Egypt

Ex-Post Evaluation of Japanese Grant Aid Project

The Project for Rehabilitation and Improvement of Sakoula Regulator on Bahr Yusef Canal

External Evaluator: Masami Tomita, Mitsubishi UFJ Research and Consulting Co., Ltd.

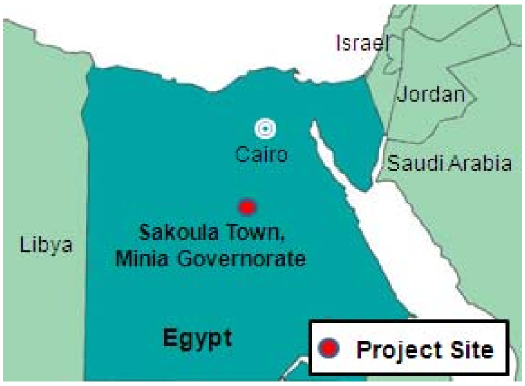
0. Summary

This project aimed at achieving and ensuring appropriate water management and stable provision of irrigation water to the benefited area by rehabilitating the Sakoula Regulator on the Bahr Yusef Canal and introducing an overflow type gate that enables easier control of water level and flow volume.

Relevance of this project is high, as the project is consistent with priority areas of Egypt's development plans and Japan's ODA policy, and moreover development needs for the project are high. Efficiency of the project is high, as both project cost and period were within the plan. Effectiveness of the project is fair, as on the one hand the project more or less achieved targets in a major operation and effect indicator, which is the amount of water intake from the Sakoula Regulator to the gravity irrigation area, but on the other hand, the amount of water intake from the Sakoula Regulator is still in deficit in July and water shortage has not been solved yet in the benefited area (especially at downstream of branch canals) largely due to deteriorated small water structures etc. Sustainability of the project is fair, as some problems have been observed in terms of operation of the regulator and water flow management, while no major problems have been observed in the O&M system and financial status.

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

1. Project Description



Project Location

Sakoula Regulator

1.1 Background

In Egypt, where annual amount of precipitation is approximately as little as 5 mm, 55.5 billion m^3 of the water right per year which is stated in the Nile Agreement is the major available amount of water for agricultural, industrial and domestic (daily life) uses. On the other hand, population of the country is expected to increase from approximately 38 million in 1977 to approximately 83 million in 2017[1], and the horizontal expansion of agricultural land has been promoted in order to increase food production in line with the population growth. However, as the available amount of water resources within the country is limited and the cultivated area is merely 4% of the area of the whole country[2], the vertical expansion which aims at increasing cropping intensity and yield of production in existing cultivated areas has also been promoted. The Egyptian government determined to renew and/or upgrade deteriorated water structures such as weirs and water intake facilities within the country to modern facilities for the efficient use of limited amount of water resources as part of the vertical expansion policy.

The amount of water intake into the Bahr Yusef Canal on which the Sakoula Regulator is situated is 4.5 billion m^3 per year, which equals to approximately 8% of the amount of the water right stated in the Nile Agreement. The total area benefited from the Bahr Yusef Canal is 11% of the total cultivated area within the country and the canal is one of the important agricultural infrastructures for the country's agriculture[3]. The Japanese government has provided assistance for the rehabilitation of the canal since 1990 based on requests from the Egyptian government. The Japanese government reported the survey results of the canal as a whole in 1992 as "Feasibility Study for Rehabilitation and Improvement of Delivery Water System on Bahr Yusef Canal", and provided grant aid for rehabilitation of the Lahoun Regulator (completed in 1997) and the Mazoura Regulator (completed in 2002) based on the F/S report. One thing to note is that an overflow type gate that enables easier control of water level and flow volume has been introduced to these regulators. This project was implemented for the purpose of an integrated water flow management among the three regulators in order to utilize the limited amount of water resources of the Nile River efficiently, by renewing the heavily deteriorated Sakoula Regulator, which is located at the upstream of the above mentioned two regulators, and introducing an overflow type gate which is the same as those introduced to the other two regulators.

1.2 Project Outline

The objective of this project is to achieve and ensure appropriate water management and stable provision of irrigation water to the benefited area by rehabilitating the Sakoula Regulator on the Bahr Yusef Canal and introducing an overflow type gate that enables easier control of water level and flow volume.

Grant Limit / Actual Grant Amount	2,001million yen / 1,897 million yen
Exchange of Notes Date	June, 2004

[1] National Water Resources Plan 2017 P.22
[2] Basic Design Report on the Project for Rehabilitation and Improvement of Sakoula Regulator on Bahr Yusef Canal in the Arab Republic of Egypt (2003) P.S-1
[3] Same as above. P.1-6

Implementing Agency	Ministry of Water Resources and Irrigation
Project Completion Date	June, 2006
Main Contractor	Dai Nippon Construction
Main Consultant	Sanyu Consultants Inc.
Basic Design	"Basic Design Report on the Project for Rehabilitation and Improvement of Sakoula Regulator on Bahr Yusef Canal in the Arab Republic of Egypt" Japan International Cooperation Agency (JICA), Sanyu Consultants Inc. August, 2003
Detailed Design	June, 2004
Related Projects (if any)	"Feasibility Study for Rehabilitation and Improvement of Delivery Water System on Bahr Yusef Canal" (1990-1992), "Project for the Rehabilitation and Improvement of Lahoun Regulator of Bahr Yusef Canal in the Arab Republic of Egypt" (1995-1997), "Project for Rehabilitation and Improvement of Mazoura Regulator of Bahr Yusef Canal in the Arab Republic of Egypt" (2000-2002) Irrigation Improvement Project (IIP) (1996-2006) The World Bank

2. Outline of the Evaluation Study

2.1 External Evaluator

Masami Tomita, Mitsubishi UFJ Research and Consulting Co., Ltd.

2.2 Duration of Evaluation Study

Duration of the Study: December, 2010 – December, 2011

Duration of the Field Study: June 18, 2011 – July 1, 2011, September 11, 2011–September 20, 2011

2.3 Constraints during the Evaluation Study

The area covered by this project is comprised of the gravity irrigation area (old land), where irrigation water is supplied to branch and secondary canals by gravity, and the pump irrigation area (newly reclaimed land), where irrigation water is delivered to branch and secondary canals through pump stations. At the time of the basic design study, target figures were set for required amount of irrigation water, actual water intake, agricultural production volume and yield per unit area in the gravity irrigation area after the project implementation. However, for the pump irrigation area, target figures were not set, as the area has been expanded due to the horizontal expansion policy and thus making assumption for the increase of cultivated areas and yield per unit area was very difficult. Moreover, at the time of ex-post evaluation, reliable data regarding the cultivated area by major crops and water intake volume in the pump irrigation area (it accounted for approximately 40% of the entire area benefited from the project at the time of the basic design study) was not provided by the executing agency, and therefore it cannot be judged whether water shortage has been solved or not in the area. Consequently, the ex-post evaluation study focuses on the gravity irrigation area only to evaluate this project. Furthermore, reliable data regarding production volume of major crops, yield per unit area and agricultural income in the benefited area after the project implementation was not provided by the executing agency, and thus, impact of the project is evaluated based on a qualitative analysis such as beneficiary survey etc.

3. Results of the Evaluation (Overall Rating: B[4])

3.1 Relevance (Rating: ③[5])

3.1.1 Relevance with the Development Plan of Egypt

The Fourth Five-Year Plan of Egypt (1997-2002) focused on an effective use of limited amount of water resources and improvement of irrigation efficiency, and targeted at saving approximately one billion m^3 of water during the plan period of five years by improving efficiency of irrigation systems through renewal of deteriorated water structures such as pump stations, water intake facilities and weirs etc.

On the other hand, the Sixth Five-Year Plan of Egypt (2007-2012), which is the national development plan at the time of ex-post evaluation, aims at saving water for agricultural uses (promotion of production of crops which consume less amount of water and reuse of agricultural drainage etc) and developing new water resources (use of ground water), and securing water resources is still a critical issue in Egypt. The Five-Year Plan states that the country will carry out construction of weirs and dams etc in Assiout, construction of drainage networks (target area: 560,000 feddan[6]), expansion of drainage networks (target area: 450,000 feddan), and renewal of drainage networks (target area: 550,000 feddan) etc, in order to save approximately two billion m^3 of water. Moreover, National Water Resources Plan 2017 states that the country will carry out construction of weirs and drainages for the purpose of appropriate distribution and effective use of water.

Therefore, construction and renewal of water structures for the purpose of effective use of water resources were/are prioritized in Egypt's development plans both at the time of basic design study and ex-post evaluation.

[4] A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory
[5] ③: High, ② Fair, ① Low
[6] 1 feddan = approximately 0.42 hectare

3.1.2 Relevance with the Development Needs of Egypt

At the time of basic design study (2003), the Sakoula Regulator on the Bahr Yusef Canal which was constructed more than 100 years ago was deteriorated severely, and water leakage from the regulator caused unstable water level at upstream of the regulator, which resulted in the shortage of water inflow into branch canals. Consequently, the gravity irrigation area (approximately 50,000 feddan) at upstream of the regulator was faced with the shortage of 5,640 thousand m^3 of irrigation water for summer cropping and 3,515 thousand m^3 for winter cropping. Meanwhile, in the pump irrigation area (approximately 33,000 feddan) unstable water intake level caused excessive hours of operation of pumping facilities. Moreover, previously the gates of the regulator had been operated manually (by hand) in order to control the downstream water level of the regulator (the control of the upstream water level of the regulator had not been carried out), which took a long time, increased the amount of waste discharge during the gate operation, and resulted in the unstable upstream water level of the regulator.

On the other hand, at the time of ex-post evaluation, agricultural land in Egypt keeps being developed and expanded for the purpose of improving the rate of food self-sufficiency and increasing production of export crops etc. The cultivated areas in the country are expected to increase from approximately 8 million feddan in 1997 to approximately 11 million feddan in 2017[7]. On the other hand, the amount of water for agriculture that could be increased during the same period is limited to 200 million m^3 even if efforts are made to reuse agricultural discharge water etc. Under these circumstances effective use of water resources has become ever more important. In the area benefited from the Sakoula Regulator, newly reclaimed land (pump irrigation area) has been expanded (approximately 33,000 feddan in 2002 and approximately 45,000 feddan in 2010[8]), and the Sakoula Regulator is a very important facility in order to supply limited amount of water stably to both old land (gravity irrigation area) and newly reclaimed land, and hence development needs for the project are still high.

3.1.3 Relevance with Japan's ODA Policy

In Japan's Official Development Assistance (ODA) Charter revised in 2003, assistance for the area of agriculture targeted at poverty reduction was prioritized, and the Country Assistance Program for Egypt formulated in 2000 stated provision of agricultural infrastructure and increase of agricultural production as important areas for Japan's assistance to Egypt.

This project has been highly relevant with Egypt's development plan, development needs, as well as Japan's ODA policy, therefore its relevance is high.

[7] National Water Resources Plan 2017 P.15-16
[8] Data provided by the executing agency

3.2 Efficiency (Rating: ③)

3.2.1 Project Outputs

Table 1 below shows outputs of the project (both planned and actual) which were constructed and provided with Japan's grant aid, and Table 2 below shows outputs of the project (both planned and actual) which were provided with Egypt's budget.

Table 1: Outputs of the Project Constructed and Provided with Japan's Grant Aid (Planned/Actual)

Item	Planned	Actual
Regulator Body	Reinforced concrete structure, Maximum discharge: 193.64m^3/sec, Minimum discharge: 39.76 m^3/sec, Highest control water level (upstream): 33.70m, Lowest control water level (downstream): 30.28m	Almost as planned (In detailed design, widening of a regulator base plate was required, which accompanied changing the location of the regulator body towards 2.5m right bank of the canal)
Gate	Slide type double leaf roller gate, Gate span width: 8.0m, Height of upper leaf: 2.8m, Height of lower leaf: 3.0m, Quantity: 4sets	As planned
Bed Protection	Concrete block, Length of downstream protection: 44m, Width: 38m	As planned
Closure Dike	Steel sheet pile type III and IV: 10.5-12.5m Stone pitching slope protection:133m	Almost as planned (Steel sheet pile type III and IV: 10.5-15.0m) (Changing the location of the regulator body required a modification of the length of steel sheet pile)
Slope Protection	Steel sheet pile type III and IV: 9.0-12.5m Stone pitching slope protection: 157m	Almost as planned (Steel sheet pile type III and IV: 9.0-15.0m) (Changing the location of the regulator body required a modification of the length of steel sheet pile)
Attached Bridge	Reinforced concrete structure, Length of bridge: 40.0m, Design load: 60ton, One side single lane, Total width: 12.8m	As planned
Control House	One story, RC structure, Floor area: 78m^2	As planned
Control Panel	Upper and lower gate operation button, Recorder for water level, gate opening and discharge, Upper and lower gate opening indicator, Upstream and downstream water level gauge etc	As planned

Emergency Generator	50kVA, 380V/220V 1unit	As planned

Source: Basic Design Study Report, JICA Internal Documents, Answer to Questionnaire

Table 2: Outputs of the Project Provided with Egypt's Budget (Planned/Actual)

Planned	Actual
Regulation of flow in the Bahr Yusef Canal during construction including repair of existing gates (4 gates)	As planned
Land acquisition (3,000m^2) for temporary yards and preparation	As planned
Internal transportation of products for permanent use from the port of disembarkation to the project site	As planned
Installation of a permanent transformer and switch gear at near the control house and extension cable from the existing high voltage power line	As planned

Source: Basic Design Study Report, JICA Internal Documents, Answer to Questionnaire

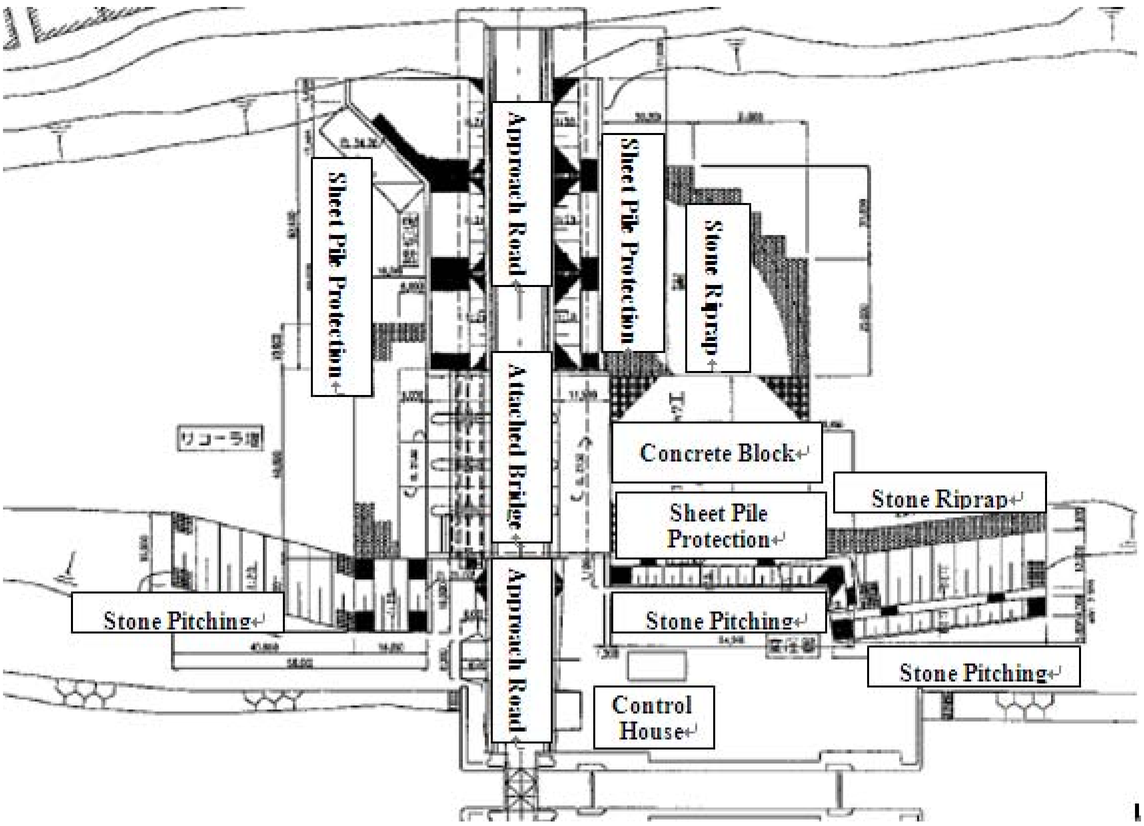


Figure 1: Overview of the Sakoula Regulator

Source: Edited based on the ground plan of the regulator in the basic design study report

Outputs of the project were as planned. A state-owned land was used for the temporary yard, which was to be acquired and prepared with the Egyptian budget, and thus land acquisition cost was not required.

Control House

Gates and Attached Bridge

3.2.2 Project Inputs

3.2.2.1 Project Cost

The grant limit at the time of the basic design study was 2,001 million yen, on the other hand, the actual grant amount was 1,897 million yen, and it was lower than planned (95% against the plan). The planned Egyptian budget was 278 million yen[9], while the actual cost was 95 million yen[10], and it was lower than planned (34% against the plan). The reason for the large reduction of the project cost financed with Egyptian budget was due to the fact that land acquisition cost was not required as a state-owned land was used for the temporary yard, that outsourcing cost was not required as employees of the executing agency carried out repair and operation of existing 4 gates during the construction, and that custom fee was not required (became exempted) in the middle of the project implementation.

3.2.2.2 Project Period

The planned project period at the time of the basic design study was 29 months in total (5 months for detailed design and preparation of bidding documents, 3 months for bidding and selection of a contractor and 21 months for civil works)[11]. On the other hand, the actual project period was 27 months in total (5 months for detailed design and preparation of bidding documents, 3 months for bidding and selection of a contractor and 19 months for civil works), and it was shorter than planned (93% against the plan). The reason for the shorter project period was due to efforts made by contractors to proceed construction works efficiently through conducting concrete works during night time.

[9] Basic Design Report on the Project for Rehabilitation and Improvement of Sakoula Regulator on Bahr Yusef Canal in the Arab Republic of Egypt (2003) P.3-110

[10] Calculated as multiplying 5.08 million LE of the total cost by the average exchange rate of 1LE=18.65 yen (the average exchange rate of the period of 2004/6/10-2006/6/11).

[11] Basic Design Report on the Project for Rehabilitation and Improvement of Sakoula Regulator on Bahr Yusef Canal in the Arab Republic of Egypt (2003) P.3-99

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

3.3 Effectiveness[12] (Rating: ②)

3.3.1 Quantitative Effects

3.3.1.1 Irrigation Water Intake in the Gravity Irrigation Area

Figure 2 below shows the conceptual diagram of the area benefited by the project.

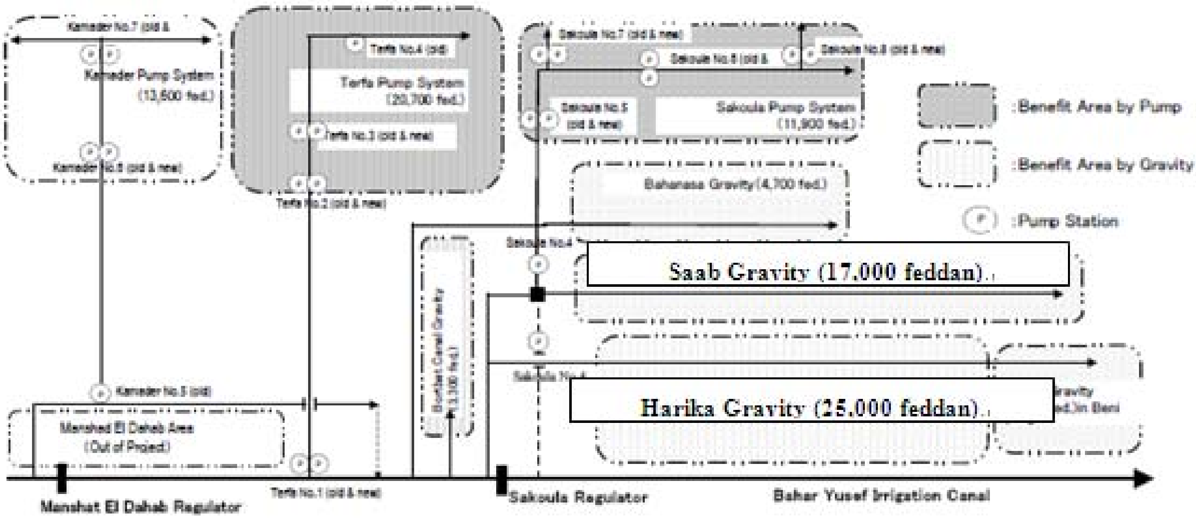


Figure 2: Conceptual Diagram of the Benefited Area

Source: Basic Design Study Report

As mentioned earlier, the area covered by this project is comprised of the gravity irrigation area and the pump irrigation area, and the former was faced with water shortage at the time of the basic design study, particularly in the areas benefited from the Harika and Saab Canals indicated above. The table below shows baseline data at the time of the basic design study (2003) and target figures after the completion of the project of the amount of water required, the actual water intake, and water deficit in the gravity irrigation area.

[12] The rating of the project's effectiveness takes into account the evaluation of the project's impact.

Table 3: Baseline Data (2003) and Target Figures (2007) of the Amount of Water Required and the Actual Water Intake in the Gravity Irrigation Area

Indicator	Before Project (2003, baseline)			After Project (2007, target)
	Summer Cropping (May - September)	Winter Cropping (October - April)	Total	
Amount of Water Required (thousand m^3)	120,176	78,103	198,279	198,279
Amount of Water Taken (thousand m^3)	114,536	74,588	189,124	198,279 (4.8% increase)
Deficit (thousand m^3)	－5,640	－3,515	－9,155	0

Source: Basic Design Study Report
Note: The table above indicates the amount of water required and actually taken into the major branch canals (Harika, Saab and Bahanasa: the area covered is approximately 46,700 feddan) in the gravity irrigation area shown in the Figure 2.

The objective of the project was to solve the water deficit indicated above by renewing the severely deteriorated Sakoula Regulator and introducing an overflow type gate that enables easier control of water level and flow volume. The table below shows actual figures after the completion of the project (2007 and 2010) of the amount of water required, the actual water intake, and balance in the gravity irrigation area. While data on the actual cultivated area by major crops in each month for the whole year in 2007 and 2010 was requested to the executing agency in order to calculate the amount of water required after the project completion, figures for each month were not available. Thus, the amount of water required was calculated using the rate (percentage) of cultivated area in each month at the time of the basic design study[13]. Therefore, the amount of water required indicated below is the approximate value.

Table 4: Actual Figures after the Project (2007 and 2010) of the Amount of Water Required and the Actual Water Intake in the Gravity Irrigation Area

Indicator	After Project (2007, actual)			After Project (2010, actual)		
	Summer Cropping (May - September)	Winter Cropping (October - April)	Total	Summer Cropping (May - September)	Winter Cropping (October - April)	Total
Amount of Water Required (thousand m^3)	130,344	92,089	222,433	122,934	100,015	222,949
Amount of Water Taken (thousand m^3)	142,516	130,994	273,510	146,844	134,954	281,798
Balance (thousand m^3)	＋12,172	＋38,905	＋51,077	＋23,910	＋34,939	＋58,849

[13] For example, as for wheat, which is winter crop, the total cultivated area was 20,000 feddan and it was cultivated 100% during January to March, 90% in April, 50% in May and November, 90% in December at the time of the basic design study (2003). The cultivated area by types of crops in each month after the project was calculated using the rate (percentage) above, and then the amount of water required after the project was calculated based on the cultivated area. Moreover, in calculating the amount of water required, the amount of water consumption for each type of crop which was standardized in the "Utilization of Water Resources and Basic Development Plan 1980" was used at the time of the basic design study. As the executing agency confirmed that the same standard is currently used in calculating the amount of water required, the same standard was used in the ex-post evaluation. Furthermore, the irrigation efficiency was taken as 60.5% which is the same as at the time of the basic design study.

Source: Cultivated area by major crops and amount of water taken: provided by the executing agency
Note: The table above indicates the amount of water required and actually taken into all branch canals (the area covered is approximately 50,000 feddan) in the gravity irrigation area shown in the Figure 2.

The amount of water required shown above might have a margin of error, as the figures are the approximate value as explained above. However, the table above suggests that deficit of water has more or less been solved in the gravity irrigation area after the project implementation. On the other hand, an analysis of the amount of water shown above by each month reveals that deficit of water is still seen in July when the amount of water required is the largest. The tables below show actual figures of the amount of water required, the actual water intake, and balance in each month in the gravity irrigation area.

Table 5: Actual Figures after the Project (2007) of the Amount of Water Required and the Actual Water Intake in Each Month in the Gravity Irrigation Area

Indicator	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Amount of Water Required (thousand m^3)	16,155	21,798	22,591	19,877	30,314	39,982	28,345	11,827	9,243	9,636	12,665
Amount of Water Taken (thousand m^3)	19,247	23,622	24,599	24,562	29,713	31,114	31,437	25,691	24,035	22,466	17,027
Balance (thousand m^3)	+3,092	+1,824	+2,008	+4,685	-601	-8,868	+3,092	+13,864	+14,792	+12,830	+4,362

Source: Cultivated area by major crops and amount of water taken: provided by the executing agency
Note: January was not included in calculating the amount of water required at the time of the basic design study, as water is stopped for 20 days and dredging of the Bahr Yusef Canal and repair and maintenance of irrigation facilities are carried out in January. Thus, January is not included in calculating the amount of water required in the ex-post evaluation study.

Table 6: Actual Figures after the Project (2010) of the Amount of Water Required and the Actual Water Intake in Each Month in the Gravity Irrigation Area

Indicator	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Amount of Water Required (thousand m^3)	17,546	25,875	24,835	17,289	27,006	36,653	28,493	13,493	10,825	8,696	12,238
Amount of Water Taken (thousand m^3)	20,048	26,435	24,560	27,447	30,509	31,863	31,948	25,077	25,370	21,549	16,994
Balance (thousand m^3)	+2,502	+560	-275	+10,158	+3,503	-4,790	+3,455	+11,584	+14,545	+12,853	+4,756

Source: Cultivated area by major crops and amount of water taken: provided by the executing agency
Note: January was not included in calculating the amount of water required at the time of the basic design study,

as water is stopped for 20 days and dredging of the Bahr Yusef Canal and repair and maintenance of irrigation facilities are carried out in January. Thus, January is not included in calculating the amount of water required in the ex-post evaluation study.

According to the tables above, approximately 20% of the amount required is in deficit in July 2007 and approximately 10% of the amount required is in deficit in July 2010. The ratio of the amount of water deficit to the amount of water required in July at the time of the basic design study was 11.5%[14], and looking at the amount of water in July alone reveals that the same level of water deficit is still seen in July after the project completion and careful water flow management is required in July when the amount of water required is the largest in a year.

3.3.2 Qualitative Effects

A beneficiary survey was conducted in order to evaluate the project qualitatively[15]. The overview of the survey results is presented below.

In the gravity irrigation area, approximately 80% of respondents replied that the amount of irrigation water supplied was decreased after the project and approximately 20% replied that there is no difference in the amount of irrigation water supplied before and after the project. According to the executing agency and consultants who were involved in the study for rehabilitation of the Dirout group of regulators[16] conducted by JICA in 2010, farmers generally tend to claim that irrigation water is not supplied sufficiently in Egypt where the amount of water resources is very limited, however, short interviews were conducted with beneficiaries regarding the situation of water shortage for summer and winter cropping at upstream, midstream and downstream of branch canals in order to understand the situation in detail. The results are shown below.

[14] Basic Design Report on the Project for Rehabilitation and Improvement of Sakoula Regulator on Bahr Yusef Canal in the Arab Republic of Egypt (2003) P.4-1

[15] The beneficiary survey was conducted in a following manner. Time: June, 2011, place: the area benefited from the Sakoula Regulator, the number of samples (valid responses): 111 in total in the gravity irrigation area (66 in total of the Harika gravity area (22 in upstream, 22 in midstream and 22 in downstream of the canal) and 45 in total of the Saab gravity area (15 in upstream, 15 in midstream and 15 in downstream of the canal)), sampling method: random sampling by selecting equal numbers from upstream, midstream and downstream of branch canals according to the area benefited from the canals, survey method: questionnaire survey.

[16] The area benefited from the Dirout group of regulators includes the area benefited from the Bahr Yusef Canal where the Sakoula Regulator is located.

Table 7: The Current Amount of Irrigation Water Supplied for Summer Cropping

(Unit: %)

Area	No water shortage at all	Rarely have water shortage	Sometimes have water shortage, but not the level that affects growing crops	Frequently have water shortage, which affects growing crops to some extent	Frequently have water shortage, which seriously affects growing crops
Harika Upstream	0.0	0.0	4.6	63.6	31.8
Harika Midstream	0.0	0.0	31.8	54.6	13.6
Harika Downstream	0.0	0.0	0.0	0.0	100.0
Saab Upstream	0.0	0.0	13.3	80.0	6.7
Saab Midstream	0.0	0.0	13.3	13.3	73.3
Saab Downstream	0.0	0.0	0.0	0.0	100.0

Table 8: The Current Amount of Irrigation Water Supplied for Winter Cropping

(Unit: %)

Area	No water shortage at all	Rarely have water shortage	Sometimes have water shortage, but not the level that affects growing crops	Frequently have water shortage, which affects growing crops to some extent	Frequently have water shortage, which seriously affects growing crops
Harika Upstream	0.0	72.7	18.2	9.1	0
Harika Midstream	0.0	36.4	27.3	31.8	4.5
Harika Downstream	0.0	4.5	0.0	27.3	68.2
Saab Upstream	0.0	6.7	20.0	60.0	13.3
Saab Midstream	0.0	6.7	6.7	40.0	46.7
Saab Downstream	0.0	0.0	6.7	26.7	66.7

As shown above, water shortage is particularly serious in summer cropping and the tendency is stronger at downstream of branch canals. Many beneficiaries who replied that they face water shortage use groundwater by digging a well themselves in order to compensate for water deficit. Water shortage for summer cropping seems to be attributable to some extent to the fact that the amount of water intake is in deficit in July when the amount of water required is the largest in a year, as shown in the Tables 5 and 6. On the other hand, the major reason for the water shortage in the benefited area (particularly at downstream of branch canals) despite the fact that the amount of water intake from the Sakoula Regulator has increased overall after the project is considered that there are problems in small irrigation facilities including branch canals such as deterioration and lack of proper maintenance. According to the study report of rehabilitation of the Dirout group of regulators submitted in 2010, which was mentioned above, among 128 sites of small structures (intake weirs, regulators, aqueducts and culverts etc) which were taken as samples from 2,000 – 3,000 sites of those structures within the benefited area subject to the study, 103 sites were identified as in need of rehabilitation and renewal within 5 years. In the Minia governorate, where the project was implemented, 54 sites of small structures were identified as in need of rehabilitation and renewal within 5 years. Moreover, according to those involved in the Dirout study, garbages tend to be dumped and left in branch and end canals and these garbages are piled up at the front of gate facilities and block water flow. Many cases were reported that the water level of canals (many of them are earth canals) was dropped by digging out garbages piled up in branch and end canals periodically, which made water intake from the canals difficult.

Moreover, the Dirout study investigated the annual water flow from major regulators on the Bahr Yusef Canal from 1999 to 2009 and revealed that there is no major difference in the amount of water flow from the Sakoula Regulator before and after the project that is likely to cause serious water shortage in the benefited area. Taking into account the overall increase of the actual water intake in the gravity irrigation area as shown in Table 4 as well as the finding of the Dirout study, water shortage in the benefited area (particularly at downstream of branch canals) revealed in the beneficiary survey seems to be largely attributable to deteriorated small structures etc. Deterioration of the small structures was not pointed out in the basic design study, nor was included in the scope of the project, however, the objective of the project was to solve water shortage in the benefited area, and it cannot be said that the project objective has been completely achieved.

In light of the increasing tendency of the actual water intake in the gravity irrigation area, this project has somewhat achieved its objectives, therefore its effectiveness is fair.

3.4 Impact

3.4.1 Intended Impacts

3.4.1.1 Volume of Agricultural Production and Yield per Unit Area in the Gravity Irrigation Area

In the basic design study, an increase of the volume of agricultural production and yield per unit area through an increase of irrigation water intake to the benefited area was expected as indirect effects of this project. Data on production volume of major agricultural crops, yield per unit area and agricultural income in the area benefited from the Sakoula Regulator after the project implementation was requested to the executing agency, however, reliable data was not provided. Therefore, a quantitative analysis of the indirect effects is not possible, and evaluation of the indirect effects is conducted qualitatively utilizing beneficiary survey data etc. The tables below show the results of the beneficiary survey.

Table 9: Changes of the Volume of Agricultural Production after the Project

(Unit: %)

Area	Increased	Decreased	Unchanged
Harika Upstream	31.8	13.6	54.6
Harika Midstream	4.6	31.8	63.6
Harika Downstream	0.0	59.1	40.9
Saab Upstream	20.0	0.0	80.0
Saab Midstream	6.7	33.3	60.0
Saab Downstream	0.0	60.0	40.0

Table 10: Changes of Yield per Unit Area after the Project

(Unit: %)

Area	Increased	Decreased	Unchanged	Unanswered
Harika Upstream	45.5	13.6	40.9	0.0
Harika Midstream	4.6	9.1	63.6	22.7
Harika Downstream	0.0	45.5	36.4	18.2
Saab Upstream	20.0	0.0	73.3	6.7
Saab Midstream	13.3	13.3	66.7	6.7
Saab Downstream	0.0	60.0	20.0	20.0

Results regarding the volume of agricultural production and yield per unit area turned out to be different in different areas. Approximately 20% to 40% of respondents at upstream of branch canals replied that agricultural production volume and yield per unit area have increased, on the other hand, there is a tendency that more respondents (approximately 40% to 60%) at downstream of branch canals replied that these have decreased (some of them replied that they stopped summer cropping due to water shortage). As there are many factors influencing agricultural productivity apart from the amount of irrigation water such as types and qualities of seeds and fertilizers used etc, and thus it cannot be said that the above is the result brought by the project only. However, as explained in 3.3.2, the decrease of agricultural production at downstream of branch canals seems to be affected by water shortage due largely to deteriorated small structures etc.

3.4.1.2 Irrigation Improvement Project (IIP)

At the time of the basic design study, the Irrigation Improvement Project (IIP), which was promoted by the Egyptian government with assistance from the World Bank, was expected to be implemented in the area targeted by this project (the area benefited from the Sakoula Regulator) for the purpose of increasing agricultural productivity and agricultural income. IIP is a project which rehabilitates severely deteriorated end canals called Mesqa and promotes formulation of water users associations that are responsible for operation and maintenance (O&M) of irrigation facilities. Before IIP was started, there was no water users association and farmers took water from irrigation canals to their farm land directly and individually, which prevented appropriate and equal distribution of limited amount of water resources. At the time of ex-post evaluation, IIP is implemented in the area under the jurisdiction of the East Bahr Yusef Inspectorate Office, which is under the West Minia Irrigation Directorate responsible for O&M of the facilities provided by the project (the project of the Sakoula Regulator), however, IIP has not been implemented in the area (the area benefited from the Sakoula Regulator) under the jurisdiction of the West Bahr Yusef Inspectorate Office, nor has water users association been formulated yet. Earlier implementation of IIP in the area benefited from the Sakoula Regulator is desired for equal distribution of limited amount of water resources and appropriate O&M of irrigation facilities such as end canals.

3.4.2 Other Impacts

3.4.2.1 Impacts on the Natural Environment

At the time of the basic design study, in Egypt, Environmental Impact Assessment (EIA) was conducted for only projects which are large-scale, involve land acquisition and resettlement, and are more likely to have serious impacts on the natural environment, and EIA was not implemented for projects which are small-scale and more likely not to have serious impacts on the natural environment. EIA was not required for this project, as the project scope is rehabilitation of irrigation facilities, which is less likely to have serious impacts on the natural environment. According to the executing agency, results of environmental monitoring during construction were not required to be reported to JICA. According to both the executing agency and the result of the beneficiary survey, no negative environmental impact was seen related to this project.

3.4.2.2 Land Acquisition and Resettlement

Neither land acquisition nor resettlement was required in this project.

3.4.2.3 Other Benefits to Residents

At the time of the basic design study, the width of the existing bridge attached to the Sakoula Regulator was as narrow as 4 m and the bridge was overcrowded, as vehicles had to follow one way traffic only to cross the bridge and there was always a large flow of people. In the beneficiary survey, some respondents raised savings of travelling time and an improvement of the situation regarding distribution of goods in the area through rehabilitation of the attached bridge as indirect effects of the project.

As a result of the project implementation, an increase of agricultural production was seen in part of the upstream of branch canals in the gravity irrigation area and some other positive impacts were seen such as an increase of the level of convenience for local residents through rehabilitation of the attached bridge etc. On the other hand, a decrease of agricultural production was seen particularly at downstream of branch canals, which seems to be affected by water shortage due largely to deteriorated small structures etc, as explained in 3.3.2, and therefore, impact of the project is fair.

3.5 Sustainability (Rating: ②)

3.5.1 Structural Aspects of Operation and Maintenance

The West Minia Irrigation Directorate under the Ministry of Water Resources and Irrigation is responsible for O&M of the Sakoula Regulator renewed by the project, the West Bahr Yusef Inspectorate Office is in charge of O&M of the regulator, and the Edwa Irrigation Office actually conducts O&M of the regulator (the Edwa Irrigation Office carries out daily, monthly, annual inspection and long-term repair of the Sakoula Regulator). The table below shows the comparison of the number of staff in charge of O&M at the time of the basic design study and ex-post evaluation.

Table 11: The Number of Staff in Related Organizations and O&M Staff of the Sakoula Regulator

(Unit: persons)

Organization	2003	2010
West Bahr Yusef Inspectorate Office	53	451
Edwa Irrigation Office	109	67
Of which staff who operate and maintain the Sakoula Regulator	8	6

Source: 2003: basic design study report, 2010: answer to questionnaire

According to the West Minia Irrigation Directorate, there has not been a major change in the number of staff who directly operates and maintains the Sakoula Regulator before and after the project and sufficient number of staff is assigned. As explained below, the Sakoula Regulator was visited during the field study of ex-post evaluation, and no major problem was seen regarding the condition of regulator. Thus, no major problem has been observed in the structure of O&M.

3.5.2 Technical Aspects of Operation and Maintenance

The number of engineers such as irrigation engineers and mechanical engineers is 36 in the West Minia Irrigation Directorate as a whole, and the number of university graduates is 8 and the number of special secondary school (upper-intermediate) graduates is 33 in the West Bahr Yusef Inspectorate Office, and no major problem is seen in terms of the number of engineers.

Technical training on O&M of the regulator was provided to O&M staff of the Sakoula Regulator in 2005 by the O&M agency of the Mazoura Regulator, which was also renewed with Japan's grant aid. Moreover, OJT on O&M of the regulator was conducted by the contractors when the Sakoula Regulator was handed over, and O&M is carried out based on O&M manuals provided by the contractors. According to the West Minia Irrigation Directorate, an integrated water flow management is carried out among the Lahoun, Mazoura, Sakoula and Dahab Regulators that have already been renewed, however, as explained below, an underflow operation, which is different from the operation assumed at the time of the basic design study, is carried out in all of these regulators from June to August. According to the consultants who were engaged in this project, experts were dispatched from Japan three times during and after the project and technical guidance on the overflow operation of the regulator gate was provided. However, as explained below, the overflow operation is not carried out only in summer in order to avoid excessive water intake at upstream of the Bahr Yusef Canal by the overflow operation in summer, while the overflow operation was expected for throughout a year at the time of the basic design study.

3.5.3 Financial Aspects of Operation and Maintenance

At the time of the basic design study, the annual O&M cost of the Sakoula Regulator after renewal was estimated as 76,900LE (1,920 thousand yen), and it was judged feasible to secure the budget based on the O&M cost of the West Bahr Yusef Inspectorate Office in the past five years[17]. At the time of ex-post evaluation, according to the West Minia Irrigation Directorate, O&M budget for irrigation facilities allocated to the Directorate is further allocated to the West Bahr Yusef Inspectorate Office, the East Bahr Yusef Inspectorate Office and the West Samalot Inspectorate Office according to the amount required annually. The actual budget allocation within the West Minia Irrigation Directorate is unknown, as such data was not provided. The tables below show the actual amount of budget allocated to the West Minia Irrigation Directorate and the actual O&M cost of the Sakoula Regulator in the recent three years.

Table 12: Actual Amount of Budget Allocated to the West Minia Irrigation Directorate

(Unit: LE)

	2008	2009	2010
Amount	6,705,710	4,451,600	5,094,700

Source: answer to questionnaire

Table 13: Actual O&M Cost of the Sakoula Regulator

(Unit: LE)

	2008	2009	2010
Labour Cost	3,000	3,500	4,000
Utilities	4,202	4,272	2,350
Maintenance cost (lubrication, fixing wires etc)	4,000	4,000	4,000
Total	11,202	11,772	10,350

Source: answer to questionnaire

The reason for the large reduction of the actual O&M cost of the Sakoula Regulator compared with the estimate at the time of the basic design study (76,900 LE (1,920 thousand yen)) is largely due to the reduction of the labour cost, and according to the West Minia Irrigation Directorate, the labour cost of the estimate seems to include all the employees of the Edwa Irrigation Office, and on the other hand, the labour cost of the actual O&M cost is calculated based on the number of staff actually operate and maintain the Sakoula Regulator. According to the Directorate, O&M cost of the Sakoula Regulator is allocated every year without any problems.

3.5.4 Current Status of Operation and Maintenance

According to the interview with the O&M staff of the regulator, cleaning of the regulator and motors and inspection of sensors are carried out for daily inspection, lubrication and inspection of

[17] Basic Design Report on the Project for Rehabilitation and Improvement of Sakoula Regulator on Bahr Yusef Canal in the Arab Republic of Egypt (2003) P.3-111

oiling devices are carried out once in two weeks, and inspection of mechanical parts and wires etc is carried out for annual inspection. Moreover, according to the O&M manual, an exchange of wires is required once in ten years. Small spare parts are procured when needed. No major problem was seen regarding the condition of the Sakoula Regulator when the regulator was visited during the field study of ex-post evaluation.

On the other hand, when the regulator was visited in June, an underflow operation was carried out at the Sakoula Regulator. According to the Water Distribution Department of the Ministry of Water Resources and Irrigation, the Ministry needs to distribute the limited amount of water resources of the Bahr Yusef Canal equally to the benefited area, and as the flow volume increases and the water level becomes higher on the canal from June to August, the overflow operation makes it easier for those at upstream of the canal to intake the amount of water more than actually needed, which is likely to cause water shortage at downstream of the canal, and thus the underflow operation is also carried out (apart from June to August, only the overflow operation is carried out). In short, the Ministry manages the regulators by combining both overflow and underflow operations as practical operation and management for the purpose of equal water distribution to the benefited area. It might be said that the Ministry carries out operations according to the current conditions of the locality, however, according to the consultants who were engaged in the project, the overflow operation is more desirable from the viewpoint of appropriate water intake management, as the control of water level and flow volume is easier by the overflow operation. Moreover, as shown in the Tables 5 and 6, the amount of water intake in the gravity irrigation area was in deficit in July, but on the other hand, the amount of water intake was much more than actually needed in other months. Furthermore, considering the fact that reliable data on the cultivated area by major crops and actual water intake in the pump irrigation area was not provided by the executing agency, it cannot be said that appropriate management of the amount of water required and actually taken is carried out in the benefited area. A system of an integrated water management on the Bahr Yusef Canal is necessary to carry out water flow management on a real time basis.

Some problems have been observed in terms of operation of the regulator and water flow management, therefore sustainability of the project effect is fair.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

Relevance of this project is high, as the project is consistent with priority areas of Egypt's development plans and Japan's ODA policy, and moreover development needs for the project are high. Efficiency of the project is high, as both project cost and period were within the plan. Effectiveness of the project is fair, as on the one hand the project more or less achieved targets in a major operation and effect indicator, which is the amount of water intake from the Sakoula Regulator to the gravity irrigation area, but on the other hand, the amount of water intake from the Sakoula Regulator is still in deficit in July and water shortage has not been solved yet in the benefited area (especially at downstream of branch canals) largely due to deteriorated small water structures etc. Sustainability of the project is fair, as some problems have been observed in terms of operation of the regulator and water flow management, while no major problems have been observed in the O&M system and financial status.

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

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

(1) As explained in 3.3.2, there is a tendency that the benefited area (particularly at downstream of branch canals) still faces serious water shortage especially in summer, despite the fact that the amount of water intake from the Sakoula Regulator to the gravity irrigation area has increased overall after the project. This is considered largely due to problems in small irrigation facilities including branch canals as well as the deficit of water intake from the Sakoula Regulator in July as explained earlier, and investigation, rehabilitation and renewal of these small irrigation facilities would be necessary, as these are one of the factors that affect achievement of the project objective, although these were not included in the project scope.

(2) As explained in 3.4.1.2, IIP has not been implemented in the area targeted by the project, nor has water users associations been established in the area. Earlier implementation of IIP in the area is desired for equal distribution of limited amount of water resources and appropriate O&M of irrigation facilities such as end canals.

(3) As explained in 3.5.4, it cannot be said that appropriate management of the amount of water required and the amount of water actually taken is carried out in the benefited area. Properly understanding the amount of water required in the benefited area based on the current cultivated area by major crops and distributing water based on the water requirement are necessary.

4.2.2 Recommendations to JICA

As explained earlier, rehabilitation of small irrigation facilities including branch canals was not included in the project scope, however, rehabilitation and renewal of these facilities and establishment of a system of an integrated water management to carry out water flow management on a real time basis at major water intake facilities are important factors that affect achievement of the project objective. While self-reliant efforts of the executing agency are necessary, it would be beneficial to provide financial and/or technical assistance for the parts that cannot be completed by the executing agency.

4.3 Lessons Learned

(1) In the basic design study, to solve water shortage in the benefited area was stated as the project objective, and it was judged that there was no major problem regarding small irrigation facilities that are one of the factors affecting the achievement of the project objective. At the time of ex-post

evaluation, on the one hand, there seems to be no major problem in the amount of water intake from the Sakoula Regulator except for July, however, on the other hand, the benefited area still faces water shortage particularly at downstream of branch canals due largely to deterioration of small water structures etc. When implementing a project that has a similar objective in the future, it would be desirable to conduct a detailed investigation of factors that affect the achievement of the project objective in advance including small irrigation facilities.

(2) Considering the fact that a grant aid is generally provided for projects that have urgent needs in a short period, it would have been difficult to rehabilitate and renew a large number of small irrigation facilities as well as renewal of the Sakoula Regulator in this project. When implementing a similar project in the future, it might be beneficial to implement parts of the project that have urgent needs with a grant aid and to implement parts of the project that require a relatively long time with other schemes such as loan.