BASIC DESIGN STUDY REPORT
ON
THE PROJECT
FOR
REHABILITATION AND IMPROVEMENT
OF
SAKOULA REGULATOR
ON
BAHR YUSEF CANAL
IN
THE ARAB REPUBLIC OF EGYPT

AUGUST 2003

JAPAN INTERNATIONAL COOPERATION AGENCY
SANYU CONSULTANTS INC.

Preface

In response to a request from the Government of the Arab Republic of Egypt, the Government of Japan decided to conduct a basic design study on the Project for Rehabilitation and Improvement of Sakoula Regulator on Bahr Yusef Canal and entrusted the study to the Japan International Cooperation Agency (JICA)

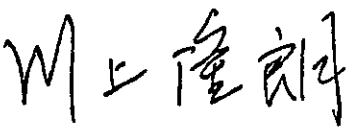
JICA sent to Egypt a study team from February 16th to March 22nd, 2003

The team held discussion with the officials concerned of the Government of Egypt, and conducted a field study at the study area After the team returned to Japan, further studies were made Then, a mission was sent to Egypt in order to discuss a draft basic design, and as this result, the present report was finalized

I hope that this report will contribute to the promotion of the project to the enhancement of friendly relations between our two countries

I wish to express my sincere appreciation to the officials concerned of the Government of the Arab Republic of Egypt for their close cooperation extended to the teams

August 2003



Takao Kawakami
President
Japan International Cooperation Agency

August 2003

Letter of Transmittal

We are pleased to submit to you the basic design study report on the Project for Rehabilitation and Improvement of Sakoula Regulator on Bahr Yusef Canal in the Arab Republic of Egypt

This study was conducted by Sanyu Consultants Inc , under a contract to JICA, during the period from January to August 2003 In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Egypt and formulated the most appropriate basic design for the project under Japan's grant aid scheme

Finally, we hope that this report will contribute to further promotion of the project

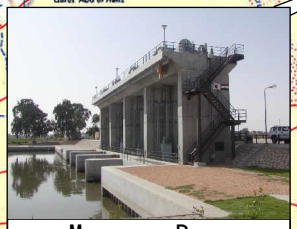
Very truly yours,

津村 和光

Kazumitsu Tsumura
Project manager,
Basic Design Study Team on the Project for Rehabilitation and Improvement of Sakoula Regulator on Bahr Yusef Canal
Sanyu Consultants Inc

LOCATION MAP

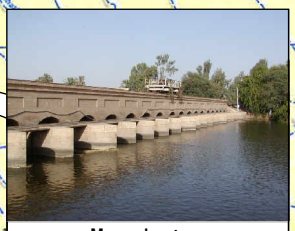
Lahoun Reg.
(Rehabilitated in 1997)



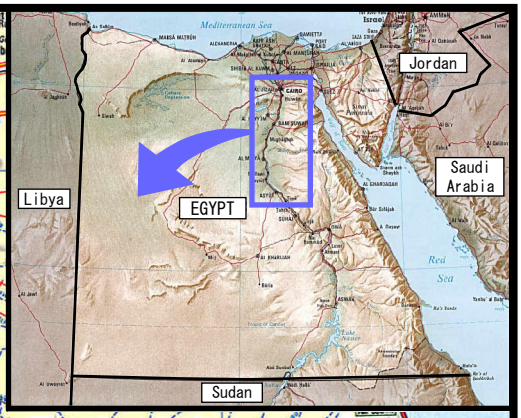
Mazoura Reg.
(Rehabilitated in 2002)

Dairout Reg.

Sakoula Reg.
(Requested Japanese Assistance)



Manshat
El Dahab Reg.



Cairo

Giza

Faiyum

Beni Suef IDir.

Minia IDir.

Asiout Reg.

Lake Qarun

GEBEL EL GALÂLA EL BAHARIYA (NORTH GALALA PLATEAU)

GEBEL EL GALÂLA SOUTH GALALA EL QIBLIYA PLATEAU

Sahra esh Sharqiya Desert

N

LEGEND
- Bahr Yussef Canal
- Regulators
- ID Directorates (IDir.)

0 10 20 30 40 50 60 70 80 km
0 10 20 30 40 50 miles

Perspective

SUMMARY

As result of the construction of Aswan High dam completed in 1970, surrounding countries along the Nile River including Egypt have continuously developed water resources. However, since 1983, it has been enmeshed in difficulties to develop water resources further in Nile River caused by the internal trouble in Sudan. Thereby, available water resources for Egypt, whose annual rainfall is only about 5mm, are only 55.5 billions m^3 per year as acquired by the Nile Agreement, potential ground water and recycle water. Under such circumstances, the serious shortage of water resources is predicted in Egypt from 2020 onward.

Total population of Egypt is about 69 millions as of 2001 and it increased 12 millions in the last 10 years. Self-sufficient rate of wheat, the staple food, is only 50% and they depend on import. Due to the difficulty to increase agricultural food production to keep balance with the rapid population growth within the limited water resources and limited cultivated land which is about 4 % of all national land, the government of Egypt is concerned to increase unit crop yield and cropping intensity (vertical expansion) in existing cultivated land as an important agricultural policy, as well as to develop a new available land (horizontal expansion). Accordingly, it has been the important issue to raise the efficiency of water use and stable supply of necessary quantity of water through comprehensive water management at all levels by introducing advanced techniques.

Based on the above mentioned background, Ministry of Water Resources and Irrigation (MWRI) of Egypt intends to improve agricultural productivity and increase farmer's income by replacing over-aged regulators and irrigation facilities to modern systems enable to contribute to effective use of water resources and can ensure the balance between demand and supply of food products.

By the request of the Government of Egypt, the Government of Japan has supported the development of Bahr Yusef Irrigation Canal since 1990 and carried out a development study titled "Feasibility Study for Rehabilitation and Improvement of Delivery Water System on Bahar Yusef Canal" in 1992 for the whole irrigation canal system. Based on the study, the government of Egypt requested Japan's Grant Aid Scheme for the rehabilitation of the Lahoun Regulator. Accordingly, "The Project for Rehabilitation and Improvement of Bahr Yusef Canal" was implemented in 1997. In succession, "The Project for Rehabilitation and Improvement for Mazoura Regulator of Bahr Yusef Canal" located at the upstream of the Lahoun Regulator was taken up and completed in 2002.

This Grant Aid Scheme was requested by the government of Egypt to practice appropriate water management and ensure stable supply of irrigation water to beneficial area by replacing decrepit Sakoula Regulator located in the Bahr Yusef Irrigation Canal and introducing overflow-type gate to regulate the water level and flow rate efficiently.

Contents of the request are as follows;

- Replacement the decrepit brick regulating body
- Change the manually-operated gates to electric-driven steel gates
- Construction of a control house to accommodate equipment that receives water control information
- Construction of maintenance bridge

Responding to the request, Japan International Cooperation Agency (JICA) dispatched a team for Basic Design Study from February to March in 2003. The Team discussed with related agencies of Egypt, confirmed the contents of the request, and carried out field investigation for Sakoula Regulator of Bahr Yusef Irrigation Canal, farming conditions of beneficial area and present condition of organization of operation and maintenance and so on. As the result of study, existing Sakoula Regulator was considered to be improved immediately. Because of its decrepit condition, makes the water supply for beneficial area from the upstream of the regulator unstable. The Team prepared the basic design of the project in Japan, and visited Egypt in June 2003 for explaining the outlines of the basic design and confirming contents of the project. Contents of the Project are as follows;

Replacement of Body of Existing Sakola Regulator and Gates:

For the purpose of stopping leakage from the Sakoula Regulator through the body and gates, the Regulator shall be reconstructed with electric powered driven overflow-type gates. This type makes delicate-regulation of water level at upstream possible and flow-rate control at the Regulator smooth and easy by available correspondence between small and large discharges better than underflow-type in order to stable the water level at upstream of the Regulator. Japan's Grant Aid Scheme, therefore, offers funds for supplying irrigation water to the beneficial area stably by replacing over-aged existing Sakoula Regulator to modern regulator with electric powered driven overflow-type gates.

Control House:

To regulate water level and flow-rate accurately by the mentioned overflow-type gates, maintenance equipment and facilities such as gate control panel, electric facilities and emergency generator are necessary. Also, storage facility to protect these from bad weather like sand storms shall be provided. To maintenance the regulator body, gate and the above equipments, an operation and maintenance office that can correct operation data shall be installed. Furthermore, a water management office that plays a sub-system of flow-rate control management and unitary water management system in the whole Bahr Yusef Irrigation Canal in future and the place for training of technology transfer is required. By the above reason, a control house shall be constructed.

Maintenance Bridge:

Sakoula Regulator is located at the center of Sakoula town in Minia governorate and about 180 km south from Cairo. The Sakoula town and vicinity area are scattered along both side of Bahr Yusef Irrigation Canal. The maintenance bridge of Sakoula Regulator lies in the center of the flow of local people and agricultural products, and it plays an important role in the daily local traffic. Based on the investigation of traffic at the Basic Design Study, the wheel traffic, which is related with the distribution including the crops, such as trucks, small trucks, tractors and carriages are about 1,100 cars/day. Moreover, the comings and goings including motorbikes and bicycles are about 9,500 people/day. And, an open market is hold around Sakoula Regulator every Sunday, the existing bridge is very crowed whole the day by people and wheels from the outskirts. Thus, maintenance bridge plays an important role for not only the distribution and comings and goings but the daily transportation.

However, the width of existing maintenance bridge is only 4 m and vehicles have to follow one way traffic only, and it is crowded with both vehicles and passersby. The type of the bridge is a brick arch structure, surface brick is broken off and large vehicles are prohibited to pass according to load limit. Therefore, this maintenance bridge is planned to be improved to suit present condition of traffic and transportation of agricultural products and to contribute

to improvement of the circumstances of flow to the market in the beneficial area of the Project.

The contents and scale of Sakoula Regulator and related facilities to be improved, which were decided in the basic design, are as follows;

Outline of Replacement of Sakoula Regulator

1. Design discharge / Design water level	・Max. discharge: 193.64 m^3/sec ・Highest control water level (upstream): 33.70m ・Min. discharge: 39.76 m^3/sec ・Lowest control water level (downstream):30.28m
2. Regulator body	・Reinforced concrete
3. Gate drive system	・Electric wire rope winch ・Upper gate: 1.5kW, Lower gate: 5.5kW
4. Gate span	・Width 8.0m × height 5.8m × 4 spans ・Gate sill elevation: 28.0m
5. Gate type	・Overflow-type gate ・Slide type double leaf roller gate ・3 Edges with rubber seals at upstream ・Operation speed: more than 0.3m/min ・Height of upper leaf: 2.8m, Height of lower leaf: 3.0m
6. Apron	・Length of upstream apron: 6.0m ・Elevation of upstream apron surface: 27.55m ・Length of middle and downstream apron: 27.0m ・Elevation of downstream apron surface: 27.50m
7. Canal bed protection	・Concrete block ・Length of downstream protection: 44.0m, Width :38.0m
8. Closure dike	・Steel sheet pile type III and IV: L=9.0～12.5m ・Riprap slope protection: Total length 133.0m
9. Slope protection	・Steel sheet pile type III and IV: L=9.0～12.5m ・Riprap slope protection: Total length 157.0m
10. Maintenance bridge	・Reinforced concrete T-beam ・Length of bridge: 40.0m ・Design load: 60 ton ・One side single lane, Total width: 12.8m
11. Control house	・One-story, RC structure and block wall ・Floor area: 78.0 ㎡ ・Remote control room, Storage, Kitchen, Toilet, Emergency generator room, etc.
12. Control panel (Remote control/ Local control)	・Upper and lower gate operation button ・Accumulative release discharge meter ・Buzzer stop button ・Recorder for water level, gate opening & discharge ・Lump test button ・Emergency stop button ・Upper and lower gate opening indicator ・Local telecommunication ・Upstream and downstream water level gauge
13. Emergency generator	・50kVA, 380V/220V ・1 unit (1.3m × 2.63m × 1.0m)

It will take 5 months for detail design and 21 months for the construction of the Project. Total cost of the Project under the Japan's Grant Aid Scheme is estimated 2,411 million yen (2,133 million yen borne by Japan, 278 million yen borne by Egypt).

Implementation of this Project will improve Sakoula Regulator and stabilize the water supply to the beneficial area upstream of Sakoula Regulator. The direct effect that will be brought by the Project are to increase Irrigation Water Quantity in Gravity Irrigation Area. It is expected that shortage of water of 9,156,000 m^3 (5,639,000 m^3 for summer crops, 3,517,000 m^3 for winter crops) per year will be solved by stabilizing water level of upstream of Sakoula Regulator and discharging irrigation water to the beneficial area properly. And also following indirect effects are expected;

Increase of Unit Crop Yields and Agricultural Production in the Gravity Irrigation Area:

After improvement of Sakoula Regulator, the water shortage (shortage of 5,639,000 m^3 for summer crops, 3,517,000 m^3 for winter crops) will be solved and unit crop yields is expected to increase 2 to 11 % comparing to

present situation. And also agricultural production is estimated to increase 35,645 ton from 525,348 ton of present yield.

Improvement of Value of Agricultural Production:

As the Unit Crop Yields is increased in the Gravity Irrigation Area, the value of agricultural production is estimated to increase from present 292,749 thousand LE/year to 303,221 thousand LE/year in the whole beneficiary area and it equals to 3.6 % increase. Multiplying it into present average income of farmer 2,250 LE/year, income of farmer will improve to 2,330 LE/year after implementation of the Project.

Reduction of Excess Running of Pump and Cost of Maintenance in Pump Irrigation Area:

Due to unstable water level at the upstream of Sakoula Regulator in Bahr Yusef Canal, design intake water level of irrigation pump is not ensured and it causes shortage of pump water supply. Under such situation, required water has to be supplied by lengthening the running time of pump and frequently forcing the reserve pump to put in operation. Improving Sakoula Regulator, the water level of upstream of the Regulator will become stable and design intake water level will be ensured, and it is expected that running cost and maintenance cost of pump will be reduced.

Improvement of Agricultural Product Flow by Widening of Maintenance Bridge:

After rehabilitation, the width of the maintenance bridge will be widened to 12 m enabling dual lane traffic at the same time. Restrictions on heavy traffic of 60 ton will also be removed. Accordingly, rehabilitation of the maintenance bridge will be effective for the improvement of circumstances of agricultural product flow such as smooth delivery and mass transportation of agricultural product in the Project area.

Improvement of Sanitation:

Local people and cattle utilize the canal water for drinking and various purposes just at downstream of Sakoula Regulator. Water quality, however, is judged not suitable for potable based on the result of simplicity water quality test around the Regulator. Existing gates were very old and some were out of order, and workable gates have been operated in the manner of underflow release, which caused to remain carcass of cattle and garbage for long period and helped to out break of flies and mosquitoes causing unhygienic environment. These carcasses and garbage go rotten and make water quality worse. Therefore, improving the regulator with overflow-type gate, it is also expected to contribute to improvement of water quality and health.

While the Self-sufficient rate of wheat, the staple food in Egypt, is about 50 %, increase of food production corresponding to the population is pressing. Vertical expansion in agricultural policy is hold up in the national development plan to enhance the efficiency of water use and to supply the required water volume to farmlands stably by comprehensive water management is conducted. Under these circumstance, although the MWRI has been rehabilitating and reconstructing over-aged irrigations facilities gradually, regulating and intake facilities, which are over 100 years and having leakage problem, are still widely utilized, and this situation is disturbing vertical expansion in agricultural policy.

Bahr Yusef Irrigation Canal plays an important role of mainstay as agricultural facility in Egypt due that intake

water volume from Nile River to the Canal is occupied about 8% of Agreement among Nile River countries, and the command area irrigated by the Canal is 11% of whole cultivated farmland in Egypt. However, agricultural productivity is affected by situation, which the irrigation water supply to farmland is not stable due to over-aged intake facilities to branch canals such a Sakoula Regulator. It is expected that supplying stable water by the improvement of Sakoula Regulator will contribute growth of agricultural productivity in Egypt while Sakoula Regulator has 34,700 ha of command area with 97,000 households (about 536,000 people) of total beneficiary.

Government of Egypt has been requesting to European countries for supports of some studies and implementation of large-scale regulator along with Nile River. Meanwhile, irrigation facilities companying to main canal such a Bahr Yusef Canal requests to the government of Japan, then Lahoun and Mazoura Regulators were already reconstructed under Japan's Grant Aid Scheme. Accordingly, it is expected this Project has a validity with the above both Regulators.

After completion of this Project, West Minia Irrigation Directorate (IDir.) and West Bahr Yusef Inspectorate offices will carry out the operation and maintenance (O&M). According to the result of O&M by Beni Suef IDir. for other two Regulators already implemented by Japan's Grant Aid Scheme, appropriate O&M would be expected. Concerning O&M structure, it has no problem because of sufficient number of personnel and enough budget, and further through the discussion with the government of Egypt during the Basic Design Study, the implementing agency of Egypt confirmed to provide appropriate personnel arrangement and budget for O&M.

As mentioned the above, it is considered that there is a great necessity for this project and it is proper to implement the project through Japan's Grant Aid Scheme. Further, there is no negative influence to the environment by this project. While improving Sakoula Regulator, following subjects are proposed to be executed by the government of Egypt in order that the expected effect will be appeared more efficiently and sustained.

Extension of IIP:

Based on the results of projects of improvement of Mesqa implemented in ten(10) governorates by MWRI, it is expected that irrigation efficiency will be improved by introducing Mesqa improvement project in the beneficial area of Sakoula Regulator and further crop intensity and unit product yields will be improved. Furthermore, it is expected to expand irrigation area by utilizing excess water yielded from the improvement of irrigation efficiency. Therefore, prompt implementation of Mesqa improvement project for the beneficial area of Sakoula Regulator is anticipated.

Replacement of Pump Unit of Old Pumping Station:

Units of old pumping station in pump irrigation area of Sakoula Regulator constructed in 1960s' are feared to begin to deteriorate its function and to interfere the appropriate flow-rate, therefore timely replacement is expected. All of these pump units are decided to replace in 2004. MWRI is required to implement this replacement project without any fail.

Collaboration of Irrigation Directorates on Training on Gate Operation:

Operation and maintenance of Lahoun and Mazoura Regulators implemented under the Japan's Grant Aid Scheme

are maintained and operated by Beni Suef IDir. (Irrigation Directorate) and it is expected a short-term expert to be dispatched from Japan to Beni Suef IDir. for their further training on operation of gate, and improvement of gate operation skills and obtaining integrated water flow management skills for 2 regulators already implemented. While, West Minia IDir. will carry out O&M of Sakoula Regulator after implementation of the Project. It is essential for Beni Suef IDir. who has already experienced operation of 2 Regulators, to train the staff of West Minia IDir. for the operation of Sakoula Regulator.

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Abbreviations

Abbreviations

MWRI	Ministry of Water Resources and Irrigation
MFT	Ministry of Foreign Trade
ID	Irrigation Department
MED	Mechanical and Electrical Department
IIS	Irrigation Improvement Sector
IS	Irrigation Sector
Minia IIP	Minia Irrigation Improvement Project
Beni Suef IIP	Beni Suef Irrigation Improvement Project
IDir.	Irrigation Directorate
West Minia IDir.	West Minia Irrigation Directorate
Beni Suef IDir.	Beni Suef Irrigation Directorate
IIP	Irrigation Improvement Project
IAS	Irrigation Advisory Service
JICA	Japan International Cooperation Agency
O/M or O&M	Operation and Maintenance
WUA	Water User's Association
FAO	Food and Agricultural Organization
GDP	Gross Domestic Product

Units

cm	centimeter	℃	centigrade
cu.m	cubic meter	cms (m^3/sec)	cubic meter per second
fed.	feddan (= 0.42ha)	ha	hectare (=2.38 fed.)
hr	hour	kg	kilogram (=1,000 gram)
km	kilometer	km^2	square kilometer
lit.	liter	lit/sec	liter per second
m	meter	MCM	million cubic meter
mg/lit.	milligram per liter	meq/lit.	milliequivalent per liter
m/s	meter per second	ppm	parts per million
t	ton (1,000 kg)	%	percent
Aldap	Weight unit for agricultural products (differing by products) 1 ardap = wheat(150kg), beans(155kg), maize(140kg), sesame(120kg)		
Cantar	1 Cantar=Cotton(100kg)		

Currency

LE	Egyptian Pond
Pt	Egyptian Piaster (1 LE = 100 Pt)
Yen or J¥	Japanese Yen
US$	US Dollar

Exchange Rate （April 2003）

LE	= ¥ 24.95
LE	= US$4.88
US$	= ¥121.77

Glossary

Sakia	Water wheel to lift water by animal to field ditch from lateral canal
Mesqa	Small irrigation field canal constructed by the farmers themselves