulating the next Five-Year National Development Plan. For the water sector, one of the key sectors of the country, the Second Ten-Year Hydraulic Resources Development Strategy (2012 – 2022) was developed by the Ministry of Agriculture, Hydraulic Resources and Fisheries (hereinafter referred to as the "Ministry of Agriculture"), based on which the Provisional Government continued to implement various projects. The new government took over the said Strategy and announced its intention to continue constructing hill dams toward improving agricultural productivity, preventing soil erosion in farmland, and meeting other development needs. This project was also consistent with Japan's ODA policy at the time of the project's appraisal. Therefore, the relevance of the project is high.

The project initially planned to construct both hill dams and irrigation facilities in 22 sites in 7 governorates. However, due to massive droughts between 1999 and 2002, the then already completed dams were unable to store enough amounts of water to allow constant operation of irrigation facilities. Because of this, a feasibility study (hereinafter abbreviated as "F/S") was conducted to review and revise the content of the planned irrigation facilities. As a result of the F/S, it was determined that it would be more appropriate to construct the original irrigation facilities in three dam sites and provide portable pumps and other irrigation equipment for other sites instead. The F/S also revealed that irrigation farming had been expanding in the target regions due to private investment, the residents' independent efforts, and other factors. However, the F/S did not

[1] Small-scale dams constructed under this project are called "hill dams *(French: barrages collinaires)"* in Tunisia. While the construction of hill dams began in earnest around 1990, Tunisia, since old times, has been adopting a water-harvesting technique that takes advantage of its hilly topography to utilize rainwater flowing down to the Mediterranean Sea by building a network of *wadis* (dry riverbeds that usually do not contain water) to direct and store water to and in the *wadis* during times of heavy rain for irrigation and other purposes. It can be said that "hill dams" originates from this technique. In addition, the term "hill dams" is used only when referring to dams constructed by the General Directorate of Dams and Large Hydraulic Works, Ministry of Agriculture while similar facilities constructed by the Department of Forestry and Soil Conservation are called "hill lakes *(French:lac collinaires)*.

go so far as to reexamine the operation and effect indicators or revise the target values of the project. For this reason, the total irrigated area[2], one of the effect indicators of this project, turned out to be 620.5ha, attaining only 27% of the target of 2,298.1ha.

On the other hand, the quantitative indicators, such as the farm size and production volume of major crops, have mostly achieved their respective targets as a result of promoting the farming methods[3] that take into account reservoir levels that fluctuate depending on annual rainfall, as well as groundwater recharge effects. However, because irrigation facilities were not constructed as originally planned in 19 of the total 22 dam sites, it is difficult to attribute the high attainment levels entirely to the effects of the project, which, likewise, may not be the sole contributor to the moderate increase and stabilization of agricultural production in the target regions. In addition, because the remaining service life for irrigation use of the hill dams constructed by the project is assumed to be 5 to 10 years depending on the sedimentation speed of each dam based on their average life span of 20 to 30 years, the project's contribution toward the increase of agricultural production will not be permanent but will likely be for a limited time period[4].

With regard to project impacts, the farmers' annual income mostly attained the target level and the annual production of livestock meat has increased since the time of appraisal, though it is difficult to ascertain whether or not these results are solely attributable to the effects of the project. Moreover, trees were planted around the dam sites to prevent soil erosion over a total area of 6,154ha, which was 200% of the planned area. These trees are also thought to be helping the retention of floodwater during the rainy reason, prevention of soil erosion in farmland, and sedimentation mitigation and life prolongation of large-scale dams.

Comprehensively considering the above, effectiveness and impact of this project are fair.

Although the project cost was lower than planned, the project period far exceeded the plan. Therefore, efficiency of the project is fair. With regard to operation and maintenance of the project, though the speed of sedimentation in each reservoir has been mostly as expected, the need remains to implement measures to enhance the O&M system of the hill dams in each governorate, fortify the institutional aspects, update the technical guidelines

[2] "Irrigated area" refers to an area of irrigated farmland that has been officially approved by the government in accordance with the Ordinance of the Ministry of Agriculture, which stipulates that the Tunisian government has the obligation to secure and provide irrigation water for farmers who engage in agriculture in publicly-approved irrigated farmland. However, since the small-scale dams constructed by this project are not permanent water resources, the irrigated crop fields are approved for limited periods only with the understanding of the farmers that permanent water supply is not guaranteed for those fields.

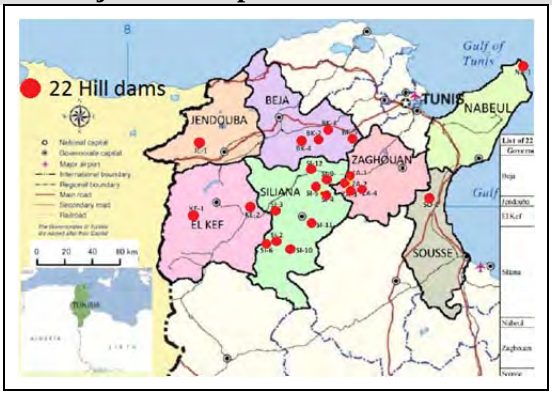
[3] Farming methods that take into account groundwater recharge effects refer to types of irrigation farming that draw water not from dam reservoirs but from shallow wells, etc. whose water levels have been raised.

[4] The service life of small-scale dams is said to be around 20 to 30 years, and the average 20-year life span is used in the estimation of this project. However, actual life span of each dam varies depending on how quickly or slowly the dam gets completely filled up with sedimentation.

by incorporating the accumulated know-how and providing response procedures to unexpected hazards, etc., and increase budget. Therefore, sustainability of the project effects is fair.

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

1. Project Description



Project location

Hill dam constructed by this project (photo taken in Sousse Governorate in June 2015)

1.1 Background

Tunisia is located in a semiarid climate zone. While overall precipitation is low, rainfall is erratic and varies significantly from year to year, causing floods in some years. For this reason, the country has been searching for ways to utilize excess rainfall (surface water) for many years. Since some regions rely heavily on groundwater in addition to rainwater, the Tunisian government has been promoting the conservation of groundwater resources as one of its major strategies as well.

Agriculture, which accounts for 13 – 15% of Tunisia's GDP, has been regarded as one of key industrial sectors that drive the country's economic growth. The Tunisian government was striving to achieve food self-sufficiency and secure stable food production, for which development of water resources and irrigation facilities became essential. Under these circumstances, the Tunisian government formulated the Water Resources Development Plan, under which to construct 1 large-scale dam, 20 medium-scale dams, 203 hill dams, 1,000 hill lakes, 1,760 wells, and other water facilities across the country between 1991 and 2000.

At the time of the project's appraisal, 63 of the planned 203 hill dams had been completed, 42 were under construction, and the remaining 100 or so were to be implemented under the Ninth Five-Year Development Plan (1997 – 2001). Hill dams were expected to bring about a variety of positive effects, including storage of surface water to secure irrigation water and replenishment/increase of groundwater resources, as well as

flood mitigation, soil erosion control, and prevention of sediment flow to downstream large dams.

Under these circumstances, the Government of Tunisia requested an ODA loan from the Government of Japan for the construction of some of the hill dams.

1.2 Project Outline

The objective of this project is to improve agricultural productivity through irrigation and groundwater replenishment by constructing hill dams and irrigation facilities in the mountainous regions in north-central Tunisia, thereby increasing livestock numbers and farmers' income, as well as contributing to the conservation of agricultural water resources and the prevention of soil erosion in farmland.

Loan Approved Amount/ Disbursed Amount	7,184million yen / 3,617million yen
Exchange of Notes Date/ Loan Agreement Signing Date	January 1999 / March 1999
Terms and Conditions	Interest Rate 1.7% Repayment Period 25 years (Grace Period 7 years) Conditions for Procurement General untied (Bilateral untied for the consulting service)
Borrower / Executing Agency	Government of the Republic of Tunisia / General Directorate of Dams and Large Hydraulic Works, Tunisian Ministry of Agriculture, Hydraulic Resources and Fisheries (At the time of appraisal: General Directorate of Hydraulic Studies)
Final Disbursement Date	November 2009
Related Studies (feasibility study (F/S), etc.)	Special Assistance for Project Formation Study (SAPROF) on Hill Dams Construction Project, Republic of Tunisia (JICA, August 1998) Special Assistance for Project Sustainability (SAPS) for Water Resource Management in the Republic of Tunisia (JICA 2014)

2. Outline of the Evaluation Study

2.1 External Evaluator

Machi Kaneko, Earth and Human Corporation

2.2 Duration of Evaluation Study

This ex-post evaluation study was carried out in the following schedule.

Duration of the study: August 2014 – November 2015

Duration of field study: January 29 – February 28, 2015 and May 26 – June 17, 2015

2.3 Constraints during the Evaluation Study

Field study was not conducted in some of the target locations in Kef and Jendouba Governorates pursuant to JICA's safety standards (travel restrictions) in Tunisia.

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

3.1 Relevance (Rating: ③[6])

3.1.1 Relevance to the Development Plan of Tunisia

At the time of the project's appraisal, the Tunisian government was actively implementing water resources development projects under its Ninth Five-Year Development Plan (1997 – 2001). Specifically, construction of the following infrastructure facilities was being planned under the Water Resources Development Plan (1991 – 2000), which was aiming to construct hill dams in 203 locations.

Table 1 Water Resources Development Plan (1991 – 2000)

Facility	No. of locations	Developed water volume (million m3/yr.)
Large-to-medium-scale dam	20	739
Hill dam (barrages collinaires)	203	110
Hill lake (lac collinaires)	1,000	50
Irrigation facility	4,000	43
Deep well	1,760	288
Water purification plant	98	200
Total		1,430

Source: Documents provided by JICA

With regard to irrigation facilities development, the Ninth Five-Year Development Plan intended to expand the irrigated areas by 30,000ha (with a scheduled investment amount of 3 million TND[7]), of which 3,000ha was to be created based on water resources to be developed through the construction of hill dams.

With regard to agricultural development, the Ninth Five-Year Development Plan was aiming to increase the country's self-sufficiency ratios for wheat, barley, and meat, which had been largely relying on imports, while reducing imports of dairy products and sugar

[5] A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory
[6] ③: High, ② Fair, ① Low
[7] TND: an abbreviation of Tunisian dinar, the currency used in Tunisia.

and increasing exports of agricultural and food products in order to ensure food security.

As of the time of the ex-post evaluation, a new government has already been inaugurated in February 2015 after completing a four-year democratization process following the outbreak of the Jasmine Revolution in January 2011. Though no new national development plan has been established since the Revolution, the new government is currently in the process of formulating the next Five-Year National Development Plan for the period between 2016 and 2020.

In accordance with the new government's policy, each Ministry/Department is preparing for the formulation of a development plan for each sector and governorate. As for the development of water resources, which is one of Tunisia's priority agendas, the Provisional Government's plan to construct additional 50 hill dams based on the Second Ten-Year Hydraulic Resources Development Strategy (2012 – 2022) has been taken over and is now implemented by the new government, according to the Ministry of Agriculture. At the time of this ex-post evaluation, 3 of the planned dams had already been completed, 2 were under construction, and the remaining 45 were scheduled to be constructed during a nine-year period between 2014 and 2022.

With regard to agricultural development, the irrigated area expanded from 394,000 ha in 2001 to 459,570 ha in 2011 as a result of continuing promotion of irrigation farming by the Tunisian government. According to the Ministry of Agriculture, development strategies for the period of 2015 – 2020 are currently being developed at the national and governorate levels. For instance, the Regional Agricultural Office (CRDA) of Siliana Governorate, where 40% of the hill dams of this project were constructed, is currently formulating governorate-level development strategies toward reducing the cropped area of grain by 2020 while expanding the growing area of vegetables and promoting livestock farming by taking into consideration the central government's policy and the actual situations of the governorate. According to CRDA, the governorate intends to reduce the area of grain crops to mitigate soil erosion and flooding, which has been aggravated by the expansion of grain fields, and instead plans to improve the unit yield of wheat by introducing high-yield varieties, etc., expand vegetable crops, and promote livestock (especially cattle) farming. The strategies of Siliana CRDA suggest the Tunisian government's continued commitment to improving agricultural productivity, expanding intensive irrigation farming (vegetable cultivation), promoting livestock farming, and fortifying soil erosion control for agricultural development in the northern region. Therefore, development of water resources by this project is relevant to the Tunisian government's plan to improve agricultural productivity and expand intensive irrigation farming.

3.1.2 Relevance to the Development Needs of Tunisia

Water Resources Development

At the time of the appraisal, effective utilization of limited water resources was one of critical development needs of Tunisia. As shown in Table 2, the northern region, which was targeted by this project, is abundant with surface water and has a relatively high annual precipitation of 500 – 700 mm compared to other regions of Tunisia. For this reason, the region had been promoting the storage and utilization of limited water resources by constructing large-scale and hill dams and other water facilities.

Table 2 Available Water Resources in Tunisia by Region (2013)

	Region			
	North	Central	South	Whole
Area ratio of region	17%	22%	61%	100%
Surface water (million m^3/yr)	2,185	290	225	2,700
Groundwater (million m^3/yr)	550	465	830	1,845
Total (million m^3/yr)	2,735	755	1,055	4,545
Water resource ratio of region	60%	17%	23%	100%

Source: System Hydraulique de la Tunisie a l' Horizon 2030, 2014 edition

As of the time of this ex-post evaluation, there has been no change in Tunisia's general approach to utilizing limited water resources, and the need for storing surface water during floods for agricultural and other purposes is still very high. As shown in Table 3, agricultural water accounts for 80% of total water intake in Tunisia, calling for measures to use water even more efficiently. According to the General Directorate of Dams and Large Hydraulic Works, Ministry of Agriculture (DG/BGTH), 208 hill dams have been constructed as part of the water resources development strategies as shown in Table 4 below. The present total reservoir capacity of all dams in Tunisia is 1,645 million m^3/year, of which hill dams account for 270 million m^3/year or about 13% of the total. Though each hill dam has a short life span due to sedimentation, construction of many small dams is playing an important role in storing surface water effectively.

Table 3 Water Intake in Tunisia by Sector (2011)

(Unit: million m^3)

	Agriculture	Household	Industrial	Tourism	Total
Water intake	2,644	463	165	33	3,305
%	80%	14%	5%	1%	100%

Source: Agriculture in Tunisia, FAO, 2015

Table 4 Actual No. of Hill Dams Constructed under Water Resources Development Plan (1991-2000)

Financed by	Plan	Actual			
	No. of dams	No. of dams	Reservoir capacity (million m^3/yr)	Investment (100 million TND)	Completion
Tunisian government	-	84	121	126.9	2005
JICA	19	19	28.6	31.5	2001
JICA	22	22	19.8	34.4	2005
BEI	20	26	50	60	2010
FKDEA	30	15	12.4	27	2005
WB	6	15	18.8	23.8	1998
AFD	15	20	12.5	39.3	2010
Italy	2	2	3.6	14	In progress
China	7	7	3.2	14	2013
Total	203	208	270	371	

Source: Ministry of Agriculture

Development of Irrigation Farming

At the time of the appraisal, agricultural development through the construction of irrigation facilities was considered to be of high needs from the standpoints of Tunisia's economic development and food security/self-sufficiency, and the Tunisian government had been actively implementing water resources development projects to promote irrigation farming as described above.

As of the time of the ex-post evaluation, the irrigated farmland area in Tunisia has increased significantly from 394,000 ha in 2001 to 459,570 ha in 2011. While the irrigated area accounts for only 9% or so of the total farmland area, its agricultural production amounts to 35% of the total. For this reason, irrigation is regarded as a highly economical method for improving agricultural profitability in the semiarid zone in Tunisia. In addition, in order to make efficient use of precious water resources for agricultural purpose, the government has been actively promoting and subsidizing the adoption of water-saving irrigation techniques, increasing the need for drawing irrigation water from hill dams.

However, as later discussed in detail in Section 3.2, due to the record drought that hit the project's target regions while the dams were being constructed or completed, a F/S was conducted to redesign the irrigation system that would have accompanied each dam under the original plan. As a result of the F/S, it was determined that the originally planned stationary-type irrigation facilities should be built only in three dam sites (the planned irrigated area of these dams was 189.9ha) and that the other sites should be installed with portable-type facilities and equipment by taking into account the effects of

climatic other changes in the future. The F/S also confirmed that due to private investments and self-help efforts of the residents since the completion of the dams, irrigation farming was spreading by using water from the dams' reservoirs or drawing replenished groundwater from shallow wells, etc. For this reason, the project was partially modified to provide farming assistance, lend equipment, and extend other support through CRDA according to the actual conditions of each dam.

In light of the above, though the original irrigation facility plan had to be revised substantially, such revision was appropriate given the water levels of the reservoirs and the status of farming activities in the surrounding areas. Moreover, the plan at the time of the appraisal to attach an irrigation system to each small-scale dam was a generally accepted approach in those days, and thus it would have been difficult to devise a plan not to attach an irrigation system to a newly constructed reservoir at that time.

3.1.3 Relevance to Japan's ODA Policy

At the time of the project's appraisal, Japan's ODA policy for Tunisia was placing emphasis on the securing/utilization of water resources, reduction of poverty in rural areas, and enhancement of industrial competitiveness; and JICA had been implementing projects centered on the water resources sector (which included the agricultural sector in its wider sense), as Tunisia's economic activities were largely dependent on rainfall.

Since the resumption of yen loan to Tunisia in 1993, JICA had been continuously implementing assistance projects for the water resource sector of Tunisia, starting with a yen-loan project in FY1994 followed by two projects in FY1995, four in FY1996, and two in FY1997 to support the most pressing agendas of the Tunisian government. This project was part of such assistance for Tunisia's water sector, which includes agriculture, and therefore was relevant to Japan's ODA policy.

In Tunisia, there was a political regime change between the times of the appraisal and ex-post evaluation of the project, during which the country was unstable in the absence of official national policies. February 2015 saw the inauguration of a new government, which is in the process of formulating the next Five-Year National Development Plan and is continuing the construction of hill dams and related facilities based on the Second Ten-Year Hydraulic Resources Development Strategy (2012 – 2022). For agricultural development, the new government also announced its intention to give priority to the expansion of irrigation farming, improvement of agricultural productivity, and so forth, which were consistent with the objectives of this project both at the times of the project's appraisal and ex-post evaluation.

The Tunisian government's policy to efficiently use limited water resources to meet its

development needs did not change between the project's appraisal and ex-post evaluation, and it intends to continue promoting the construction of hill dams as an effective means for maximizing the use of surface water. The need for storing surface water and recharging groundwater to improve agricultural productivity is still high and will need to be satisfied further after the ex-post evaluation.

This project was also consistent with the ODA policy of the government of Japan.

In light of the above, this project has been highly relevant to Tunisia'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

The original plan of this project was to construct: 1) hill dams and 2) irrigation facilities at the same time. However, though the dams were constructed as planned, the content of the irrigation facilities was revised.

The planned and actual scopes of this project are shown below.

Table 5 Scope of this Project

	Plan	Actual
1) Construction of hill dams	22 sites in 7 governorates	22 sites in 7 governorates
2) Watershed management (windbreak trees, etc.)	3,080ha	6,165ha
3) Irrigation facilities		
Main irrigation system *1	22 sites	3 sites
On farm irrigation system*2	22 sites (2,270ha)	2 sites (38.5ha)
4) Land acquisition	22 sites	22 sites
5) Surveying & engineering	1 set	1 set
6) Logistics and O&M equipment*3	1 set	-
7) Consulting service	Overall project management, supervision of civil works, institutional enhancement (promotional activities, farmer's association)	F/S on irrigation facilities in 6 governorates

Source: Documents provided by JICA (2014)

Note 1: pump stations, balancing tanks, pipelines, etc. were to be constructed as main irrigation facilities.
Note 2: sprinklers were to be installed as on-farm irrigation equipment.
Note 3: bulldozers, trailer trucks, backhoes, pickup trucks, and dump trucks were to be purchased as O&M equipment.

(1) Construction of Hill Dams

Under this project, construction of a total of 22 hill dams began as originally planned, of which 18 were completed between 2001 and 2002, and the remaining 4 were completed between 2003 and 2005 as shown in Table 6 below.

Table 6 No. of Hill Dams by Governorate

Governorate	Siliana	Kef	Béjà	Jendouba	Nabeul	Zaghouan	Sousse	Total
No. of dams	9	2	4	1	1	4	1	22

Source: Ministry of Agriculture

(2) Irrigation Facilities

Tunisia experienced extremely low precipitation between 1999 and 2002, and as a result, many of the reservoirs constructed by the project did not fill to sufficient levels. The General Directorate of Dams and Large Hydraulic Works of the Ministry of Agriculture submitted to JICA a request for concurrence to conduct a F/S on the irrigation facilities planned for each governorate. JICA officially agreed to the request in February 2006 and began the F/S. However, because the selection of a consultant for the F/S was not carried out by the Ministry of Agriculture but by CRDA, a local branch of MOA inexperienced in bidding produce, the selection process was delayed, and it took some three years to complete the study in all the target governorates.

Based on the results of the F/S, it was decided to install the originally planned main irrigation facilities (pipelines) in three sites and provide portable pumps to seven sites. Due to the subsequent political and other changes, however, construction and installation of the irrigation facilities and equipment did not complete until 2013. Given the weather conditions of the target regions at that time, the revision made to the original irrigation facilities as a result of the F/S was appropriate. The Tunisian side’s decision to conduct the F/S and revise the plan to construct stationary facilities was also appropriate, considering that many of the hill dams built under the project had already been operating for five years at the time of the F/S, which meant that their remaining service life was reduced to 15 years, assuming the average life span of hill dams for irrigation purpose to be 20 years.

Table 7 Status of Irrigation Facilities Development by the Project and Private Sector

Main irrigation facility	Plan	Actual	
		This project	Private
Pipeline facility with pump station	17 sites	1 site	
Gravity pipeline without pump station	5 sites	2 sites	2 sites (private)
Irrigation using portable pump (Portable pump is a type of equipment used to suck up water from hill dams)	4 sites 29 units	7 sites 24 units	10 sites
On-farm irrigation equipment (sprinkler)	2,270ha	38.5ha	Unconfirmed

Source: Documents provided by JICA (2014) and Ministry of Agriculture

When the Ministry of Agriculture began the F/S, private farmers had already begun using water from the dams for irrigating their crop fields. As shown in Table 7 above, gravity pipelines were laid in two sites and portable pumps installed in 10 sites while farmers in other sites also began adopting irrigation farming by drawing groundwater from shallow wells, which were recharged by the upstream dams, or by using tractors, etc. to draw and transport water from the dams. The expansion of private investments was encouraged by timely increase in government subsidies for water-saving irrigation facilities, etc. when impoundment of the dams began.

(3) Consulting Service

Though the consulting service for this project was initially to be provided by a Japanese company, the bidding for the service was unsuccessful because no Japanese companies made a bid. Subsequently, a consultant was selected from consulting firms in Tunisia, and JICA approved the consulting service contract in January 2002. However, the contract was later cancelled because most of the hill dams were completed while the negotiations with the consultant were taking place, and the Tunisian government decided to revise the irrigation facilities plan. As a result, another consultant was hired to conduct a F/S on the irrigation facilities instead of supervising the construction work of the originally planned dams and irrigation facilities and assisting residents' participation in decision making processes of CRDA, etc.

While the above change did not negatively affect the construction of the hill dams, irrigation farming would have been promoted even more efficiently if the support for residents' participation in the processes of CRDA, etc. had been provided at an appropriate timing.

3.2.2 Project Inputs

3.2.2.1 Project Cost

Under the original plan, the estimated total cost of this project was 9,609 million yen, of which 7,184 million yen was to be financed by a yen loan. The actual total cost was 5,105 million yen (of which 3,617 million yen was yen loan disbursement) accounting for 53% of the planned total project cost. In other words, the actual project cost was lower than the planned amount.

Table 8 below shows the breakdown of the total project cost. The actual cost of dam construction was 29,180,000 TND, which is significantly lower than the planned amount of 45,326,000 TND. According to the Ministry of Agriculture, the significant difference is due to overestimation of the project cost at the time of the project's appraisal, as well as competition among the bidders, which led to price discount. Considering that all 22 dams were constructed as planned, the project cost was appropriate for the output.

The construction cost of irrigation facilities was initially 8,808,000 TND but turned out to be 1,285,000 TND (15% against the original figure). Irrigation facilities were constructed in 3 locations instead of 22 locations as originally planned (14% against the plan). This portion of the project cost was also appropriate for the output for the most part.

The cost of watershed management increased from the original amount of 2,428,000TND to 7,673,000 TND. According to the Ministry of Agriculture, the reason for the increase was the fortification of control measures against soil runoff caused by flood, etc., which, as a result, doubled the tree-planting area from the original 3,080ha to 6,154ha. This decision to revise the plan was appropriate. It should be noted, however, that the cost of tree planting per hectare also increased from the original estimation due to rise in fuel price, etc.

In summary, the actual total project cost of 5,105 million yen was lower than the initially estimated cost of 9,609 million yen (54%) due to change in the irrigation facilities and overestimation of the initial dam construction cost, which more than offset the increase in watershed management cost.

Table 8　Planned and Actual Total Project Cost

(Unit: 1,000 TND)

Item	Plan	Actual	Ratio against plan
Construction cost	54,134	30,465	56%
(Construction of dams) (Irrigation facilities)	(45,326) (8,808)	(29,180) (1,285)	(64%) (15%)
Contingencies	2,853	1,004	35%
Consulting service	6,518	243	4%
Farmland development	2,707	97	4%
Due diligence (D/D)	600	0	0%
Watershed management	2,428	7,673	316%
Land acquisition, etc.	1,935	1,935	100%
Taxes, etc.	11,665	6,903	59%
Total	82,840	48,320	58%

Source: Documents provided by JICA

3.2.2.2　Project Period

The actual project period was 115 months from March 1999 to October 2013, which exceeded significantly than the planned period of 63 months from March 1999 to June 2004 (183% of the planned period) even though the outputs were smaller than planned as a result of reduction in irrigation facilities.

The major causes of the prolongation of the project period were delays in selecting a consultant and filling up the reservoirs due to droughts between 1999 and 2002, as well as the addition of the F/S to revise the irrigation system and resulting modifications of contracts, etc. Though the final disbursement of yen loan took place in November 2009, the Tunisian government continued the installation and provision of irrigation facilities and equipment until October 2013, which constitutes the official completion of the project.

3.2.3　Internal Rates of Return (reference only)

(1) Financial Internal Rate of Return (FIRR)

Due to the nature of the project, a quantitative analysis of the financial internal rate of return was not possible.

(2) Economic Internal Rate of Return (EIRR)

The result of recalculating the economic internal rate of return (EIRR) based on the parameters used at the time of the project's appraisal is shown below. Because of the change in irrigation facilities, the EIRR at the time of the ex-post evaluation was lower than that at the time of appraisal.

	At the time of appraisal (1999)	At the time of ex-post evaluation (2014)
EIRR	Max. 15.1%, Min. 3.1% (EIRR was calculated on all sites)	Max. 9.3%, Min. 0.54% (EIRR was calculated on 5 sites, for which data were available)

Source: Project Completion Report (PCR2014)

【Parameters of calculation】

- Cost: construction, O&M (including livestock feed and veterinary fees)
- Benefit: farmers' income from crop & livestock farming (TND)
- Project life: 20 years

Although the project cost was lower than planned, the project period far exceeded the plan. Therefore, efficiency of the project is fair.

3.3 Effectiveness[8] (Rating: ②)

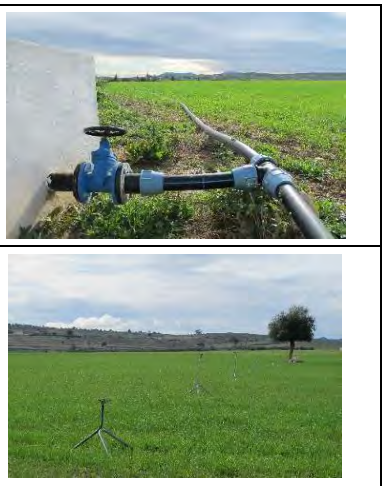
3.3.1 Operation and Effect Indicators

As discussed in the Relevance and Efficiency Sections, the content of irrigation facilities was revised considerably from the original plan as a result of conducting the F/S. However, the F/S did not review or change the operation and effect indicators that were set at the time of the project's appraisal. Thus, the target figures set at the time of appraisal were compared to the actual figures in the ex-post evaluation.

(1) Irrigated Area

Total Irrigated Area

Irrigated areas that were to be or have been created by the project in the 22 target locations are shown in Table 9 below. The actual total area was 620.5ha (of which 440.5ha was created by the project), which was substantially smaller than the original target of 2,298.1ha. This was because only 3 sites (planned irrigated area: 189.9ha) were installed with the originally planned main irrigation facilities (pipelines, etc.), thus substantially reducing the irrigated area installed with stationary facilities as shown in the photo at right. However, 7 of the remaining 19 sites are irrigating fields using portable pumps and other equipment provided by the project while other sites have installed or are in the process of installing gravity pipelines or portable pumps and other equipment using private funds or government subsidies.



Zangou Dam area, Zaghouan Governorate
Top: 80ha irrigated land is installed with irrigation valves and pipes at 11 locations, which can be connected to drip tubes and sprinklers.
Bottom: sprinklers in a wheat field

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

Table 9　Irrigated Area Created by the Project

	Plan	Actual (2014)
Total irrigated area [1)]	2,298.1ha	620.5ha (Area created by the project: 440.5ha) (Breakdown) Main irrigation system(stationary pump) built by the project : 164.0ha (26%) Portable pump provided by the project : 276.5ha (45%) Private irrigation system : 180.0ha (29%) Total : 620.5 ha (100%)
Area installed with on-farm irrigation equipment under the project [2)]	2,270ha	38.5ha

Source: Documents provided by JICA

Note 1): The planned "total irrigated area" means the area of farmland that can be irrigated. The "actual" area indicates an area of irrigated fields officially approved by the Ministry of Agriculture that draw water from the hill dams constructed by the project. More specifically, it is the total area of 10 sites (3 sites installed with irrigation facilities and 7 sites provided with portable pumps by the project) and sites officially approved by MOA/CRDA as irrigated land installed with privately-funded pipelines and portable pumps and other equipment.

Note 2): The planned "area installed with on-farm equipment under the project" means the area where watering of crop fields is possible using sprinkler equipment. The "actual" figure means the area where the use of 2 sprinkler facilities installed by the project, as well as the amount of water to be sprinkled, is approved by MOA/CRDA. For this reason, the area which can be watered without sprinklers or by drawing recharged groundwater from shallow wells is not included.

According to the Tunisian Ministry of Agriculture, the actual total irrigated area refers to the area of irrigated farmland that has been officially approved by the government in accordance with the Ministerial Ordinance. In order to be approved by the Ministry of Agriculture, the "official irrigated farmland" must have "sufficient water resources for irrigating the land." The government has the obligation to guarantee a certain amount of irrigation water for the farmers growing crops in the official irrigated farmland while the farmers are required to engage in farming activities in the official irrigated farmland and may be subjected to penalties for non-performance. However, because the hill dams constructed by the project are not permanent water resources, the associated irrigated crop fields are approved for limited time periods only with clear understanding of the farmers that such fields are not guaranteed with permanent access to irrigation water.

The field survey of the ex-post evaluation observed some crop fields, other than those officially approved, that were also irrigated using the hill dams as water sources (including those drawing groundwater from recharged shallow wells). However, the area of these fields cannot be quantitatively ascertained at this time because the size of the

area fluctuates depending on the annual precipitation (expands when rainfall is high and shrinks when low) and because the Ministry of Agriculture has yet to grasp accurate data.

Area Installed with On-Farm Irrigation Equipment

The area installed with on-farm irrigation equipment refers to the area of two sites, where sprinkler facilities were installed by the project as originally planned, and for which use of water supplied by such facilities, as well as the amount thereof, has been approved by the MOA/CRDA. As shown in Table 5 above, the actual area was only 38.5ha, which is much less than the target of 2,298.1ha. This is because the target area size was set based on the assumption that all sites would be installed with sprinkler facilities according to the initial plan.

Top: Drip tubes installed in farmland 1.5km from Zangou Dam reservoir, Zaghouan Governorate. The agroforestry system is used to grow melons.
Middle: self-propelled sprinkler
Bottom: sprinkler truck

In the actual crop fields, multiple irrigation techniques are employed as shown in the photos at right. Sprinklers are used mainly for growing wheat and barley whereas drip tubes are used for cultivating vegetables and fruits. Since drip tubes are subject to government subsidies for water-saving irrigation farming, many farmers in the project's target regions have adopted this technique. Because drip tubes increase yield per hectare while saving water, the required irrigation area tends to be smaller than normal though no data were available to accurately grasp the actual area installed with drip tubes.

For the reasons stated above, it was determined not to use the "area installed with on-farm irrigation equipment" as an effect indicator of this project, as it does not accurately represent the status of various types of irrigation equipment adopted in the actual crop fields.

The unavailability of data on the agricultural activities of farmers around the dam sites is due to the limited personnel and financial resources of CRDA of each governorate, which are making it very difficult to collect chronological data of agricultural activities around numerous hill dams.

(2) Cropped Area of Major Crops

The planned and actual (2014) areas of major crops are shown in Table 10 below. By promoting farming methods that can cope with fluctuating reservoir and groundwater

recharge levels depending on annual rainfall, the project has created 3,098.3ha of irrigated land, which is very close to the original target of 3,165ha. However, as mentioned in 3.2 Efficiency, inputs of irrigation facilities were cut back substantially in 19 of the 22 target dam sites. For this reason, it is not possible to evaluate the effectiveness of the project based solely on the actual cropped area.

The agricultural activities observed during the ex-post field survey around each dam site are worthy of note and thus separately described in BOX 1 below.

Table 10　Cropped Areas of Major Crops in the 22 Target Sites of the Project

	Plan	Actual (2014)
Cropped areas of major crops[2)]	3,165 ha [1)]	3,098.3 ha[3)]
（By type of crop）		
Hard wheat		1259.2 ha
Soft wheat		710.7 ha
Barley		352.6 ha
Oats		408.8 ha
Livestock feed (barley fodder)		237.6 ha
Chickpeas		5.0 ha
Broad beans		19.4 ha
Olives		105.0 ha

Source: Documents provided by JICA

Note 1): the target cropped area at the time of planning was calculated based on the planned cropping intensity and irrigated area.

Note 2): including the area of livestock feed crops.

Note 3): refers to the area where crops are grown using water from new reservoirs that were created by the hill dams constructed by this project, including crop fields that are using the irrigation facilities or recharged groundwater due to the effects of the project.

BOX 1: Note-Worthy Agricultural Activities around the Target Sites of the Project

As mentioned in the Relevance Section, hill dams not only store surface water but also recharge groundwater. According to the interviews with farmers and CRDA personnel in the field survey, water situations of the crop fields around the reservoirs, including those not installed with irrigation equipment, changed dramatically from before to after the construction of the dams, making it possible to grow wheat (double cropping of spring wheat and winter wheat) in the lower reaches, as well as olives, almonds, and other fruits using portable pumps and sprinkler trucks in the upper reaches. These changes are also seen in crop fields around the dam sites, whose reservoirs are no longer storing water due to sedimentation, indicating that the current (and past) existence of the dams are having major impact on the surrounding farmland. In addition, the Ministry of Agriculture is promoting especially the cultivation of olives, which require irrigation when the trees are very young (1 – 5 years old) but can grow with rainwater alone after the sixth year, meaning that they can adapt to decline in reservoir level.

Breck Dam in Sousse Governorate as shown in the photos below (taken in June 2015), for instance, is one of the dams that are bringing notable groundwater recharge effects. According to the Sousse CRDA, most of water stored in Breck Dam is used to recharge downstream groundwater and deep groundwater. The maintenance record of the dam indicates that 600,000 to 700,000m^3 of water flows from wadis into the dam every year, most of which is released to downstream wadis. Because of the release, 18 shallow wells downstream of the dam are experiencing a rise in water level by 1.5m or so in general, expanding the irrigated area of about 100 farms (approx. 35ha per farm). Moreover, a drop in salinity of water (7 g/l → 3.5 g/l) in some shallow wells after the construction of the dams has been observed. In regards to deep wells, the static level of the Sidi Abiche Aquifer measured by a water gauge has dropped only slightly compared to other areas despite the recent increase in the volume of groundwater withdrawn.

		
Water level of this shallow well rose due to recharging effect of Breck Dam in Susse Governorate. The distance between wells is 50m in this area while it is normally 200m or greater.	Shallow well pump station of Breck Dam (electricity is supplied from the grid). Electrification is allowed only for households that already had wells before the construction of the dam.	Drip irrigation system drawing water from Break Dam via a shallow well. Water conservation and diversification of crops have become possible by planting vegetables between olive trees.

(3) Annual Production of Major Crops

The target and actual annual production volumes of major crops are shown in Table 11 below. The actual production was 3,098 tons, which is 59% of the planned target of 5,250 tons. The annual agricultural income, which will be discussed in the subsequent Impacts Section, was 3,900,000 TND or 81% of the planned income of 4,800,000 TND. The reason behind this is the higher sales price of vegetables and olives than grain. However, as was the case in the preceding subsection (2), it is difficult to evaluate the effect of this project based solely on the actual production volume because the inputs of irrigation facilities were substantially reduced from the original plan.

Table 11　Annual Production of Main Crops in 22 Target Sites of the Project

(Unit: ton)

	Plan (2015, 1 year after completion)	Actual (2014)
Annual production of major crops[1)]	5,250	3,098

Source: PCR 2014

Note 1): including the annual production of livestock feed

3.3.2　Qualitative Effects

The intended effects of this project, which, under the original plan, were to be measured qualitatively by the increase and stabilization of agricultural production of the target regions, have materialized to a degree as described in 3.3.1. However, it is difficult to clearly determine whether or not these effects were brought by the project alone, as the irrigation facilities were not constructed as originally planned. In addition, based on the general life span of hill dams of 20 to 30 years, the remaining service life of the dams constructed by this project for irrigation purposes will be around 5 to 10 years depending on the progress of sedimentation, which means that the project does not guarantee stable agricultural production for farmers permanently in the future, but rather for limited time periods.

3.4　Impacts

3.4.1　Intended Impacts

(1) Annual Agricultural Income

The target and actual amounts of annual agricultural income are shown in Table 12 below. The actual income was 3,900,000 TND or 81% against the planned income of 4,800,000 TND. Farmers in Siliana Governorate responded to an interview by saying that, before the construction of the hill dams, they had been suffering from chronic water shortages and had to travel nearly 30km to the nearest water supply station to get drinking water for their livestock. They also said that several attempts to drill wells failed, but the dams solved the water problems in the surrounding farmland, increased the number of farmers that began growing fruits and other high-cash crops, and thus dramatically changed their lives in a positive way.

Currently, MOA/CRDA is encouraging farmers to change crops from wheat, barley, and other grains to more high value-added vegetables and fruits (such as olives and almonds), which is also contributing to the increase in agricultural income. Since young olive trees can be grown with rainwater alone after the sixth year as described earlier, the Ministry of Agriculture is especially promoting olive cultivation in anticipation of the end of service life of the dams due to sedimentation. However, such effort needs to be

accompanied with increased assistance for the adoption of water-saving irrigation techniques and the development of alternative water resources in order to ensure stable income for the farmers.

Table 12 Annual Agricultural Income of this Project

(Unit: 1,000 TND)

	Plan (2010)	Actual (2014)
Annual agricultural income	4,800	3,900

Source: PCR 2014

According to the result of the beneficiary interview survey[9], 57% of the surveyed households responded that their income increased after the construction of the hill dams as shown in Table 13. Though there are certain difficulties in obtaining an honest response to income-related questions, the fact that only 6% said their income decreased indicates that the project has generated an expected impact for the most part.

Table 13 Change in Agriculture/Livestock Income after Construction of Hill Dams

Response	No. of households	Percentage
1. Increased	42 1)	57%
2. Unchanged	20	27%
3. Decreased	6	8%
4. Do not know	6	8%
Total	74	100%

Source: beneficiary questionnaire survey

Note 1): Of the 42 households that enjoyed "increased" income, 62% answered that their income increased by about 1.5 times, 19% by about 2 times, and 19% by 3 times or more.

(2) Annual Livestock Numbers and Meat Production

The expansion of farmland to grow livestock feed (barley fodder, etc.) using the newly created water resources as a result of the construction of the hill dams by this project, led to the increase in livestock numbers. According to the beneficiary interview survey result, 46% of the households responded that their livestock increased as shown in Table 14. Though the figure seems low, it nevertheless indicates a positive impact of the project.

[9] A local consultant was hired to conduct a beneficiary survey in Siliana, Zaghouan, Béjà, and Sousse Governorates. Though the consultant intended to collect questionnaire responses from at least 100 households, the actual number of beneficiary households that the consultant was able to visit turned out to be 74 due to flooding and other problems in the northern region.

Table 14　Change in No. of Livestock Animals After Construction of Hill Dams

Response	No. of households	Percentage
1. Increased	34	46%
2. Unchanged	30	41%
3. Decreased	4	5%
4. Do not know	6	8%
Total	74	100%

Source: beneficiary questionnaire survey

Tables 15 and 16 show the numbers of livestock animals by year. Though it was difficult to obtain data that purely represent the effects of the project, the fact that 53% of cattle, 40% of sheep, and 29% of goats in all of Tunisia are being raised in the seven target governorates of this project according to data provided by each governorate, indicates that the target regions of the project are the key center of meat production in Tunisia. Meat production in Tunisia in 2012 increased from that of 2004 as shown in Table 17.

Table 15　No. of Livestock Animals in 7 Target Governorates and All of Tunisia (2010)

(Unit: 1,000 heads)

Governorate	Cattle		Sheep		Goats	
Nabeul	64	(10%)	250	(3%)	35	(3%)
Beja	92	(14%)	447	(6%)	58	(5%)
Jendouba	97	(14%)	216	(3%)	63	(5%)
Kef	27	(4%)	597	(8%)	40	(3%)
Siliana	40	(6%)	684	(9%)	128	(10%)
Zaghouan	27	(4%)	387	(5%)	44	(3%)
Sousse	11	(2%)	286	(4%)	12	(1%)
Subtotal	358	(53%)	2,867	(40%)	380	(29%)
National total	671	(100%)	7,234	(100%)	1,296	(100%)

Source: Agricultural Statistics FY2010, February 2012

Table 16　No. of Livestock Animals in Tunisia by Year

(Unit: 1,000 heads)

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2012
Cattle	753	679	657	686	703	710	*	679	671	654
Sheep	6833	6613	6949	7213	7484	7618	*	7361	7234	6802
Goats	1449	1379	1411	1426	1497	1551	*	1455	1296	1273

Source: Statistical Yearbook 2008-2012, 2013 edition

*: Data not available due to drought

Table 17 Livestock Meat Production in Tunisia

(Unit: ton)

	Baseline (2004)	Actual (2012)
Cattle	89.8	105.2
Sheep	100.4	106.0
Goats	19.5	21.4
Poultry	142.5	170.7
Other	52.1	94.4

Source: Statistical Yearbook 2008-2012, 2013 edition

(3) Flood/Soil Erosion Control and Reduction of Sediment Inflow into Downstream Large/Medium-Scale Dams

Trees were planted around the dam sites of this project to prevent soil erosion. As shown in Table 18 below, compared to the planned area of 3,080ha, 6,154ha were actually planted with trees backed by the Tunisian government's reinforced effort to control soil erosion. According to CRDA and farmers, the tree-planting operation has contributed to the protection of downstream farms and facilities, as well as to the recharging of groundwater.

Table 18 Tree Planting Operation Around the Dam Sites of this Project

	Plan	Actual (2014)
Tree-planting	3,080ha	6,154ha

Source: Documents provided by JICA

The hill dams of this project were also expected to help protect the downstream structures and houses from floods and prevent soil runoff from farmland by retaining floodwater during the rainy season and keeping most of sediments carried by floodwater in the reservoirs. According to the result of SAPS conducted in 2014, the initially planned capacity of the dams was 2,119,000m^3, which was reduced to 1,319,000m^3 (62.3% of the plan) due to sedimentation. The difference between the planned capacity and the actual capacity was the volume of sedimentation, which amounted to some 8,000,000m^3, which was very close to the anticipated volume under the initial plan, meaning that the hill dams have been preventing soil erosion and producing other intended effects. These effects are also likely helping to retard sedimentation in large-scale dams, thereby extending their service lives.

3.4.2 Other Impacts

(1) Impacts on the Natural Environment

Implementation of this project was not assumed to have any negative impact on the natural environment, but was expected to prevent sedimentation, promote greening, and

bring other positive impacts to areas around the dam sites. According to the Ministry of Agriculture, no adverse effects of this project have been reported while positive effects, such as prevention of sediment discharge to the lower reaches and protection of downstream structures and houses from floods by some of the dams, have been observed.

(2) Land Acquisition and Resettlement

According to the Ministry of Agriculture, this project did not require resettlement of residents. Most of the land needed for the project was publicly owned, and the privately owned portion was acquired from, and compensations paid to, the landowners in accordance with the procedures prescribed by law.

(3) Impacts on Gender Issues

Drip irrigation has been adopted increasingly across the crop fields around the dam sites of this project, leading to the lessening of workload for women. The FAO study of 2014 reported that drip irrigation reduces farm work, as it does not require making of ridges and furrows. Some female farmers responded to the interview by saying that their work had been very hard before the completion of the hill dams because they had to make ridges and furrows to irrigate the farmland with water from sprinkler trucks. For growing olive and other fruit trees, they also had to plow the field and create a circular ridge around each tree to save water. Diffusion of drip irrigation using water supplied from the dams constructed by this project has reduced the workload of female farmers in the target regions, which is another positive impact of this project. No negative impact, on the other hand, has been observed so far.

To summarize, this project initially intended to construct hill dams and irrigation facilities in 22 locations in the mountainous regions in the northwestern and central parts of Tunisia, where precipitation was relatively high. However, due to massive droughts between 1999 and 2002, the completed dams did not fill to sufficient levels for consecutive years. Because of this, the plan was revised to construct the original irrigation facilities in three dam sites only and provide portable pumps and other irrigation equipment instead for the remaining sites. Concurrently, development of irrigation facilities by private investment also progressed. As a result, the total irrigated area created by this project (effect indicator) turned out to be only 620.5ha compared to the original target of 2,298.1ha.

On the other hand, the quantitative indicators, such as the cropped area and production of major crops, have mostly achieved their respective targets as a result of promoting irrigation farming that took into account the annual reservoir fluctuation of each dam and

its recharging effect on groundwater. The actual cropped area was 3,098.3ha against the original target of 3,165ha. However, because 19 of the 22 dam sites were not installed with the originally planned irrigation facilities, the expansion of the cropped area may not be purely attributable to the effect of this project. Likewise, though the project's objectives to increase and help stabilize agricultural production in the target regions have been achieved to a degree, it cannot be clearly attributed to the effects of the project because of the substantial reduction in the irrigation facilities. In addition, because the remaining service life of the hill dams constructed by this project will be around 5 to 10 years based on their general life span of 20 to 30 years, this project's contribution to the increase in agricultural production is not permanent but is for a limited time period.

With regards to impacts, the annual income of the farmers of the target regions has mostly achieved the target level though it may not be totally attributable to the project. The annual livestock meat production has increased since the time of the project's appraisal. To prevent soil erosion, trees have been planted around the dam sites over a total area of 6,154ha, which is 200% against the plan. In addition, the hill dams are preventing floods and soil erosion in farmland by storing excess rainwater during the rainy season and also helping the control of sedimentation in large-scale dams thereby extending their lives.

In light of the above, this project has to some extent achieved its objectives. Therefore, effectiveness and impact of the project are fair.

3.5 Sustainability (Rating: ②)

3.5.1 Institutional Aspects of Operation and Maintenance

CRDA of each governorate has been operating and maintaining the hill dams under technical assistance from DG/BGTH as originally planned without major problems thus far. However, due to lack of budget and other resources, each CRDA does not have a department or personnel dedicated to the operation and maintenance of hill dams and hill lakes, resulting in situations from time to time, where dam maintenance cannot be performed adequately, as pointed out by the SAPS Report (2014)[10]. The Tunisian Government, which intends to continue constructing hill dams, needs to establish a long-term mechanism for ensuring the safety of dams that have lost their hydraulic power due to sediment buildup, as well as for proper operation and maintenance of existing and newly constructed dams. In order to sustain the effects of this project and the safety of the

[10] The SAPS Report (2014) points out that "a sufficient budget needs to be allocated for dam repair and maintenance to properly handle such problems as dam slope erosion, cracks in dam crest, and spillway slope failure, as it is important to secure the stability of the dam bodies even if they have been filled up with sedimentation."

dam facilities, it is important for each governorate to fortify its institutional structure.

On the central government level, on the other hand, the institutional aspects for hill dam projects are expected to be enhanced in the future, as indicated by the Decree of the Ministry of Agriculture of September 17, 2014 (Décret n° 2014-3486), which expressly states that a special department will be established within DG/BGTH of the Ministry of Agriculture for hill dam construction projects as part of the Second Ten-Year Water Resources Development Strategy. In addition, the Ministry of Agriculture, which was reorganized in June 2015 following the inauguration of the new government, has set out to restructure and mobilize its subordinate organs, including the said department.

However, the above Decree does not clearly provide as to how DG/BGTH should collaborate with the General Directorate of Rural Engineering and Water Management (DG/GREE) that supervises irrigation facilities accompanying hill dams. Furthermore, DG/GREE is not currently taking part in the planning of hill dam construction projects by DG/BGTH. DG/GREE's involvement begins with the planning of irrigation facilities after the completion of a related hill dam, which is the major cause of delay in providing support for the farmers around the dam site in installing irrigation facilities. In order to allow farmers to begin and develop irrigation farming within a limited life span of hill dams, which is said to be between 20 and 30 years, it is important for DG/GREE and DG/BGTH to collaborate in hill dam projects.

CRDA and the provisional farmers' associations are taking charge of the operation and maintenance of the irrigation facilities and equipment under the technical assistance of DG/GREE. As some of the responsibilities and rules of GDA (Groupements de Développement Agricole) are obscure, albeit they are government-approved bodies, the Ministry of Agriculture is in the process of establishing new organizations which are different from GDA and defining the division of their responsibilities, including the O&M of facilities and equipment. Accordingly, CRDA is supporting the formation of new farmers' associations, as a provisional measure for transition period, and has concluded an agreement with the new associations concerning the provision, operation, and maintenance of equipment.

MOA and CRDA are of the opinion that because obscurities also exist in the ownership of some farmland around the dam sites managed by the Ministry of the Environment and Sustainable Development, the cadastral system needs to be improved in order to continue expanding farmland around dam sites and provide an environment for farmers to engage in farming with a sense of ease and trust.

In summary, in order to sustain the effects of the hill dams and irrigation facilities, it is

necessary to improve the coordination between DG/BGTH and DG/GREE on the state level and fortify the organizational structure on the governorate level. Institutional enhancement is also needed to further promote the development of irrigated land.

3.5.2 Technical Aspects of Operation and Maintenance

According to the Ministry of Agriculture, dam facilities are being monitored by the hill dam project unit (PIU) appointed by DG/BGTH. PIU is headed by the Unit Manager and comprised of two divisions with one division performing surveys and monitoring related to construction and the other taking charge of five sectors (geological survey, soil engineering, civil works, financial management, and land acquisition). The staff members are engineers with specialized knowledge and skills, having adequate capacity to perform their respective duties.

According to DG/BGTH, DG/GREE, and CRDA, each PIU engineer has accumulated practical knowledge and skills for the operation and maintenance of hill dams and hill lakes through the implementation of numerous projects since 1990. In addition, each CRDA has a track record of successfully operating and maintaining hill dams by incorporating various creative approaches devised by local engineers. Sousse Governorate CRDA, for instance, has constructed farm roads, etc. to expedite water release and other operations to prevent sedimentation and control flooding. It is also planning to carry out bank protection work in some dam sites this year by using riprap stones from quarries. Because of these efforts, no major problems have surfaced so far.

However, each CRDA's experience and accumulated know-how in operating and maintaining hill dams are not fully shared, and the Guidelines for the Operation and Maintenance of Hill Dams do not provide as to how to control dams, in which sedimentation is building up, or how to ensure safety of dams that have already been filled up. While the Guidelines, which were established in 2001 and revised in 2008, provide how to conduct daily inspections and monitoring, they do not systematically incorporate the know-how and lessons learned by the on-site engineers through handling a variety of unexpected occurrences over many years. Also, no studies or surveys have been conducted to evaluate or check the operation and maintenance statuses of more than 200 hill dams across the country or their usages for irrigation and other purposes. In order to maximize the benefits of hill dams, the Guidelines need to incorporate the technical solutions applied in the past and the analysis results of monitoring activities. Fortification of the O&M system to cope with the recent climate changes is also called for. It is important to update the Guidelines by analyzing and incorporating the successful past experiences in dam operation and maintenance and share them with each CRDA.

In light of the above, though no problem is currently observed in the technical aspects of the operation and maintenance of the hill dams, there is a need to update the Guidelines in a systematic manner by incorporating the accumulated know-how and experiences in handling sudden or unexpected occurrences in order to ensure technical sustainability of the project.

3.5.3 Financial Aspects of Operation and Maintenance

Table 19 below shows the trend in annual budget of the Ministry of Agriculture. There is no significant change in the budget amount before and after the Revolution. Table 20 shows the budget for hill dams owned by DG/BGTH, which increased from 326,938,000 TND in 2013 to 521,565,000 TND in 2014 and has been sufficient in the opinion of the Ministry of Agriculture. Though data of budget execution was unavailable, the field survey did not confirm any situations, where problems were arising in O&M or personnel deployment due to lack of budget. Pursuant to the Ministerial Decree of September 17, 2014 described in Section 3.5.1, budgets for FY2015 and FY2016 were allocated to DG/BGTH, which has already begun carrying out activities under a new institutional system as of the time of the ex-post evaluation.

Table 19 Annual Budget of Ministry of Agriculture

（Unit: million TND）

2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
2 168	5 219	1,451	979	1,820	1,435	5,880	2,121	895	2,935

Source: Ministry of Agriculture

Table 20 Budget Execution in 2013 and 2014

	2013	2014
Budget for hill dam projects	326,938,447 TND	521,565,287 TND

Source: Ministry of Agriculture

The new government has been continuing to provide financial support for farmers, such as subsidizing 60% of the cost of installing water-saving irrigation systems (drip irrigation, etc.) and 25% of the cost of non-water-saving equipment (sprinkler, motor pump, etc.).

On the governorate level, the O&M cost actually spent by CRDA was 1,245,280 TND against the total annual budget of 303,780 TND (114,000 TND for hill dams, 107,280 TND for irrigation systems, and 82,500 TND for pumps). According to CRDA, the

collection rate of water charges from farmers, an important revenue source for CRDA, has dropped since the Revolution, as it brought to surface and intensified their distrust in the government. In order to raise the collection rate, it is necessary to regain their trust by providing technical and other forms of assistance for farmers. In addition, as mentioned in Section 3.5.1, budgetary reinforcement is called for in order to secure sufficient personnel and funds dedicated to the operation and maintenance of hill dams and hill lakes.

In summary, while the overall budget of the Ministry of Agriculture does not seem to present particular issues, CRDA of each governorate needs to strengthen its income stream and increase its budget to enhance its institution for operation and maintenance.

3.5.4 Current Status of Operation and Maintenance

As part of the ex-post evaluation, the evaluator visited the target sites in Zaghouan, Siliana, Béjà, and Sousse Governorates to exchange opinions with the CRDA personnel in charge of this project.

CRDA has continually been providing various forms of assistance for the farmers of the target regions, including provision of motor pumps and aqueducts appropriate for the irrigation capacity of each hill dam and the soil and other conditions of the fields, as well as support for the formulation of annual action plans. Periodic inspections and monitoring of the hill dams have been conducted mostly properly according to the guidelines. Therefore, operation and maintenance of the dams are generally satisfactory.

Operation and maintenance of the irrigation facilities by the farmers have been generally satisfactory, except for the chaotic year of the Revolution in 2011. The farmers have been operating and maintaining the provided pumps and pipelines with great care in accordance with the rules established by themselves, as such care is crucial for making the best use of the water-saving and other irrigation systems. CRDA is providing technical assistance for farmers in selecting and using appropriate equipment so that the equipment they purchased will produce the intended effects, thus promoting proper operation and maintenance of the irrigation facilities.

While the design reservoir capacity of the dams of this project was 21,185,000m^3, the estimated capacity as of 2014 was 13,188,000m^3, which means that about 8,000,000m^3 of sediments have accumulated in the dam reservoirs during this time. Though the sedimentation speed has been mostly as predicted, it could accelerate in the future depending on the geographical and climatic conditions of each dam site. While it is difficult to make accurate future predictions in the midst of global climate change, many of the dams will likely remain usable for irrigation purposes for another 5 to 10 years. For

this reason, it is important to continue enhancing the sustainability of the project by fortifying the institutional aspects, updating the guidelines, and increasing budget of each CRDA.

In summary, there are minor problems in the institutional, technical, and financial aspects of the operation and maintenance system. Therefore sustainability of the project effects is fair.

4. Conclusion, Lessons Learned, and Recommendations

4.1 Conclusion

This project aimed to improve agricultural productivity, increase livestock numbers and farmers' income, and consequently contribute to the conservation of water resources and prevention of soil erosion, etc. by constructing hill dams and irrigation facilities in the north-central region of Tunisia, where precipitation was relatively high.

Tunisia formed a new government in February 2015 after completing a four-year transition process toward democracy since the Jasmine Revolution in 2011 and is currently in the process of formulating the next Five-Year National Development Plan. For the water sector, one of the key sectors of the country, the Ministry of Agriculture developed the Second Ten-Year Hydraulic Resources Development Strategy (2012 – 2022), based on which the Provisional Government continued to implement various projects. The new government took over the said Strategy and expressed its intention to continue constructing hill dams toward improving agricultural productivity, preventing soil erosion in farmland, and meeting other development needs. This project was also consistent with Japan's ODA policy at the time of the project appraisal. Therefore, the relevance of the project is high.

The project initially planned to construct both hill dams and irrigation facilities in 22 sites in 7 governorates. However, due to massive droughts between 1999 and 2002, the then already completed dams were unable to store enough amounts of water to allow constant operation of irrigation facilities. Because of this, a F/S was conducted to review and revise the content of the planned irrigation facilities. As a result of the F/S, it was determined that it would be more appropriate to construct the original irrigation facilities in three dam sites and provide portable pumps and other irrigation equipment for other sites instead. The F/S also revealed that irrigation farming had been expanding in the target regions due to private investment, the residents' independent efforts, and other factors. However, the F/S did not go so far as to reexamine the operation and effect indicators or revise the target values of the project. For this reason, the total irrigated area, one of the effect indicators of this project, turned out to be 620.5ha, attaining only 27% of

the target of 2,298.1ha.

On the other hand, the quantitative indicators, such as the farm size and production volume of major crops, have mostly achieved their respective targets as a result of promoting the farming methods that take into account reservoir levels that fluctuate depending on annual rainfall, as well as groundwater recharge effects. However, because irrigation facilities were not constructed as originally planned in 19 of the total 22 dam sites, it is difficult to attribute the high attainment levels entirely to the effects of the project, which, likewise, may not be the sole contributor to the moderate increase and stabilization of agricultural production in the target regions. In addition, because the remaining service life for irrigation use of the hill dams constructed by the project is assumed to be 5 to 10 years depending on the sedimentation speed of each dam based on their average life span of 20 to 30 years, the project's contribution toward the increase of agricultural production will not be permanent but will likely be for a limited time period.

With regard to project impacts, the farmers' annual income mostly attained the target level and the annual production of livestock meat has increased since the time of appraisal, though it is difficult to ascertain whether or not these results are solely attributable to the effects of the project. Trees were planted around the dam sites to prevent soil erosion over a total area of 6,154ha, which was 200% of the planned area. These trees are also thought to be helping the retention of floodwater during the rainy reason, prevention of soil erosion in farmland, and sedimentation mitigation and life prolongation of large-scale dams.

Comprehensively considering the above, effectiveness and impact of this project are fair.

Although the project cost was lower than planned, the project period far exceeded the plan. Therefore, efficiency of the project is fair. With regard to operation and maintenance of the project, though the speed of sedimentation in each reservoir has been mostly as expected, the need remains to implement measures to enhance the O&M system of the hill dams in each governorate, fortify the institutional aspects, update the technical guidelines by incorporating the accumulated know-how and providing response procedures to unexpected hazards, etc., and increase budget. Therefore, sustainability of the project effects is fair.

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

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

- It is recommended that the existing Guidelines for the Operation and Maintenance of Hill Dams incorporate the practical skills and know-how that have been accumulated

in the actual sites, as well as measures against drought, flood and other conditions that may arise from recent climate changes. In doing so, measures that effectively address the technical recommendations made by the SAPS Report (2014) should also be included in the Guidelines. In addition, it is important to objectively evaluate and analyze the operation, maintenance, safety, and usage of each of the 200 or so existing hill dams, and incorporate the results thereof in future water resources development plans.

- CRDA currently does not have a department or personnel dedicated to the administration of hill dams and hill lakes. It is recommended that the Ministry of Agriculture allocate physical and human resources necessary for establishing a department within each CRDA that takes charge of O&M of hill dams and related facilities and provision of guidance for farmers concerning irrigation techniques and efficient use of water.
- It is recommended that DG/BGTH and DG/GREE work more closely together and define more clearly their respective responsibilities toward promoting irrigation farming after the completion of hill dams. More specifically, DG/BGTH and DG/GREE need to start exchanging opinions from the planning stage of each dam construction project so that upon completion of each dam by DG/BGTH, DG/GREE can immediately start installing irrigation facilities/equipment and providing support for farming activity of the farmers.
- In order to facilitate development of irrigation farming around the hill dams and increase the annual income of farmers, it is recommended that DG/GREE and CRDA expedite the reform of farmers' associations and implement measures to further expand the area of irrigation farming by clarifying the obscurities in the ownership of some farmland, which are of concern for DG/GREE and CRDA, in cooperation with the Ministry of the Environment and Sustainable Development.

4.2.2 Recommendations to JICA

JICA is advised to continue monitoring the operation and maintenance of the hill dams constructed under this project, as well as the use statuses thereof by the farmers, in cooperation with the Ministry of Agriculture until it becomes fairly certain that the dam facilities will continue to be operated and maintained safely and sustainably.

4.3 Lessons Learned

Water Resources Development and Diffusion of Irrigation Techniques among Farmers

The original plan of this project was to construct hill dams while concurrently installing irrigation facilities in all the dam sites to irrigate a certain area size of farmland.

However, as a result of subsequent droughts, it was decided not to implement most of the planned irrigation facilities, as they would not have functioned properly and could have worked disadvantageously to the farmers.

From the standpoint of food security, on the other hand, semiarid countries like Tunisia are faced with an increasing need to irrigate their land and have been promoting the adoption of irrigation farming techniques, especially those of water-saving type.

Therefore, in providing assistance for irrigation farming in the north-central regions of Tunisia, it is important to devise an effective plan from the perspectives of both hardware and software by taking increasingly into account climate issues to protect the farmers from making wasteful investments. Assistance for the diffusion of efficient irrigation techniques (water-saving irrigation, etc.) among farmers would be especially effective, as it would also lead to optimal use of limited water resources.

Development of O&M Personnel According to Chronological Change in Hill Dams

Opinions were expressed by the affiliate agencies of MOA that each CRDA should establish a department and personnel dedicated to the operation and maintenance of hill dams and hill lakes because situations arose from time to time, where making swift responses was difficult due to the absence thereof. The reason behind this is that in order to properly operate and maintain dams, each CRDA needs engineers, who are specialized in each life stage of dams from the construction phase to the end stage of service life, as well as the accumulation of experience and know-how over a long term. For this reason, when forming similar projects, it is important to examine the necessity of establishing a dedicated department, etc. for the O&M of the facilities from a long-term perspective, in addition to allocating resources to O&M for a short term.

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Comparison of the Original and Actual Scope of the Project

Item	Original Plan	Actual
1. Project Outputs	1) Hill dams 22 sites in 7 governorates 2) Watershed management Tree planting: 3,080ha 3) Irrigation facilities Main facilities: 22sites (Breakdown) ・With pump station: 17 sites ・W/o pump station: 5 sites Portable pump: 4 sites, 29 units On-farm system: 22 sites 4) Land acquisition, etc. 22 sites 5) Survey & engineering 1 set 6) Logistics and O&M equipment 1 set 7) Consulting service 1 set (Overall project management, supervision of civil works, organizational fortification (diffusion, farmer's association))	1) Hill dams Same as plan 2) Watershed management Tree planting: 6,165 ha 3) Irrigation facilities Main facilities: 3 sites (Breakdown) ・With pump station: 1 site ・W/o pump station: 2 sites Portable pump: 7 sites, 24 units On-farm system: 2 sites 4) Land acquisition, etc. Same as plan 5) Survey & engineering Same as plan 6) Logistics and O&M equipment None 7) Consulting service 1 set (Feasibility study on irrigation facilities in 6 governorates
2. Project Period	March 1999 – June 2004 (63 months)	March 1999 – October 2013 (115 months)
3. Project Cost Amount paid in foreign currency Amount paid in local currency Total Japanese ODA loan portion Exchange rate	 2,840 million yen 6,769 million yen (58,340,000 TND) 9,609 million yen 8,184million yen 1TND＝116 yen (As of July 1998)	 3,617 million yen 1,488 million yen (18,898,000 TND) 5,105 million yen 0 million yen 1TND＝78.7 yen (Average between January 2000 and October 2013)

Arab Republic of Egypt

Ex-Post Evaluation of Japanese ODA Loan

"Cairo-Alexandria Transmission System Project"

External Evaluator: Jun Totsukawa, Sano Planning Co., Ltd

0. Summary

The project has aimed at ensuring efficient and reliable transmission of electricity to the Alexandria, Delta and Cairo regions, the largest power consumption centers of Egypt, by installing a 500kV overhead transmission lines (hereinafter referred as OHTL) between the Sidi Krir Power Station (Alexandria region) and the Cairo 500 Substation (Cairo region) and newly constructing the Sidi Krir Substation, and thereby fortifying the international electrical interconnections with the neighboring countries. These objectives are consistent with Egypt's development plan and development need, as well as Japan's ODA policy at the times of appraisal and ex-post evaluation. Therefore, the relevance of this project is high.

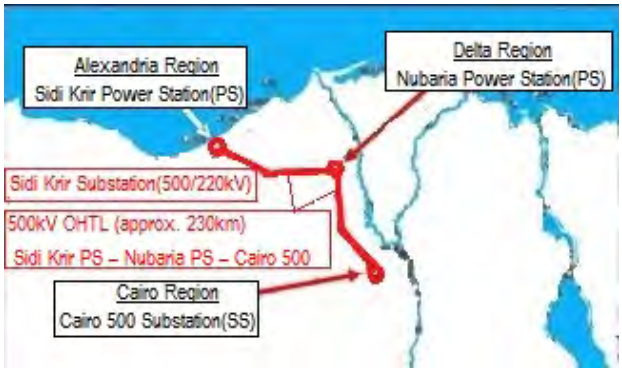
With regard to efficiency, the project period far exceeded the original plan, as it took much longer than expected to obtain approvals and consent concerning land expropriation and site selection for constructing steel towers. The project cost also exceeded the planned amount due to increase in raw material prices and labor costs. Therefore, the efficiency of the project is low.

With regard to effectiveness, the large-capacity 500kV OHTL has been operating stably since the completion of the project with very low power failure/outage rates. Although the overload on the 220kV OHTL has not been reduced to the target level, it would have resulted in much more serious consequences (premature deterioration, or destruction in the worst case scenario, of electric cables, transformers, and other electrical equipment) if the project had not been implemented. It is evident that the project has mitigated these threats. As for the impact, the fact that the industrial districts in the project's target regions are still expanding suggests that the project's outputs are providing underlying support for the industrial development of the regions. Overall, the implementation of the project has largely achieved its intended objectives. Therefore, the effectiveness and impact of the project are high.

With regard to sustainability, the institutional organization is properly set in place to operate and maintain the transmission grid and substations constructed by this project. No major problems have been found in the institutional, technical and financial aspects. Therefore, the sustainability of the project is high.

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

1. Project Description



Project Locations

500kV OHTLs (near Alexandria)

1.1 Background

With power demand growing at an annual rate of 5 - 7% since the mid-1990s and expected to continue rising, the government of Egypt was pressed to boost and expand the power generation capacity and power transmission system of the country.

Majority of power transmission in Egypt consisted of 500kV, 220kV, and 132kV OHTLs with 500kV having the largest capacity. However, there were only two 500kV OHTLs, one extending north-south from the capital city Cairo to the Aswan High Dam in southern Egypt, and the other stretching east-west from Cairo to Taba near the Jordanian border. There was no 500kV OHTL linking Cairo to Alexandria, the second largest city in Egypt, resulting in a constant overload on the 220kV line connecting the two cities, posing a threat to the realization of uninterrupted power transmission.

In addition, construction of the Nubaria Power Station was under halfway between Cairo and Alexandria to meet Cairo's growing demand for electricity, and it was predicted virtually impossible for the existing 220kV line to efficiently transmit increased power to Cairo. Thus, construction of the 500kV OHTL between two cities was urgent needs.

1.2 Project Outline

The objective of this project is to ensure efficient and reliable transmission of electricity to the Alexandria, Delta and Cairo regions, the largest power consumption centers of Egypt, by installing a 500kV OHTL between the Sidi Krir Power Station (Alexandria region) and the Cairo 500 Substation (Cairo region) and newly constructing the Sidi Krir Substation, thereby contributing to the reinforcement of the interconnections between Egypt and its neighboring countries.

Loan Approved Amount/ Disbursed Amount	5,001 million yen / 4,991 million yen	
Exchange of Notes Date/ Loan Agreement Signing Date	June 2003 / July 2003	
Terms and Conditions	[Electrical facilities] Interest rate	1.8%
	Repayment period	20 years
	(Grace period)	(6 years)
	Conditions for procurement	General untied
	[Consulting services] Interest rate	1.8%
	Repayment period	20 years
	(Grace period)	(6 years)
	Conditions for procurement	General untied
Borrower / Executing Agencies	Egyptian Electricity Holding Company / Egyptian Electricity Transmission Company and West Delta Electricity Production Company	
Final Disbursement Date	October 2011	
Main Contractors (Over 1 billion yen)	・Sumitomo Corporation (Japan) / Fujikura Ltd. (Japan) / Siemens Ltd. (Egypt) / Siemens AG (Germany) (JV)	
Main Consultants (Over 100 million yen)	・Pgesco Power Generation Engineering and Services Company (Egypt) / Tokyo Electric Power Services Co., Ltd. (Japan) (JV)	
Feasibility Studies, etc.	・Feasibility Study (1999)	
Related Projects	None	

2. Outline of the Evaluation Study

2.1 External Evaluator

Jun Totsukawa, Sano Planning Co, Ltd.

2.2 Duration of Evaluation Study

Duration of the Study: October 2014 – November 2015

Duration of the Field Study: January 4 – 16, 2015 and June 3 – 12, 2015

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

3.1 Relevance (Rating: ③[2])

3.1.1 Relevance to the Development Plan of Egypt

At the time of appraisal, the government of Egypt had announced in the National Development Plan (2002 - 2006) its intention to improve the efficiency of electric power generation, transmission, and distribution in order to meet the country's rapidly growing

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

[2] ③: High, ② Fair, ① Low

demand for electricity. Specifically, the Egyptian government was aiming at reducing the transmission/distribution loss rate from 13.7% to 12.5% by operating its transmission/distribution systems more efficiently through the renewal and upgrading of the existing distribution system and by constructing load-dispatching centers. The government also made it one of its priorities to expand the capacities of its transmission systems while constructing new power stations, as the demand for electricity was predicted to grow at an annual rate of 5 - 7% in the coming ten years.

At the time of the ex-post evaluation, the Egyptian government has yet to formulate the next National Development Plan, but has established the Strategic Framework for Economic and Social Development Plan Until Year 2022[3] as a longer-term strategy, which emphasized the importance of improving the efficiency in the production and consumption of electric energy to ensure sustainable economic development of the country. This includes the development of effective and efficient power transmission infrastructure towards "improving the efficiency of energy use."

The above indicates that the support by this project for the development of the transmission system was in line with the development policy of Egypt at the time of appraisal and can still be positioned as one of the Egyptian government's important agendas at the time of ex-post evaluation.

3.1.2 Relevance to the Development Needs of Egypt

At the time of appraisal, the Sidi Krir Power Station had been constructed in the Alexandria region and the construction of Nubaria Power Station was underway in the Delta region to meet the projected rise in power demand at an annual rate of 6 - 7% in the Cairo, Delta, and Alexandria regions.

However, the existing 220kV transmission grid was already overloaded at that time and was predicted to face increasing difficulties in supplying electricity without interruption after these new power stations began operation. For this reason, fortification of the transmission grid was urgently called for in order to ensure efficient and uninterrupted power supply to the power demand centers of the Cairo and Alexandria regions.

At the time of ex-post evaluation, it was confirmed that Ministry of Electricity and Energy, the Egyptian Electricity Holding Company (hereinafter referred as "EEHC") and the Egyptian Electricity Transmission Company (hereinafter referred as "EETC") were expressing the need to further upgrade its power transmission system concurrently with the construction of new power stations based on their domestic power demand projection[4]. To meet the nationwide growth in

[3] At present, opinions of the citizens are being heard and publicly disclosed (June 2015)
[4] Annual Report of Egyptian Ministry of Electricity and Energy (2012)

power demand, they are planning to increase power generation output by a total of 18,767MW over a 7-year period between 2012/13 and 2018/2019. In addition, of the 14 locations, where new power plants are to be constructed, 7 are planned in the Cairo, Delta, and Alexandria regions, the target areas of the project, indicating that the demand for electricity in these regions are still considerably large. In addition, to respond to the need for upgrading the transmission system, construction of over a 340km-long 500kV OHTL is currently underway or being planned in the Delta region. Overall, the need for uninterrupted power supply is still very high at the time of ex-post evaluation.

In light of the above, development of the transmission system covered by this project was relevant to the needs of the target regions both at the time of appraisal and at the time of ex-post evaluation.

3.1.3 Relevance to Japan's ODA Policy

Japan's Country Assistance Program for Egypt (2000) places the "development of socio-economic infrastructure" among its priority agendas and lists the electric power sector as one of the priority sectors. While the said program addresses the importance of the private sector's role in facilitating smooth transition to a free, open market economy; it also announces the Japanese government's policy to support the development of Egypt's socio-economic infrastructure by stating that "the government's role is still large in socio-economic infrastructure projects, which cannot be carried out by the private sector."

In light of 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: ①)

3.2.1 Project Outputs

The table below shows a comparison of planned and actual outputs of this project. The content of the outputs has been changed since the time of appraisal, the background and reasons of which are explained below.

Table 1 Comparison of the Planned and Actual Outputs

Output Item		Plan	Actual
Construction of 500kV OHTL (single circuit) linking Sidi Krir Power Station, Nubaria Power Station, and Cairo 500 Substation.		Approx. 230km	Approx. 217km
Construction of 500kV Sidi Krir Substation	Installation of 500/220kV 500MVA transformer	1 unit	2 units
	Installation of 500kV gas insulation switch (GIS)	3 phases	7 phases

Source: Questionnaire response

(Background and reasons for differences in outputs)

As shown in the above table, the planned figures differ from the actual figures due to the reasons listed below.

1) Construction of 500kV OHTL (single circuit)

As a result of change in the OHTL route (due to acquisition of land that allowed shortening of the distance), the total length of the OHTL was reduced from the original 230km to 217km.

2) Installation of additional transformers and GIS

Construction of an additional combined-cycle[5] power plant inside the Sidi Krir Power Station necessitated the installation of additional transformers and GIS (all at the expense of Egypt under its own plan). The combined-cycle plant was constructed in the power station to meet the needs of the region and therefore is deemed relevant. The additional transformers and GIS were necessary to keep pace with the increased output and, therefore, are also deemed as relevant outputs.

3.2.2 Project Inputs

3.2.2.1 Project Cost

The estimated project cost at the time of appraisal was 10,437 million yen, of which 5,001 million yen was to be financed by yen loan. The actual total project cost amounted to 13,251 million yen (of which 4,991 million yen was from yen loan), which was higher than planned by 126%. The main reason for the cost increase was the price hike in raw materials and equipment during the project period.

The cost borne by the Egyptian side for the installation of additional transformers and GIS associated with the construction of the combined-cycle plant was not included in the project cost shown in the table below[6].

Table 2 Comparison of the Planned and Actual Project Cost

	Project cost		Project total
	ODA loan	Egyptian side	
Plan	5,001 million yen	5,436 million yen	10,437 million yen
Actual	4,991 million yen	8,260 million yen	13,251 million yen (126% against plan)

Source: Documents provided by JICA

[5] A type of power generation method that combines gas and steam turbines.

[6] The total project cost, including the additional installation and construction was 16,361 million yen, significantly higher than planned by 156%.

3.2.2.2 Project Period

The original project period was 35 months, commencing in July 2003 at the signing of L/A and ending in May 2006 at the completion of construction work, whereas the actual project period took 59 months from July 2003 to May 2008 (completion of construction), significantly longer than planned by 168%. The time needed to install the additional transformers and GIS associated with the construction of the combined-cycle plant is not included in the actual project period, as is the case with the project cost[7].

Table 3 Comparison of the Planned and Actual Project Period

Plan	Actual
July 2003 - May 2006 (35 months)	July 2003 - May 2008 (59 months) (168% against plan)

Source: Documents provided by JICA

The main reasons for the significant prolongation of the project period are described below. The estimated numbers of delayed months are based on the opinions of EETC and the West Delta Electricity Production Company (hereinafter referred as "WDEPC").

1) Prolonged P/Q and tender processes

P/Q and bidding processes did not go as smoothly as anticipated, and contract signing took longer than expected (causing a delay by about one year).

2) Delay in steel tower test

Delay in the production of steel towers by the manufacturer resulted in the delay in the subsequent testing and installation of the towers.

3) Change in the steel tower installation sites

It took longer than anticipated to negotiate the terms and conditions of compensation, etc. with the owners of the houses and buildings on the planned installation sites. As a result, the original route was changed, causing a delay of several months. (This and Paragraph 2) above caused a delay of over one year).

4) Delay in obtaining government approval

It took a considerable amount of time to obtain government approval for installing the OHTL that would traverse Lake Mariut. The Ministry of Civil Aviation and the Egyptian military imposed a set of requirements concerning the height and locations of the steel towers, which

[7] The project period, including the additional installation and construction was from July 2003 to August 2008 (62 months), an increase by 177% from the original plan.

took some time to satisfy (causing a delay of around eight months).

5) Installation of additional transformers and GIS

It took about nine months to install the additional transformers and GIS in the Sidi Krir Substation at the responsibility of the Egyptian side.

The above delay periods were partially overlapping. Of the nine-month delay caused by the additional work in the substation (additional transformers and GIS) under Paragraph 5) above, six months were overlapping the period, during which the construction of OHTL was taking place. Thus, it is noted that the additional work under Paragraph 5) resulted in an extension of the project period only by three months.

3.2.3 Financial Internal Rate of Return (reference only)

The financial internal rate of return (FIRR) was estimated at 15.13% at the time of appraisal. At the time of ex-post evaluation, calculation of FIRR was not possible because the amount paid and the revenue received (benefit of the project) each year by the Egyptian side under this project were not available.

As described above, both the project cost and project period significantly exceeded the plan. Therefore, efficiency of the project is low.

3.3 Effectiveness[8] (Rating: ③)

3.3.1 Quantitative Effects (Operation and Effect Indicators)

The operation indicators of this project are the operating rate and annual power failure/outage rates of the OHTL. The effect indicators are the overload and transmission/distribution loss rate. The achievement statuses of these indicators are shown in Tables 4 and 5, respectively.

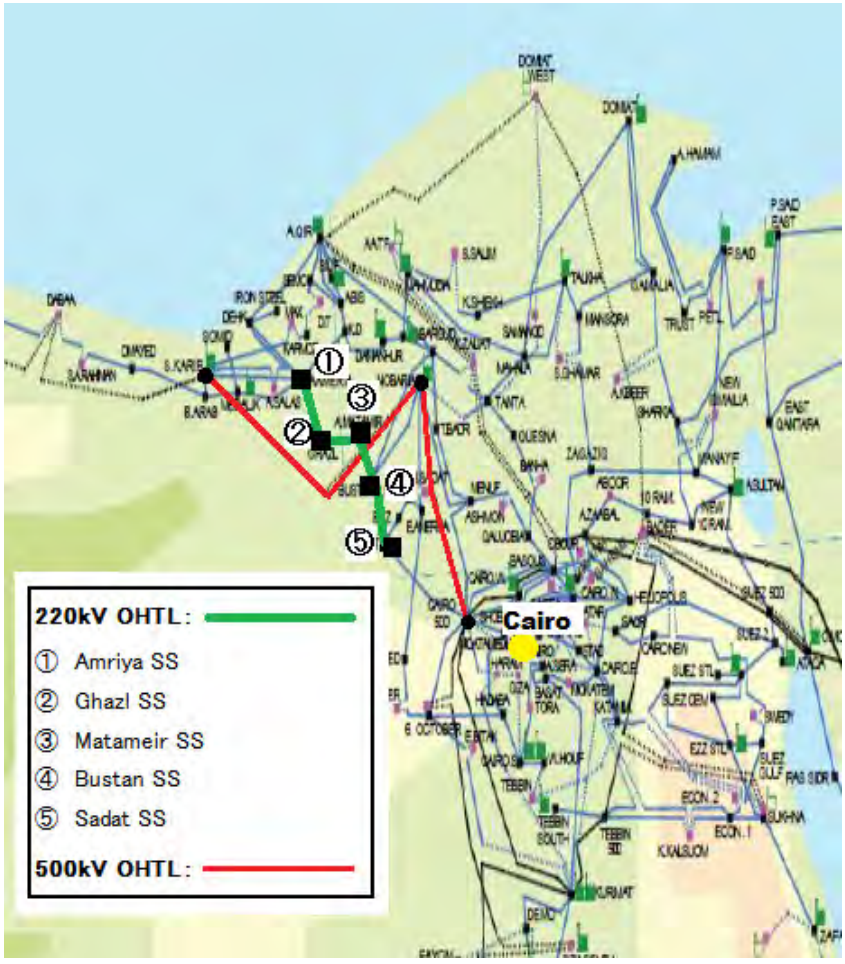
Table 4 Operation Indicators

		Baseline	Target	Actual	Actual	Actual	Actual
		2003	2008	2008	2011	2012	2013
		Baseline year	2 yrs. after completion	Completion year	3 yrs. after completion	4 yrs. after completion	5 yrs. after completion
Operating rate (%)	500kV OHTL Sidi Krir SS – Nubaria SS	-	100 or less	NA	80	86	76
	500kV OHTL Nubaria SS – Cairo 500 SS	-	100 or less	NA	81	79	80

[8] Effectiveness rating is determined by taking also into account the impacts of the project.

		Baseline	Target	Actual	Actual	Actual	Actual
		2003	2008	2008	2011	2012	2013
		Baseline year	2 yrs. after completion	Completion year	3 yrs. after completion	4 yrs. after completion	5 yrs. after completion
Annual failure/ outage rates (%)	500kV OHTL Sidi Krir SS – Nubaria SS	-	0.3 or less	NA	0.0	0.0	0.0
	500kV OHTL Nubaria SS – Cairo 500 SS	-	0.3 or less	NA	0.07	0.0	0.07

Source: Documents provided by JICA, questionnaire response
Note: There are no baseline figures for operating rate and annual power failure/outage rates in 2003, as the OHTL was newly constructed and completed in 2008.



Source: Power Systems at 2020: Define the needs of refurbishment and reinforcement, The European Neighbourhood and Partnership Instrument (ENPI), 12/2012
Note: Lines ① to ⑤ are the 220kV OHTL existed, and 500kV OHTL is the project's output.

Figure 1 Distribution Diagram

All indicators of this project, except for the "overload on 220kV OHTL," have achieved their respective target values.

Considering the fact that the large-capacity 500kV OHTL has been operating steadily with minimum interruptions since the completion of this project, the project's objective to "ensure efficient and reliable transmission of electricity to Cairo and other major power consuming regions" is deemed to have been achieved. Overload on the 220kV OHTL has not been reduced as planned for reasons discussed below. However, it would have resulted in much more serious consequences (such as premature deterioration, or even destruction in worst cases, of cables, transformers, and other related equipment) if overload on the 220kV OHTL in the target regions had not been lessened by the implementation of the project, which evidently mitigated these threats. From the standpoint of with-without comparison, the effectiveness of the outcomes of the project is high even though the indicators concerning the 220kV OHTL fell below the target.

The reasons, for which the overload on the 220kV OHTL has not been reduced as planned, are described below.

Table 5 Effect Indicators

		Baseline	Target	Actual	Actual	Actual	Actual
		2003	2008	2008	2011	2012	2013
		Baseline year	2 yrs. after completion	Completion year	3 yrs. after completion	4 yrs. after completion	5 yrs. after completion
Overload (MVA)	220kV OHTL Amriya SS - Ghazl SS	225	217 or less	NA	260	270	280
	220kV OHTL Ghazl SS – Matameir SS	218	209 or less	NA	210	212	236
	220kV OHTL Matameir SS - Bustan SS	165	152 or less	NA	180	145	163
	220kV OHTL Bustan SS - Sadat SS	186	152 or less	NA	230	250	260
Transmission/distribution loss rate (%)	Entire transmission/ distribution systems of Egypt	13.7	11 or less	NA	NA	11	NA

Source: Documents provided by JICA, questionnaire response

1) Power demand of the target regions

The demand for electricity in the target regions is still rising, and power stations are forced to supply power beyond the capacity of the OHTL to meet the needs. In other words, the

transmission system as a whole is still insufficient (lacking capacity) to satisfy the demand of the target regions[9].

2) Increased output of Sidi Krir Power Station and delay in the construction of interconnection with Libya

As a result of the additional construction of the combined-cycle power plant, the output of the Sidi Krir Power Station increased from 650MW to 1,350MW, part of which, according to the original plan, was to be sent to Libya via the interconnection, which has yet to be completed. Because of this delay, electricity is transmitted via the existing transmission grid. This means that the present overload problem will probably be alleviated once the interconnection with Libya is completed to provide more diverse transmission links.

3.3.2 Qualitative Effects

Qualitative effects will be discussed as part of "Impacts" in the following section.

3.4 Impacts

3.4.1 Intended Impacts

Though the project was expected to contribute to the fortification of the interconnections with Libya and other neighboring countries, the development of these interconnections is not progressing as intended due to political/economic instabilities in the African region triggered by the Arab Spring. However, the intention to reinforce the interconnections is still strong, and it was agreed in 2014 to proceed with the interconnection project between Egypt and Saudi Arabia (which is scheduled to commence in 2015 and begin service in 2017).

3.4.2 Other Impacts

1) Impacts on the Natural Environment

EETC and the General Authority for Fisheries Resource Development (hereinafter referred as GAFRD) have signed an agreement concerning the installation of the OHTL traversing Lake Mariut. Despite GAFRD's initial concern over possible adverse impacts of the OHTL on the fisheries of the lake, there has been no report of such impacts from fisheries-related individuals and organizations, including GAFRD.

Aside from Lake Mariut, possible environmental impact of this project has not become of concern in any other areas.

[9] As described in "3.1.2 Relevance to the Development Needs of Egypt," EETC is making efforts toward expanding its power generation and transmission capacities, yet, both are not presently sufficient to meet the power demand of the regions.

2) Land Acquisition and Resettlement

EETC has paid about 13,632,000 EGP (approx. 230 million yen) to 557 people as compensation for using their land for installing steel towers. While most of the installation sites were idle or agricultural lots scattered in desert or other uninhabited land, 40 houses, which were located within a 25-meter distance from the OHTL, had to be resettled in accordance with the related laws and regulations of Egypt. EETC paid compensation to each of these households upon amicably reaching an agreement (the amount of compensation is included in the above land acquisition cost). Construction of the substation did not require resettlement of residents or acquisition of land.

3) Unintended Positive/Negative Impact

It is safe to assume that the implementation of this project has supported the industrial development of the target regions, especially Sadat City, which has seen remarkable growth in recent years as Egypt's largest industrial zone[10]. This project is supporting its growth by supplying electricity to the area[11].

In light of the above, the project has largely achieved its objectives. Therefore effectiveness and impact of the project are high.

3.5 Sustainability(Rating: ③)

3.5.1 Institutional Aspects of Operation and Maintenance

1) OHTL

Separate local units of EETC are respectively taking charge of the operation and maintenance of the Sidi Krir – Nubaria section (O&M of 318 steel towers) and the Nubaria – Cairo section (239 towers) in the target regions of this project.

The former section is attended by the Alexandria – Coastal Zone Transmission System Unit, and the latter by the West Delta Transmission System Unit, each staffed by the following technical personnel.

[10] One of the largest industrial zones in Egypt, consisting of 22 industrial parks. In addition to Sadat, the target regions include Natroun, Nubaria, and other major industrial zones.
[11] According to the results of interview surveys with EETC and WDEPC.

Table 6　Organizations in charge of O&M of transmission systems in the target regions

Organizational Unit	Position	No. of persons
Alexandria – Coastal Zone Transmission System Unit (in charge of Sidi Krir – Nubaria section)	Manager	1
	Engineer	7
	Technician	35
West Delta Transmission System Unit (in charge of Nubaria – Cairo section)	Manager	1
	Engineer	7
	Technician	70

Source: EETC questionnaire response
Note: Each unit is headed by the manager, and the technicians carry out general operation under the supervision of the engineers

All the above engineers have diplomas from electrical-engineering or mechanical-engineering colleges. Technicians are required to undergo training at EETC's training center and generally work continuously in the same unit for 10 years. Therefore, it can be said that technically qualified personnel are being deployed to handle the O & M aspects of the project.

2) Substations

WDEPC are employing the following personnel shown in Table 7 to operate and maintain the substations.

Table 7　Organizational structure for O&M of substations in the target regions of the project

Department/Section		No. of Engineers	No. of Technicians
Operation Dept.		4	4
Maintenance Dept.	Electrical	3	5
	Mechanical	5	2

Source: WDEPC questionnaire response
Note: Electrical staff are generally in charge of operation and maintenance of high-voltage equipment, protective devices, and other electrical items whereas mechanical staff take charge of operation and maintenance of control devices, alarm management system, and emergency control and other devices.

Of the above staff members, the personnel of the Operation Department are working in three shifts of eight hours each. All engineers of both Operation and Maintenance Departments have academic background in college or higher education, and all technicians have successfully completed a training program at EETC's training center[12]. WDEPC also has a similar personnel policy to assign its technicians to work continuously in the same department/section for 10 years or more. Thus, the technical aspects of the operation and maintenance system are deemed sufficient. The same engineers have been working continuously at the substations since the start of operation.

[12] WDEPC's training is conducted at the training center owned by EETC.

In light of the above, the institutional sustainability concerning the operation and maintenance system is high.

3.5.2 Technical Aspects of Operation and Maintenance

The facilities, equipment, and materials of this project are being operated and maintained according to the following operation and maintenance plans.

1) OHTL

For the Sidi Krir – Nubaria section, live-line washing and helicopter cleaning are carried out every three months according to the maintenance plan established by EETC. Live-line washing in the coastal areas is often conducted at shorter intervals, as the cables are more susceptible to salty wind damage that could lead to insulation failure[13]. For the Cairo – Nubaria section, dry washing is carried out every three months.

EETC gave a two-week training course on washing operation at its training center in 2013 and again in 2014, through which, as well as through actual work, the maintenance personnel have acquired sufficient skills and experience.

In Egypt, live-line washing, which is a relatively advanced technical operation, is carried out only in the target regions of the project, which indicates the high technical capabilities of the staff in charge of the OHTL. Textbooks used for the training at the EETC training center are used as work manuals and handbooks, which the staff can always refer to whenever necessary to confirm the correct methods and procedures.

2) Substations

WDEPC is carrying out periodic maintenance work on its substations according to Operation and Maintenance recommendation:

- Daily maintenance: visual inspection of all equipment and materials of substations
- Monthly maintenance; inspection of batteries and SF6 (sulfur hexafluoride) gas
- Half-year maintenance: analysis of transformer oil samples
- 5-year maintenance: reclosing relay test of transformer protection circuit
- 10-year maintenance: circuit breaker test

Of the above, the 5-year maintenance work (reclosing relay test) has been conducted at 3-year

[13] Live-line washing method was first introduced to Egypt in 2014. In the Sidi Krir – Nubaria section, live-line washing accounts for 75% of cleaning work while the more expensive helicopter cleaning method accounts for 25%, which EETC intends to reduce further. Dry washing is carried out by temporarily suspending power transmission whereas live-line washing does not require such suspension as is the case with helicopter cleaning, which can be done quickly with high cleansing effect.

intervals at WDEPC's own discretion.

Staff training is carried out at EETC's training center according to the yearly training schedule. Each year's training has a different theme, such as transformer, GIS, protection, and labor safety.

In addition to the above, the ultimate technical support is provided by Siemens, the manufacturer that delivered the substation equipment, through a hot line that connects the substations with Siemens in Germany in case of emergency (however, the hot line has never been used thus far). For the operation and maintenance of each equipment item, the staffs are using the manuals provided by the manufacturers and the textbooks produced by WDEPC training center.

In view of the above, sustainability of the technical aspects of the operation and maintenance system is high.

3.5.3 Financial Aspects of Operation and Maintenance

1) OHTL

The budget and actual cost spent for the operation and maintenance of the target sections of the transmission grid of this project are as shown in Table 8.

Table 8 O & M Cost of the OHTL – Budget vs. Actual (unit: EGP)

Year	Budget	Actual
2011	3,899,000	3,342,000
2012	6,405,500	6,127,000
2013	7,519,500	7,241,000

Source: EETC questionnaire response

As shown in Table 8, the budget has been increasing over the past few years, and the expenditures have mostly been within the corresponding budget amounts. There were no major budgetary constraints for operation and maintenance. The sudden rise in budget since 2012 is due to an increase in personnel cost (special allowances for cleaning work).

2) Substations

Though WDEPC does not manage the operation and maintenance of substations as a discrete budget item, the Sidi Krir Power Station has a sufficient budget and maintains an emergency fund[14] to reserve a certain amount of fund to cope with emergency situations, which indicates that the substations are not faced with budgetary constraints that keep them from operating properly[15].

[14] The emergency fund consists of domestic and foreign currencies and is reviewed every six months (according to the interview with WDEPC Personnel).
[15] Data related to budgets and actual expenditures were not available.

Table 9 and Table 10 below are the balance sheets of EETC and WDEPC, respectively. In 2013, the liquidity ratio, which represents the organization's financial stability, was 53.1% for EETC and 68.7% for WDEPC. These are acceptable levels for electric power companies, which generally require large capital investment but can expect constant/permanent revenue from the sales of electricity[16].

Table 9 EETC Balance Sheet (unit: 1,000 EGP)

	2011	2012	2013
Current assets	10,828,442	11,435,794	14,453,373
Fixed assets	30,704,558	32,387,536	34,519,534
Total assets	41,533,000	43,823,330	48,976,572
Current liabilities	21,864,189	24,179,330	27,205,445
Fixed liabilities	14,199,258	13,847,223	14,498,496
Total liabilities	36,063,447	38,026,553	41,703,941
Capital stock	5,469,553	5,796,777	7,272,631
Total liabilities and shareholders' equity	41,533,000	43,823,330	48,976,572

Source: EETC document

Table 10 WDEPC Balance Sheet (unit: 1,000 EGP)

	2011	2012	2013
Current assets	3,893,728	4,402,318	6,453,935
Fixed assets	13,979,680	15,551,091	17,053,755
Total assets	17,873,408	19,953,409	23,507,690
Current liabilities	7,204,841	7,945,551	9,381,170
Fixed liabilities	10,004,508	11,100,324	13,062,858
Total liabilities	17,209,349	19,045,875	22,444,028
Capital stock	664,059	907,534	1,063,662
Total liabilities and shareholders' equity	17,873,408	19,953,409	23,507,690

Source: WDEPC document

In light of the above, the sustainability of the financial aspects of the operation and maintenance system is high.

[16] In case of Tokyo Electric Power Company, for instance, its liquidity ratio in FY2009 was 40.8% (since the Great East Japan Earthquake in 2011, the ratio has been over 100% because of the need to increase liquidity on hand). Liquidity ratio is one of the indicators of a company's financial stability and can be calculated by dividing the current assets by the current liabilities.

3.5.4 Current Status of Operation and Maintenance

1) OHTL

The OHTL has been operating without major problems, serious accidents, or need for major repair thus far. Since OHTLs in general have a service life of around 50 years, no specific plan for renewal or upgrade has been established.

2) Substations

The substations have been operating without major problems, serious accidents, or need for major repair thus far. Of the main components of substation equipment, circuit breakers have a service life of about 25 years, at the end of which an appropriate replacement method needs to be determined. While no specific budgetary plan is presently in place, WDEPC intends to conduct circuit breaker tests every 10 years and, depending on the result, will consider formulating a concrete renewal plan.

As described above, sustainability of this project from the standpoint of operation and maintenance is high.

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

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

The project has aimed at ensuring efficient and reliable transmission of electricity to the Alexandria, Delta and Cairo regions, the largest power consumption centers of Egypt, by installing a 500kV overhead transmission lines between the Sidi Krir Power Station (Alexandria region) and the Cairo 500 Substation (Cairo region) and newly constructing the Sidi Krir Substation, and thereby fortifying the international electrical interconnections with the neighboring countries. These objectives are consistent with Egypt's development plan and development need, as well as Japan's ODA policy at the times of appraisal and ex-post evaluation. Therefore, the relevance of this project is high.

With regard to efficiency, the project period far exceeded the original plan, as it took much longer than expected to obtain approvals and consent concerning land expropriation and site selection for constructing steel towers. The project cost also exceeded the planned amount due to increase in raw material prices and labor costs. Therefore, the efficiency of the project is low.

With regard to effectiveness, the large-capacity 500kV OHTL has been operating stably since the completion of the project with very low power failure/outage rates. Although the overload on the 220kV OHTL has not been reduced to the target level, it would have resulted in much more serious

consequences (premature deterioration, or destruction in the worst case scenario, of electric cables, transformers, and other electrical equipment) if the project had not been implemented. It is evident that the project has mitigated these threats. As for the impact, the fact that the industrial districts in the project's target regions are still expanding suggests that the project's outputs are providing underlying support for the industrial development of the regions. Overall, the implementation of the project has largely achieved its intended objectives. Therefore, the effectiveness and impact of the project are high.

With regard to sustainability, the institutional organization is properly set in place to operate and maintain the transmission grid and substations constructed by this project. No serious problem has been found in the technical and financial aspects. Therefore, the sustainability of the project is high.

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

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

The chronic overload on the existing 220kV OHTL still needs to be mitigated, toward which the following measures are recommended.

1) Construction of additional OHTL

In order to meet the growing power demand of the target regions, it is important for EETC to construct additional OHTL, which will lessen the overload on the existing OHTL and thereby extend their service lives as well. It will also enhance the reliability of power supply to the regions. In constructing additional OHTL, it is important to consider designing a transmission system that can cope with future increase in power demand by giving priority to installing larger-capacity lines.

2) Swift Resumption of Egypt-Libya interconnection Project

It is important to start reviewing the F/S and make other necessary preparations as much as possible now so that the interconnection project with Libya can be resumed as soon as the political and economic conditions of Libya are stabilized. This would facilitate the development of other interconnections extending to the Mediterranean Sea as part of Egypt's long-term plan. It could also mitigate the overload on the 220kV OHTL in the target regions of the project.

4.2.2 Recommendations to JICA

None.

4.3 Lessons Learned

1) Estimation of project period involving land expropriation

In this project, the land expropriation process for constructing OHTL and transmission steel towers took longer than originally planned. At the time of appraisal, the project schedule was designed without identifying the exact number of people to negotiate with on the assumption that the negotiation process would go smoothly, as most of the sites were desert or agricultural land. However, the actual number turned out to be 557 people, and the negotiation with each person took longer than anticipated. JICA and the recipient government are advised to establish a realistic project schedule by keeping in mind that compensation negotiation could take a considerable amount of time while avoiding optimistically assuming at the time of appraisal that the negotiation process would be short as most of the sites are desert or agricultural land not needing resettlement.

Comparison of the Original and Actual Scope of the Project

Item	Plan	Actual
①Project Outputs	1)Sidi Krir Power Station – Nubaria Power Station – Cairo 500 Sub Station ① Construction of new 500kV OHTL (single circuit): approx. 230km in total length 2)Construction of Sidi Krir 500kV Substation ① Installation of 500/220kV 500MVA transformer: 1unit ② Installation of 500kV GIS: 3 phases	1) Sidi Krir Power Station – Nubaria Power Station – Cairo 500 Sub Station ① Construction of new 500kV OHTL (single circuit): approx. 217km in total length 2)Construction of Sidi Krir 500kV Substation ① Installation of 500/220kV 500MVA transformer: 2 units ② Installation of 500kV GIS: 7 phases
②Project Period	July 2003 - May 2006 (35 months)	July 2003 - May 2008 (59 months) ＊Project period, including the additional work under Output 2)① and ②, is as follows: July 2003 - August 2008 (62 months)
③Project Cost Amount paid in foreign currency Amount paid in local currency Total Japanese ODA loan portion Exchange rate	 5,001 million yen 5,436 million yen (Local currency) 199 million EGP 10,437 million yen 5,001 million yen 1EGP＝27.2 yen (As of Nov. 2002)	 4,991 million yen 8,260 million yen (Local currency) 477 million EGP 13,251 million yen 4,991 million yen 1EGP＝17.3 yen (Average between July 2003 and May 2008) ＊ Project cost, including the additional work under Output 2) ① and ②, is as follows (only differences are shown): Foreign currency: 11,370 million yen Local currency: 657 million EGP Total: 16,361 million yen

Note: In this ex-post evaluation, the cost borne by the Egyptian side and the time period for the additional work ① and ② under Output 2) are not included in the calculations for determining the efficiency of the project. Figures that take into account such additional work are shown in the above table for reference.

Republic of Lebanon

Ex-Post Evaluation of Japanese ODA Loan

"Coastal Pollution Control and Water Supply Project (L/A No.LBN-P1)"

External Evaluator: Jun Totsukawa, Sano Planning Co., Ltd

0. Summary

The project has aimed at addressing problems of water shortage and wastewater treatment by developing water supply and sewerage systems in Saida and Kesrouan in Lebanon, thereby contributing to the improvement of the living environment of the local residents. This objective has been consistent with the country's development policy and needs as well as Japan's ODA policy both at the time of the project appraisal and ex-post evaluation. Therefore, the relevance of the project is high.

The project period, on the other hand, has largely exceeded the original plan resulting from such external factor as Israel's air strikes and internal problems related to the executing agency, namely land acquisition, design modifications, a prolonged process of approving a tunneling work. While the project cost is within the original plan, it is primarily because a part of the intended outputs were cancelled. Therefore, the project efficiency is evaluated to be low.

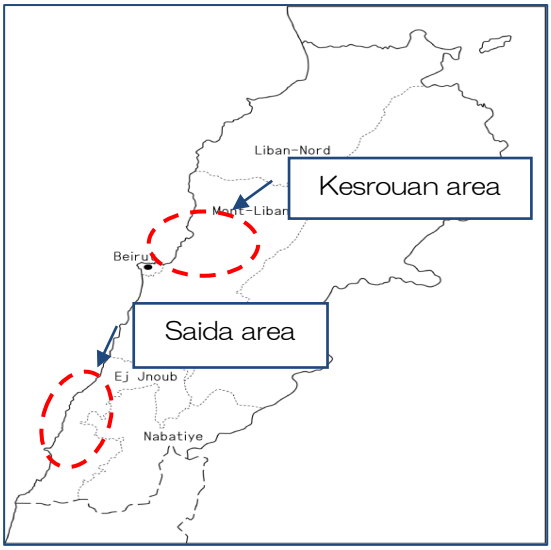
As for the project effectiveness, the water supply population has been gradually increasing in Kesrouan, achieving the target value for 2015 as of the ex-post evaluation. Many of the local residents have recognized more stable water supply and higher household efficiency than before. Population covered by the sewerage systems in Saida, has been also increasing, while also the local residents are aware of improved coastal views and odor to a certain degree. In addition, the wastewater treatment plant has mostly achieved the expected BOD[1] reduction rate. In light of the above, the project effectiveness and impact have been high.

In terms of the project sustainability, no technical problems have been identified both at Beirut Mount Lebanon Water Establishment (hereinafter referred to as BMLWE) operating and maintaining the Kesrouan water supply system and South Lebanon Water Establishment (hereinafter referred to as SLWE) operating and maintaining the Saida water treatment plant. On the other hand, the ex-post evaluation study identified organizational problems such as the number of employees (related to BMLWE) and a financial problem (related to SLWE), which may affect stable operations in the future. Therefore, the project sustainability is evaluated to be fair.

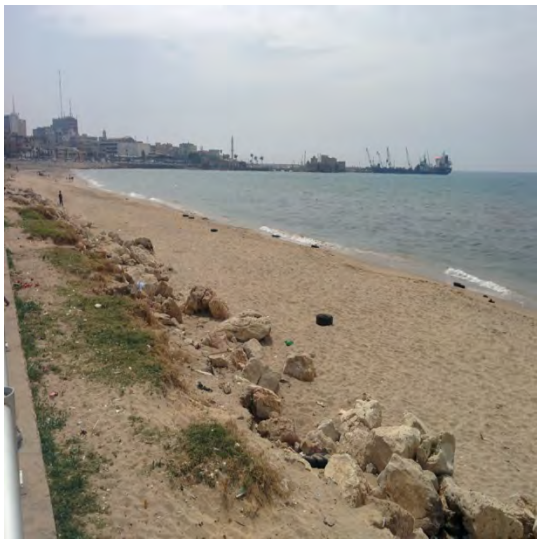
In light of the above, this project is evaluated to be partially satisfactory.

[1] Biochemical Oxygen Demand

1. Project Description



Project Locations



Coastline in Saida

1.1 Background

In 1992 when Lebanon's civil war lasted 15 years was ended, the World Bank (hereinafter referred to as "WB"), the European Union (hereinafter referred to as EU), and the European Investment Bank (hereinafter referred to as EIB) took an initiative in assessing post-conflict impact of infrastructure damage in the country. The results indicated that the water supply infrastructure had limited coverage due to the war-torn system, causing serious water shortage. Also, because of insufficient sewerage, wastewater had been released in wadis (dried rivers), polluting the groundwater as well as the environment in which the landscape and odor were worsened. This had significantly deteriorated the living environment of local residents.

Accordingly, an Emergency Rehabilitation, Recovery and Reconstruction Plan, drawing on findings of the said impact assessment of infrastructure damage, set out one of its high priorities in developing and improving water supply and sewerage infrastructure.

As a part of the post-conflict reconstruction assistance for Lebanon at that time, Japan and other aid donors such as WB, EU, EIB, Germany, France and the Arab Fund for Economic and Social Development revealed their cooperation schemes. Through the aid coordination of these donors, Japan launched this project to develop water supply in Kesrouan which was the then-developing suburban city of Beirut, and sewerage systems in the country's third largest city, Saida.

1.2 Project Outline

The objective of this project is to address problems of water shortage and wastewater treatment by developing water supply and sewerage systems in Saida and Kesrouan in Lebanon,

thereby contributing to the improvement of the living environment of local residents.

Loan Approved Amount/ Disbursed Amount	13,022 million yen/ 12,949 million yen
Exchange of Notes Date/ Loan Agreement Signing Date	July, 1996 / March, 1997
Terms and Conditions	(Construction) Interest Rate 2.5% Repayment Period 25 years (Grace Period 7 years) (Conditions for Procurement: General untied) (Consulting service) Interest Rate 2.1% Repayment Period 25 years (Grace Period 7 years) (Conditions for Procurement: General untied)
Borrower / Executing Agency	Government of Republic of Lebanon/Council for Development and Reconstruction
Final Disbursement Date	March, 2012
Main Contractor	・Baresel AG (Germany)/Al Taj Est (Lebanon)(JV) ・Sezai Turks Feyzi Akkaya Construction Company of Turkey (Turkey) ・The Arab Contractors Osman Ahmed Osman & Co (Egypt)
Main Consultant	・Dah Nazih Taleb (Lebanon)/Montgomery Watson (UK) (JV) ・Italian Environmental Engineering Co. (Italy) /Nippon Jogesuido Sekkei Co., Ltd (Japan)/Envirotech Ltd (Lebanon) ・NJS Consultants Venture (Japan)
Related Studies (Feasibility Studies, etc.)	・Special Assistance for Project Implementation for Project Management and Monitoring (SAPI), Lebanon: Coastal Pollution and Water Supply Project (LBN-P1) (2002) ・Special Assistance for Project Implementation for Project Management and Monitoring (SAPI), Lebanon: Coastal Pollution and Water Supply Project (LBN-P1) (2003)
Related Projects	The Water Supply and Sewage Improvement Project in Ein el-Hilweh Palestine Refugee Camp (associated with the Japanese ODA Loan)

2. Outline of the Evaluation Study

2.1 External Evaluator

Jun Totsukawa (Sano Planning, Co., Ltd.)

2.2 Duration of Evaluation Study

This ex-post evaluation was carried out as follows.

Duration of the Study: October, 2014-June, 2015

Duration of the Field Study: None (A Lebanese local consultant pursued this part of the Study.)

2.3 Constraints during the Evaluation Study

At the time of the ex-post evaluation, a travel to Lebanon by a Japanese evaluator was restricted for security reasons, and therefore the following steps were alternatively taken to complete the study with support from a Lebanese local consultant; (1) the local consultant collected relevant information, along with interviews and beneficiary surveys in Lebanon, (2) a Japanese evaluator analyzed a set of information obtained from the local consultant, and (3) the Japanese evaluator and the local consultant had meetings in Cairo in Egypt, and reviewed the details including information and the background of the findings.

In the Project Completion Report of this project, some of the key information was not provided, such as its outputs. Thus the ex-post evaluation study had to obtain detailed project achievements from the findings of questionnaires. However, most of the Lebanese stakeholders involved in the project or who were familiar with its background have already retired. This severely restrained meeting opportunities with the key persons as well as the number of responses and the contents that were sent back from the questionnaires. It should be noted that this has been complemented as much as possible by additional interviews and on-site visit made by the Lebanese local consultant.

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

3.1 Relevance (Rating:③[3])

3.1.1 Relevance to the Development Plan of Lebanon

(At the time of the project appraisal)

To restore the society and the economy devastated by the civil war, the Government of Lebanon set out the “Horizon 2000,” presenting a public investment plan from 1995 through 2007. Incorporated as a short and medium term component in that plan, the “National Emergency Rehabilitation Program” was developed to include “Emergency Rehabilitation and

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

[3] ③: High, ② Fair, ① Low

Reconstruction Projects" targeting particular areas of urgent needs. With support from WB, EIB and EU, Lebanon carried out an impact assessment of infrastructure damage and developed the findings into the said "Emergency Rehabilitation and Reconstruction Projects." One of the highest priority works therein was recovery of the water supply and sewerage systems.

(At the time of the ex-post evaluation)

As of 2015 when the ex-post evaluation was conducted, Lebanon has pursued a policy to develop water supply and sewerage systems in a framework of the National Water Sector Strategy (prepared by the Ministry of Water and Energy in 2010, followed by the resolution of the Government of Lebanon in 2012). The strategy intends to rehabilitate and extend the water supply networks to respond to growing domestic and industrial water needs.

As for sewage, the above strategy aims at extending the networks and increasing the sewage treatment rate. In terms of the sewage treatment process, it tries to ensure that wastewater is disposed after going through at least a secondary level treatment until 2020.

At the time of the ex-post evaluation, therefore, development of the water supply and sewerage systems continues to constitute important components of Lebanon's development policy to meet growing domestic water needs and to improve the sewage treatment.

In light of the above, the project targeting improved water supply and sewerage infrastructure was consistent with Lebanon's development policy at the time of its appraisal. It remains a vital effort to address one of the priority policy areas of the country at the time of the ex-post evaluation as well.

3.1.2 Relevance to the Development Needs of Lebanon

(At the time of the project appraisal)

At the time of the project appraisal, the war-torn water supply infrastructure caused a serious water shortage. As for the sewerage infrastructure, insufficiently treated wastewater was released into wadis (dried rivers) due to inadequate sewage treatment plants. It permeated into the nearby ground and contaminated the groundwater, and deteriorated the living environment.

Furthermore, wastewater had flowed along the wadis to the coastlines endowed with tourism resources, causing a serious problem in Saida and Kesrouan where the project sites have been located. This had also posed an international problem on which EU and North African countries along the Mediterranean Sea had a keen interest likewise. Given these backgrounds, recovery of the water supply and sewerage services was an urgent issue in Lebanon.

One of the project sites is a city of Kesrouan located in about 20 km in the north of Beirut, which was projected to achieve a significant suburban development, given a good access to the capital. The Government of Lebanon had thus regarded infrastructure development in this area

as a key task. The third largest city of Saida had also pressing needs of infrastructure development due to a coastal pollution problem. In contrast to Beirut and the second largest city of Tripoli where infrastructure development projects had been implemented in succession, Saida had somehow lagged behind. Accordingly, the Government of Lebanon sought to meet the development needs of the city.

(At the time of the ex-post evaluation)

Problems in the water supply and sewerage sector in Lebanon include (1) insufficient water supply amount and a limited capacity to meet the growing demand, (2) inefficient and deteriorating water supply and sewerage networks, and (3) the sewerage coverage rate and treatment capacity to be improved (as described in the National Water Sector Strategy 2010).

For problems of (1) and (2) related to the water supply, although Lebanon has currently the higher "access rate to safe water" than the average in neighboring countries, the leakage rate is high likewise, resulting from damaged and deteriorating water pipes (The average access rate to safe water is 75% in neighboring countries in 2010, compared with 79% in Lebanon, whereas the leakage rate is 37% and 48% respectively). As for (3) related to sewerage, the country has a lower rate of sewage treatment relative to the amount of domestic water consumption than the average in the neighboring countries (The average rate in the neighboring countries is 32%, as opposed to 8% in Lebanon).[4]

Given these circumstances, further development and improvement of the water supply and sewerage infrastructure in Lebanon remain critical development needs at the time of the ex-post evaluation.

Of the selected project sites, Kesrouan continues to develop into a city in Beirut suburbs, as projected at the time of the appraisal. Developing the water supply and sewerage infrastructure remains an essential local need at present. Similarly, Saida has critical ongoing needs of addressing coastal pollution and developing sewerage networks.

In light of the above, the water supply and sewerage development intended by the project has been consistent with needs in both target areas. Selection of the project sites has been also consistent with the local needs at the time of the appraisal.

3.1.3 Relevance to Japan's ODA Policy

To respond to a wide range of reconstruction efforts led by Hariri administration upon the termination of the prolonged civil war, the Government of Japan delegated a team to Lebanon to discuss economic cooperation policies in November 1997. Articulating its ODA policies, it consulted with the Lebanese counterpart with respect to the country's economic situations,

[4] The average rate in the neighboring countries and the rate in Lebanon are based on the "National Water Sector Strategy (2010)."

reconstruction and development policies as well as prospective bilateral cooperation. At the outset of the reconstruction process, the Government of Japan provided an emergency financial assistance of about one million dollars for the sake of those people affected by the armed conflict with Israel in April 1996. In the “Friendship League Meeting for Lebanon Reconstruction Assistance” in the following December, the Government of Japan announced support for the country’s post-conflict reconstruction process.

Along with the above post-conflict reconstruction assistance for Lebanon, Japan revealed a policy to implement its bilateral cooperation including its ODA loans, primarily focusing on environmental projects.

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

3.2 Efficiency (Rating:①)

3.2.1 Project Outputs

3.2.1.1 Project Outputs of the Water Supply Development in Kesrouan

Table 1 shows a comparison of planned and actual project outputs related to the water supply development in the Kesrouan site. The outputs have been modified from the project appraisal phase, and the background and factors underlying such changes are provided below.

(The background and factors for the modification of the project outputs)

As indicated above, some of the components have differences in the planned and actual outputs. Difference resulting from the extension of water transmission pipes was caused by topographical conditions. On the other hand, unsuccessful land acquisition led to major differences in the planned and actual outputs in terms of the number of pumping stations, distribution reservoirs and the length of water transmission lines, although the changes were considered to be inevitable. Factors related to these modifications are as follows.

Table 1. Comparison of the Planned and Actual Project Outputs
(Kesrouan site: Water supply development)

		Number and scope of facilities	
		Plan	Actual
Extension of the Madiq water intake		Renovation of water intake facility	Renovation of water intake facility
Water transmission facilities	Water transmission tunnel	5 km	5 km
	Water transmission pipes	44.5 km	61 km
	Pumping stations	13	6
Water distribution facilities	Distribution reservoirs	22	11
	Distribution lines	202 km	59 km

Source: Reference provided by JICA and the questionnaire responses

1) Water transmission pipes:

The original plan intended to install water transmission pipes along the highway between Zouk Mikael and Aaqaibe. Unable to obtain a construction approval for part of this section from the Ministry of Public Works and Transport, the project had to detour it, imparting a curved connection to the pipes. Consequently, an additional pipeline was provided for a section of 16.5 km. The reason for the disapproval of the original plan was rapidly increasing traffic volume in the highway at that time under which this transmission pipe construction planned. The said authority concluded that such highway road should not be closed for the purpose of the construction work.

2) Pumping stations, distribution reservoirs and distribution lines:

Although it was the Ministry of Water and Energy that initially planned construction of pumping stations, distribution reservoirs and distribution lines, Committee of Development and Reconstruction (hereinafter referred to as CDR) subsequently took over the plan as an executing agency when entering into the implementation phase (The project had assigned CDR as an executing agency at the time of appraisal, therefore, its transfer was in line with the original plan).

To pursue the above-mentioned construction, land acquisition should have been completed prior to the project launch. In fact, a large part of the acquisition process had not progressed beforehand, and had to be resumed at the project outset. Although CDR undertook land acquisition spending substantial time, it decided not to acquire all the land portions, considering the project's loan disbursement period. Unable to acquire all the land areas that were originally planned, the project had to reduce the number of the facilities to fit in the limited site.

Notably, CDR's report indicates that the Government of Lebanon constructed facilities corresponding to cancelled establishment in this project, allocating its own financial resources.

They include seven pumping stations and 16 distribution reservoirs. Also, BMLWE, which operates water supply services in Kesrouan, has been successively constructing distribution lines.

The above-mentioned factors account for the context in which the planned and actual outputs turned out to be different. The project is quite unique in that it was planned and implemented jointly by the competent authority in the water sector, namely the Ministry of Water and Energy, and CDR that is responsible for reconstruction and development. Although it would be reasonable, considering conditions of Lebanon on the heels of the civil war, such inter-agency effort entailed some difficulties in detailed information sharing. This will be further discussed below in the lessons learned from the project.

3.2.1.2 Project Outputs of the Sewerage Extension in Saida

(Reasons and factors for the modification of the project outputs)

Table 2 shows difference between some of the actual and planned outputs. The modifications of the plan were inevitable due to topographical conditions where the target facilities (sewer pumping stations and outfall sewer) were planned. Also, the scope of work was revised because intended output (main sewer line) had been provided by other project. Detailed factors related to these modifications are as follows.

1) Sewer lines

Sewer lines were installed in accordance with the original plan. However, they were eventually extended beyond the original scope, financed with part of the budget cancelled for main sewer line construction that is described below.

2) Main sewer line

Prior to the project launch, part of the intended main sewer line work had been alternatively provided by the City Planning Department of the Government of Lebanon to deliver a component of its own road construction project. Therefore, the JICA project constructed a main sewer line for the remaining section of 2.4 km. This completed 6.8 km of the main sewer line, as originally planned by the project, combined with the work complemented by the City Planning Department.

Table 2. Comparison of the Planned and Actual Project Outputs
(Saida site: Sewerage extension)

		Number and scope of facilities	
		Planned	Actual
Sewer lines		37.8 km	42.52 km
Main sewer line		6.8 km	2.354 km (a total of 6.8 km constructed in conjunction with other project)
Sewer pumping stations		2 stations	4 stations
Water treatment plant	Inlet pump	1	1
	Outlet pump	1	1
	Initial treatment plant	1	1
	Outfall sewer	1.7 km	1.9 km

Source: Source: Reference provided by JICA and the questionnaire responses

3) Sewer pumping stations

Additional pumping stations were required as a result of extending total length of the sewer lines and due to the topography over the construction route.

4) Outfall sewer

The outfall sewer was constructed for 1.9 km in consideration of the topography of the project site.

3.2.2 Project inputs

3.2.2.1 Project cost

The total project cost was lower than planned during the project appraisal. As mentioned in the outputs section above, while the scope of work was added and cancelled in part, the project was completed within the planned costs.

The major reasons are that; (1) the project cost was reduced because the length of the distribution lines required for the water supply facility was shortened, and the number of pumping stations as well as distribution reservoirs was also reduced; (2) part of the budget for the land acquisition was not spent because some of the targeted land was not acquired as originally planned; and (3) part of the main sewer line was provided by another project, requiring no budget execution planned for this part in the project. Calculated from the original cost estimate, the total budget equivalent to 2,666 million yen was not executed supposedly, including (1) about 877 million yen for distribution lines, (2) about 409 million yen for distribution reservoirs, and (3) about 181 million yen for pumping stations, (4) about 634 million yen for land acquisition, and (5) 565 million yen for main sewer line.

On the other hand, the output added to the original plan is an extension of sewer lines in the sewerage project. Whereas the planned cost was 458 million yen for the sewer line work, the project supposedly brought about the output worth about 512 million yen.[5,6]

In pursuant to the above, the cancelled construction portions are excluded from the original cost estimate, while at the same time adding the cost required for construction of facilities beyond the original scope. When compared with a revised cost estimate, the actually executed cost turned out to be 114% of that estimate. Given increased and decreased outputs, therefore, the project cost increased in comparison with the original plan, eventually exceeding the planned amount.

Table 3. Difference between the Planned and Actual Disbursement of the Total Project Costs

(unit: million yen)

	Output	Estimated cost	Actual cost	Difference	Rationale of the cost estimation
Water supply	Pumping stations	335	154	▲181	Reduction corresponding to the estimated cost (The project has not delivered the original output, and thus the difference indicated in the left column should be deducted from the total original cost. This applies to a reason for the reduced cost below as well.)
	Distribution reservoirs	818	409	▲409	Reduction corresponding to the estimated cost
	Distribution lines	1,234	357	▲877	Reduction corresponding to the estimated cost
Sewerage	Sewer lines	458	512	△54	Addition to the estimated cost (The additional cost contributed to enhance the project effect, and the difference indicated in the left column should be regarded as a part of the total original cost.)
	Main sewer line	863	298	▲565	Reduction corresponding to the estimated cost
Water supply and sewerage	Land acquisition	1,234	600	▲634	Reduction corresponding to the estimated cost
Total		4,942	2,330	▲2,612	―

Source: Created by the ex-post evaluation study team based on reference provided by JICA

[5] Extension of water transmission pipes and outfall sewer was attributed to a design change, and not intended to enhance the expected effect as such. Thus, the extension work is not included in the comparison with the planned cost. Also note that sewer pumping stations are not included in the comparison, as the estimated cost is unavailable.

[6] The project designed distribution reservoirs and pumping stations in varied scopes in terms of facility size, and yet the ex-post evaluation study was unable to obtain information on which sites completed the construction. Therefore, this section applies a weighted average to estimate the costs. Though possibly varied depending on the diameter, the cost of pipes is also estimated with a weighted average because detailed figures are not available.

Table 4. Planned and Actual Disbursement of the Project Costs

	Construction		The project total (Comparison with the estimated cost during the project appraisal)	The project total (Comparison with the estimated cost revised for additional and cancelled outputs)
	Japanese ODA loan	Government of Lebanon		
Planned	13,022 million yen	1,533 million yen	14,555 million yen	11,943 million yen
Actual	12,949 million yen	756 million yen	13,705 million yen (94% of the original estimate)	13,705 million yen (114% of the revised estimate)

Source: Reference provided by JICA and the questionnaire response

3.2.2.2 Project Period

The actual project period significantly exceeded the planned period, as in a difference indicated in Table 5.

Table 5. The Planned and Actual Project Periods

Planned	Actual
March 1997-November 2001 (57 months)	March 1997-November 2011 (177 months) (310% of the planned period) *This would be 228% of the planned period when 47 months were excluded from the above as a period affected by Israel's air strikes.

Source: Reference provided by JICA and the questionnaire responses
Note: The period affected by Israel's air strikes is described in detail below.

The major reasons for the extended project period are outlined below. The estimated number of additional months associated with them is based on the questionnaire response from CDR.

1) Land expropriation process

Land expropriation required a long period of time for both water supply and sewerage projects. This included time spent on obtaining financial resources necessary for the land expropriation.

⇒ A delay of more than about 18 months (Though difficult to estimate, the expropriation caused at least 18 months of the delay in the project)

2) Design change

The original plan intended to install water transmission pipes along the highway between Zouk Mikael and Aaqaibe. However, unable to obtain a construction approval for part of this section from the Ministry of Public Works and Transport, the project had to reroute the pipeline

to detour the original section, resulting in a curved laying of the pipes. A design change of this rerouting entailed additional time.

⇒ A delay of about 18 months

3) Approval related to excavation

・Tunneling work and excavation required time to obtain a construction approval (Construction of a water tunnel from Madiq catchment).

⇒ A delay of about 24 months

・Excavation work was delayed due to archeological findings in the ground.

⇒ A delay of about 12 months

・Excavation work required time to deal with soft ground in the target site.

⇒ A delay of about 12 months

4) Additional works

Additional pumping stations were constructed in Saida.

5) Influence of the war

・The entire project was suspended by the war erupted in July 2006 (Israel's attack on Lebanon) . Lasted about 2 months at most, the war damaged infrastructure extensively in the country, which significantly affected subsequent construction works in the project.

Specifically,

- Major bridges in the project area were damaged, requiring more time to transport supplies for the project.
  ⇒ About 18 months required to complete the bridge reconstruction
- Due to damage on an airport and oil storage tanks in northern Saida, the project experienced difficulties in procuring fuel necessary for its entire works. In Saida, it took a long time in finding and disposing the significant amount of unexploded cluster bombs in the ground.
  ⇒ About 18 months required for completion of the disposal
- In the water supply project in Kesrouan, although distribution line works were planned on an old road, it came to be used as an alternative route of a highway damaged by air strikes. Thus, the intended laying works were suspended until the repair of the highway was completed.
- Consultants and contractors evacuated from Lebanon for five months.
  ⇒ Although difficult to estimate a period of the entire delay, it took about 47 months

from Israel's air strikes to the above-mentioned bridge reconstruction which was most recently completed.

6) Stagnated administrative functions

Upon the expiration of Lahoud administration in October 2007, a political conflict between dominant groups intensified, resulting in postponement of election. Consequently, administrative functions had been paralyzed for months, as the presidential office had been vacant from November 2007 through May 2008, followed by major violent conflicts occurred in the country. This had suspended the project works.

⇒ About 10 months

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

At the time of the project appraisal, financial internal rate of return (FIRR) was estimated to be 13.4% in the Kesrouan project and 10.8% in the Saida project respectively. At the time of ex-post evaluation, however, FIRR could not be obtained since the data was unavailable at the executing agency regarding the annual costs paid by the Government of Lebanon for each project component as well as the profit generated from the water tariffs.

In light of the above, although the project cost was within the plan, it was because some of the original target outputs were not constructed. Also, the project period substantially exceeded the plan. Therefore efficiency of the project is low.

3.3 Effectiveness[7] (Rating: ③)

3.3.1 Quantitative Effects (Operation and Effect Indicators)

3.3.1.1 Quantitative Effects of the Water Supply Development in Kesrouan

Achievements of the target indicators in the Kesrouan water supply project are indicated in the table below.

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

Table 6. Achievements of the Target Indicators in the Kesrouan Water Supply Project

	Baseline	Target	Actual	Actual
	1997	2015	2011	2014
	Project appraisal year	4 years after completion	Project completion year	3 years after completion
Water-supply population (persons)	120,755	199,098	NA	276,450
Rate of non-revenue water (%)	NA	20	NA	35

Source: Reference provided by JICA and the questionnaire responses.

Note: 1) Data of 2015 is used to evaluate achievement of the target value, which comes closest to 2014 that provides the project's most recent actual achievement. The said target value is taken from the reference document provided by JICA.

2) The rate of non-revenue water is based on the National Water Sector Strategy (2010).

At the time of the project appraisal, quantitative indicators were not specified. The ex-post evaluation study therefore assessed the effectiveness of the Kesrouan water supply project based on the data obtained from the Government of Lebanon, specifically the population served with water supply and the rate of non-revenue water.

As indicated in Table 6, the target rate of non-revenue water has not been achieved primarily because existing distribution lines remain deteriorated. As of 2014, however, the water-supply population already reached the target value of 2015. This is achieved not only by the project effect, but also presumably by the distribution line works of the Government of Lebanon pursued in the post-project phase.

Also, many local households have recognized the improvement of water shortages and the stability of water supply, as initially intended by the project. This will be discussed in the impact section below. In light of the above, the effect of the Kesrouan water supply project has been generally high, although unable to attain the target value of the rate of non-revenue water.

As in the latest monitoring results shown in Table 7, the quality of water distributed to households satisfies the portable water requirements specifying the tolerable limit of turbidity, coliform and common bacteria.

Table 7. Monitoring Results of the Water Quality

Month and site of measurement	Measuring item	Coliform	Bacteria	Turbidity
	Baseline	Less than 1 colony/ml	Less than 150 colonies/ml	Less than 1.0 NTU
April 2015 Police station in Jounieh		Under 1 colony/ml	5 colonies/ml	0.92 NTU

Source: Reference provided by BLMWE

3.3.1.2 Quantitative Effects of the Sewerage Extension Project in Saida

Achievements of the target indicators in the Saida sewerage project are shown in the table below.

Table 8. Achievements of the Target Indicators in the Saida Sewerage Project

	Baseline	Target	Actual	Actual
	1997	2014	2011	2014
	Year of the project appraisal	3 years after completion	Year of completion	3 years after completion
Population Covered by Sewerage Systems (person)	0	NA	66,666	196,891

Source: Reference provided by JICA and the questionnaire responses

Note: It is unknown whether a target value was specified initially, and the year 2014 is used, which provides the latest available data.

Table 9. Changes in the Population Covered by Sewerage System

(unit: person)

Year	2009	2010	2011	2012	2013	2014
Population Covered by Sewerage Systems	33,178	51,472	66,666	87,782	145,348	196,891

Source: Questionnaire responses

As shown in Table 9, the population covered by sewerage systems has been increasing year by year, particularly achieving a rapid increase of the served population in those two years in the post-project period from 2011 and 2012. Given the fact that the area has the population of 387,500 as of 2014, about 51% of the residents are covered by the sewerage systems.[8]

In three years from the project completion, the coverage by the sewage networks reached more than a half of the population in the area. A main sewer line and sewerage networks extended by the project have contributed to an increase in the population covered by these systems in the target area, demonstrating its effect.

Also, the table below shows a BOD concentration measured at a treatment plant constructed by the project.[9] Given that the project appraisal set out a target BOD reduction of 30%[10] at the primary treatment plant, the current plant operation has generally achieved the objective as expected.

[8] The population in Saida estimated as 387,500 is based on the questionnaire response from SLWE. Lebanon has not carried out an accurate population survey since the last national census in 1932. Therefore, note that the number of population often varies depending on census reports.

[9] This wastewater treatment plant is intended for a primary treatment process using a sand basin and screening, as opposed to a secondary treatment plant to provide substantially high removal rates.

[10] This is based on the "Guidelines Manual for Planning and Design of Sewerage Treatment Plant" cited in the Project Appraisal Document.

Table 10. BOD Reduction at the Sewer Treatment Plant

Year	2013 (2 years after completion)	2014 (3 years after completion)
Mean inflow concentration (mg/l)	344	360
Mean outflow concentration (mg/l)	270	242
Rate of reduction	21.4%	32.9%

Source: Questionnaire responses

3.3.2 Qualitative Effects

Outcomes corresponding to qualitative effects are described in the section of Impacts.

3.4 Impacts

3.4.1 Observed Impacts

The beneficiary surveys[11] revealed project impacts described below.

3.4.1.1 Impacts by the Kesrouan Water Supply Project

As shown in Table 11 and 12, local residents have perceived improved household efficiency and living standards, by which the project has contributed to increase the amount of water supply and reduce duration of water cutoff.

Table 11. Public Awareness on the Reduced Water Shortage (summer)

(unit:%)

	Strongly agree	Generally agree	Neither agree or disagree	Slightly disagree	Disagree	Do not know
The amount of water supply has increased	50	22	6	0	20	1
Duration of water cutoff has decreased	54	18	6	0	20	2

Source: Results of the beneficiary surveys

Table 12. Public Awareness on the Living Standard and Household Efficiency

(unit: %)

	Strongly agree	Generally agree	Neither agree or disagree	Slightly disagree	Disagree	Do not know
The essential quality of life has improved	70	6	2	2	16	4
Household efficiency has increased	74	4	2	2	18	0

Source: Results of the beneficiary surveys

[11] Beneficiary surveys targeted 50 local residents in the project sites in Kesrouan and Saida respectively. In the latter, an additional survey was carried out with 15 persons working for tourism agencies to evaluate the project impact on tourism.

As shown in the results of the beneficiary surveys in Table 11 and 12, many of the local residents in the target areas are stably supplied with water compared with before. They perceived higher household efficiency and better living standards, in essence, as a result of an increased amount and improved duration of water supply.

3.4.1.2 Impacts by the Saida Sewerage Extension Project

Saida Sewerage Extension Project has achieved outcomes as in Table 13 and 14.

Table 13. Public Awareness on Neighboring River Views,Water Quality (with Visual Observation) and Odor (during the summer) (unit: %)

	Strongly agree	Generally agree	Neither agree or disagree	Slightly disagree	Disagree	Do not know
River views and water quality have been improved	10	8	2	0	20	60
Odor has been reduced	28	10	2	8	14	38

Source: Results of the beneficiary surveys

Table 14. Public Awareness on Coastal Views, Water Quality (with Visual Observation) and Odor (during the summer) (unit: %)

	Strongly agree	Generally agree	Neither agree or disagree	Slightly disagree	Disagree	Do not know
Coastal views and water quality have improved	12	34	14	14	18	8
Odor has reduced	22	28	10	12	22	6

Source: Results of the beneficiary surveys

As shown in Table 13, public awareness is relatively low with respect to improvement of the river views and water quality that can be observed visually. Only about 20% of the respondents indicated a positive response. On the other hand, about 40% of the respondents have recognized reduced odor. The response that one has not observed improved views and water quality supposedly results from frequent disposal of wastes into rivers, which is still practiced today.

Table 14 shows more respondents recognized the improvement in coastlines than in rivers, and about 50% of them answered that they “strongly agree” and “generally agree” with such improvement. For one reason, those who reside along the rivers have identified the positive changes thereof, while others may not be able to clearly observe such improvement. On the other hand, local residents in coastal areas are relatively aware of the changed view whereby they visit more frequently. Currently, a final disposal site located in the coast of Saida is being

removed, and this may have led to a response that odor has been reduced.[12]

Responses regarding the project impact on the tourism are shown in Table 15 (provided by 15 respondents).

Table 15. Public Awareness on the Project Impact on the Tourism (unit: %)

	Strongly agree	Generally agree	Neither agree or disagree	Slightly disagree	Disagree	Do not know
The project has a positive impact on the tourism.	0	0	13	13	73	7

Source: Results of the beneficiary surveys

Although the project has improved landscape views and water quality, few respondents perceive its effect leading to tourism promotion (Table 15). In fact, affected by the local security concerns in recent years, tourists in Lebanon have been decreasing as a whole (Table 16). Also, among other cities in the country, Saida has been regarded as one of those cities with a deteriorating security situation, the local tourism has a trend of stagnation.

【Reference】

Table 16. Changes in the Tourist Population in Lebanon (unit: person)

Year	2010	2011	2012	2013
Number of tourist	2,168,000	1,655,051	1,365,845	1,274,362

Source: Ministry of Tourism of Lebanon

3.4.2 Other Impacts

(Impacts on the Natural Environment)

Measured by an environmental NGO, coliform units observed in Saida coastal area are shown in the table below.[13]

Table 17. Coliform Count in Saida Coastal Area

Year	2007	2013
Number of coliform colonies (per 100 ml)	244	50

Source: Arab Forum for Environment and Development

[12] Jointly pursed by the Ministry of Environment and UNDP from 2012 to 2015, a project to remove the final disposal site operated since 1982 is mostly completed as of June 2015.

[13] The wastewater treatment plant constructed by the project is located about 200 m from the coastline.

The coliform count has been significantly improved since 2007, mostly achieving the global standard. For instance, given that the Environmental Protection Agency of the United States sets out the (recreational) water quality criteria for an allowable coliform count not more than 250 per 100 ml,[14] figures in the table are generally satisfactory.

This improvement is primarily attributed to the project effect as well as the removal of the final disposal site which has been used for a long time in the coastal area of Saida.

(Resettlement and Land Acquisition)

Although the project involved no involuntary resettlement, it required a significant time to acquire land for distribution reservoirs, pumping stations, a tunnel and a wastewater treatment plant. The land price related to the acquisition had been determined in the process duly guided by a judge in charge of land property transactions. Therefore, the project entailed no enforced proceedings, though requiring time.

Table 18. Outline of the Land Acquisition

	Acquired land area (m^2)	Number of land owners (person)
Kesrouan	51,000	596
Saida	104,000	14

Source: Questionnaire responses

As described above, local residents have recognized that the water supply project in Kesrouan has increased the amount of available water and has reduced the duration of water cutoff, while also improving their household efficiency and living standards. In the sewerage extension project in Saida, some local residents indicated that river and coastal views and odor problems have been improved. On the other hand, the project has not yet made expected visible impact that helps develop attractive tourist spots by reducing coastal pollution, ultimately promoting the local tourism.

In summary, the project has evidently demonstrated its effects. It has gradually increased the population covered by the water supply and sewerage systems, meeting the target criteria of the water quality defined in project indicators such as the portable water standard and BOD removal rate. Local residents in the target areas have experienced positive impact that hours of the water supply have been extended and their living standards improved.

In light of the above, the project has largely achieved its objectives. Therefore effectiveness and impact of the project are high.

[14] Kinji Yamada. "Criteria Applied Overseas related to Coliform Bacteria." *Journal of Japan Sewage Works Association*. Feb. 2013. Japan Sewage Works Association.

3.5 Sustainability (Rating: ②)

3.5.1 Institutional Aspects of Operation and Maintenance

The water supply systems in Kesrouan are operated by BMLWE. According to the organization, the number of full-time employees is in shortage, with approximately only one third of staff allocated. BMLWE therefore employs temporary staff to engage in operation and maintenance of the facilities.

The sewerage plants are operated and maintained by SLWE. The actual service provider pursuing regular operations and maintenance work is a private company called Nicole Saba based on an agreement with SLWE which is responsible for monitoring of its services. The three-year contract is likely to be renewed in September 2015. Under the project director, Nicole Saba allocates a total of 44 employees, which is mostly sufficient to operate and maintain the project's treatment plant, consisting primarily of staff members serving logistics (25 in total including 18 plant operators), machine maintenance (7 persons), electric facilities (5 persons), laboratory (2 persons), accounting and secretaries.

In summary, in terms of sustainability of BMLWE's organizational structure, it poses a challenge, when evaluated from the above situation, which it relies on temporary contract basis workers for its operation and maintenance. SLWE, on the other hand, has managed operation and maintenance, flexibly using an outsourcing scheme. This is evaluated to be sustainable to a certain degree at present.

3.5.2 Technical Aspects of Operation and Maintenance

Evaluation of BMLWE's operation and maintenance performances in the past indicates it has rarely experienced technically unsolvable problems, and the organization now duly manages the services.

However, it is partly uncertain how BMLWE will continuously develop technical capacities for staff. Regulations stipulating on the establishment of BMLWE mandate that an organization structure should include a labor safety and training department to conduct refresher training programs. Currently, it implements no periodical and systematic training, while practically relying on OJT to have its staff learn techniques within their organization. In fact, with such OJT-based technical learning, staff can carry out most of their routine works, though, ideally, technical capacity development should be planned and provided in a coherent manner. Related to this issue, UNICEF plans to offer a training opportunity in 2015.

In SLWE, on the other hand, staff attends a training based on its annual training plan. In 2014, it offered courses in the subjects of GIS, IT, water management, drainage, chlorination and laboratory testing. In addition, in October 2014, 8 SLWE staff participated in the water supply and sewerage training in Jordan funded by USAID.

As an actual operator of the treatment plant, Nicole Saba has a system to provide various training programs on a quarterly basis, focusing on operational improvement. In addition, the company has experiences of participating in overseas training programs assisted by Sweden, Holland, Spain and France, which indicates its training system has been developed in general.

The company has had no major problems so far in terms of operation and maintenance performances, supposedly matching a certain level of techniques.

In summary, while no major problems have been identified with respects to operation and maintenance techniques in the both projects, BMLWE has partly a technical concern as mentioned above.

3.5.3 Financial Aspects of Operation and Maintenance

Estimated expense of BMLWE's operation and maintenance in 2014 include 330,000 USD for salaries, 200,000 USD for electricity (regular power distribution), and 750,000 to one million USD for fuels (for an independent power generation). As local power supply is unstable, and is available about 10 to 14 hours a day on average, therefore requiring an independent power generation for the remaining hours.[15] As a result, operational costs have been increasing.

On the other hand, among four other Water Establishments, BMLWE has a better revenue condition that its service areas covering Beirut, which has been reaching the cost recovery level to achieve a balance of payments.[16]

SLWE proposed its operation and maintenance costs for 2014 in the sum of 990,000 USD, including 772,000 USD for operation and maintenance (service contract expenses), 136,000 USD for fuels, and electricity for 82,000 USD. However, due to non-payment of the water supply and sewerage services in the target areas, SLWE has been unable to fully obtain the water charges that should have been collected.[17] Given this circumstance, SLWE operates with the government's financial support.

As indicated above, both organizations have some challenges to be addressed for the future, including financial improvement by systematizing water rate collection, reducing fuel expenses and redressing non-subsidized operations. On the other hand, given that the water supply and sewerage services are essentially basic needs of people, it is highly likely that the government will continue to subsidize these operations. Its officials have a similar prospect.

In summary, although operation and maintenance of both project outputs have no major problems in terms of finance that may disrupt a future service delivery, some of the issues as

[15] Financial statement was unavailable for this ex-post evaluation, as they are not disclosed.
[16] Source: Lebanon - Social impact analysis: electricity and water sectors. Washington, DC: World Bank, 2009
[17] The Ministry of Water and Energy is working for applying a water rate collection system based on the amount of water used in each household, and the pilot areas have started to set up water meters. Targeting 2021, the Ministry of Water and Energy intends to gradually extend the coverage of water meters so that each Water Establishment will be able to operate with/based on its own cost recovery revenue.

mentioned above need to be addressed, including systematized water rate collection.

3.5.4 Current Status of Operation and Maintenance

The water supply facilities have been duly operated so far. In the sewerage systems provided, SLWE outsourced a repair of a pumping station to a private company in 2012, and has identified no critical problems in facility operations.

However, the sewerage systems need to cope with the following issues to ascertain higher sustainability in operation and maintenance.

1) Treatment of wastewater released from local industrial plants

Untreated wastewater is disposed from tanning factories, paint manufacturers, and soap factories. In particular, wastewater released from tanning factories are highly acid, affecting drainage pipes and water treatment systems extensively[18].

2) Maintenance responsibility and implementation of drainage pipe clearing

Article 221 of the Water Act in Lebanon defines that Water Establishments are responsible for maintenance of drainage pipes. Accordingly, the Saida project has included drainage pipe cleaning as a part of a service agreement with the entrusted private company. Provided with a truck designed for drainage pipe cleaning from UNICEF in 2014, an outsourced company, Nicole Saba, now pursues cleaning works which had not been carried out much frequently until then. This should be continued on a regular basis in accordance with a cleaning schedule.

SLWE is preparing a cost plan equivalent to about 800,000 USD related to a renewal of the installed facilities and equipment. Part of this budget is already allocated to purchase six pumps in 2015 (about 230,000 USD). BMLWE, on the other hand, does not need to renew the project's facilities and equipment for the time being, and will cope with any damage within its ordinary budget.

As mentioned in the financial sustainability section, an unstable power supply has resulted in more financial burden for BMLWE and SLWE than necessary. Power supply is usually available to BMLWE for half a day, while SLWE can obtain the supply for 18 hours per day in general, and 12 hours during the rainy season. The voltage is also unstable, frequently disrupted, which decreases operational efficiency of pumps. According to BMLWE, an independent power generation requires the cost approximately more than five times than the regular power distribution.

[18] The Ministry of Environment assumes a primary role in monitoring and inspection of wastewater released from industrial plants (The Ministry of Industry is also involved in providing administrative guidance).

In summary, the current status at the time of the ex-post evaluation is that the project facilities have been operated regularly without serious failures or damages, however, from a mid- and long-term point of view, there remain some issues to be addressed for stable facility operations.

In light of the above, some minor problems have been observed in institutional, technical and financial aspects of the operation and maintenance system. Therefore sustainability of the project effects is fair.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

The project has aimed at addressing problems of water shortage and wastewater treatment by developing water supply and sewerage systems in Saida and Kesrouan in Lebanon, thereby contributing to the improvement of the living environment of the local residents. This objective has been consistent with the country's development policy and needs as well as Japan's ODA policy both at the time of the project appraisal and ex-post evaluation. Therefore, the relevance of the project is high.

The project period, on the other hand, has largely exceeded the original plan resulting from such external factor as Israel's air strikes and internal problems related to the executing agency, namely land acquisition, design modifications, a prolonged process of approving a tunneling work. While the project cost is within the original plan, it is primarily because a part of the intended outputs were cancelled. Therefore, the project efficiency is evaluated to be low.

As for the project effectiveness, the water supply population has been gradually increasing in Kesrouan, achieving the target value for 2015 as of the ex-post evaluation. Many of the local residents have recognized more stable water supply and higher household efficiency than before. Population covered by the sewerage systems in Saida, has been also increasing, while also the local residents are aware of improved coastal views and odor to a certain degree. In addition, the wastewater treatment plant has mostly achieved the expected BOD reduction rate. In light of the above, the project effectiveness and impact have been high.

In terms of the project sustainability, no technical problems have been identified both at BMLWE operating and maintaining the Kesrouan water supply system and SLWE operating and maintaining the Saida water treatment plant. On the other hand, the ex-post evaluation study identified organizational problems such as the number of employees (related to BMLWE) and a financial problem (related to SLWE), which may affect stable operations in the future. Therefore, the project sustainability is evaluated to be fair.

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

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

(Recommendations to both BMLWE and SLWE)

1) The third network extension of the water supply and sewerage systems

To make best use of the project benefits, it is of utmost importance to extend the water supply and sewerage networks to households. While BMLWE and SLWE have been working for the installation, it is recommended that this should be continued in the future.

2) Ensuring collection of water rate

It is suggested that the percentage of collecting water supply and sewerage rates should be increased. This will directly contribute to financial improvement of Water Establishments. While currently implemented on a trial basis in the country, a meter-based system should be expanded in wider areas to urgently achieve a service delivery supported by the cost recovery. The ex-post evaluation study recommends the introduction of immediate and wider coverage of a meter-base system even to the coverage area of BMLWE, whose cost recovery has been reportedly been realized. It promises to promote the organization's financial improvement.

3) Stabilization of power supply

Unstable power supply has led to more cost burden than required for Water Establishments. Although such power supply itself cannot be attributed to BMLWE and SLWE, they need to strongly request related ministries to improve local power generation and distribution, ensuring the stability.

(Recommendation to BMLWE)

4) Allocation of a proper number of staff

Currently, BMLWE is understaffed, and therefore is managing regular operations by allocating temporary contract basis workers. In terms of sound organizational management, it is of vital importance to make techniques, experiences and lessons shared and established within an organization, which will certainly lead to more consistent facility operation and maintenance. BMLWE is recommended to plan increasing the personnel and deliver the plan to obtain an appropriate number of full-time workers.

5) Measures against water leakage

Currently, high water leakage rate is a problem in operating the water supply service. Reduction of the water leakage rate can contribute to increase profit of the Water Establishments. To cope with this, it is recommended to repair and replace water pipes.

(Recommendation to SLWE)

6) Ensuring that drainage pipe cleaning is carried out

In Saida, a private company outsourced by SLWE is cleaning drainage pipes with a cleaning truck. Regular cleaning of drainage pipes is one of the indispensable maintenance works, requiring an established practice. SLWE thus needs to prepare a cleaning schedule specifying sites and timing and ensure the implementation.

4.2.2 Recommendation to JICA

None

4.3 Lessons Learned

1) Points to be paid attention in a project, which is jointly implemented by line ministries and executing agencies

This project had been jointly implemented by the Ministry of Water and Energy responsible for the water sector and CDR in charge of reconstruction and development efforts of the country. In practice, their roles were assumed in a way that the Ministry of Water and Energy pursued preliminary planning, preparation and post-project management, while CDR an executing role separately during the project period. In a country recovering from the civil war, this kind of execution structure is understandable. However, the inter-agency information sharing had been sometimes less promoted than expected. As a result, information related to the project's land acquisition process had not been handed over sufficiently, making it difficult to complete the planned number of facilities and requiring significantly longer time than intended.

In a project in which different agencies are planned to start the implementation at different timelines, it is essential for its step-by-step delivery to check elaborately in advance to what extent they share information regularly. To do so, not only executing agencies, but also JICA, as a coordinating body, may serve as a liaison to provide an independent checking mechanism.

-End-

Comparison of the Original and Actual Scope of the Project

Item	Plan	Actual
1.Project Outputs	Kesrouan site: Water supply project Madiq catchment extension Water transmission facility Water transmission tunnel: 5 km Water transmission pipes: 44.5 km Pumping stations: 13 Distribution facilities Distribution reservoir: 22 Distribution lines: 202 km Saida site: Sewerage extension project Sewer lines: 37.8 km Main sewer line: 6.8 km Sewer pumping stations: 2 Water treatment plant Inlet pump: 1 Outlet pump: 1 Primary treatment plant:1 Outfall sewer: 1.7 km	Kesrouan site: Water supply project Madiq catchment extension Water transmission facility Water transmission tunnel: 5 km Water transmission pipes: 61 km Pumping stations: 6 Distribution facilities Distribution reservoir: 11 Distribution lines: 59 km Saida site: Sewerage extension project Sewer lines: 42.52 km Main sewer line: 2.354 km (A total of 6.8 km was constructed combined with other project.) Sewer pumping stations: 4 Water treatment plant Inlet pump: 1 Outlet pump: 1 Primary treatment plant:1 Outfall sewer: 1.9 km
2.Project Period	March 1997 - November 2001 (57 months)	March 1997-November 2011 (177 months) or *(130 months) when 47 months were excluded from the above as a period affected by Israel's air strikes
3.Project Cost Amount paid in Foreign currency Amount paid in Local currency Total Japanese ODA loan portion Exchange rate	6,436 million yen 8,119 million yen (local currency) 133,152 million LBP 14,555 million yen 13,022 million yen 1LBP＝0.0609JPY (As of October 1995)	Unknown Unknown (local currency) Unknown 13,705 million yen 12,949 million yen 1LBP＝0.0710JPY (Average between January 2000 through November 2011)