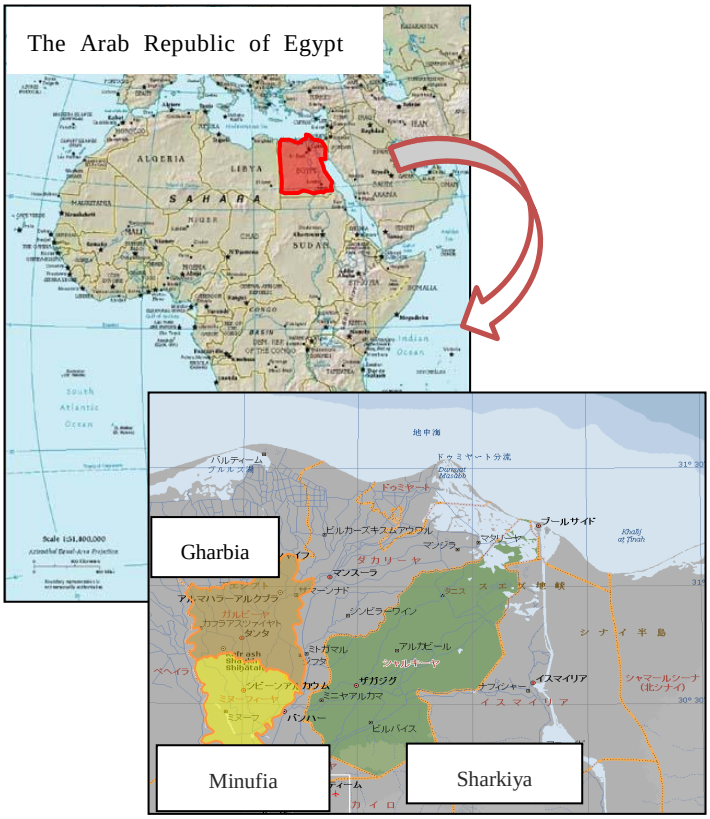
JICA Project Brief Note

THE PROJECT FOR IMPROVEMENT OF MANAGEMENT CAPACITY OF OPERATION AND MAINTENANCE FOR WATER SUPPLY FACILITIES IN NILE DELTA AREA, THE ARAB REPUBLIC OF EGYPT

— Challenges in the Nile Delta toward improved operation & maintenance —

April 2015



1. Background and Objective of the Project

Having made the construction of public water supply and wastewater systems as one of its priority goals, Egypt is striving to improve business management in the public water supply and wastewater sector. It has been converting agencies in this sector into public corporations since 2004, and currently the Holding Company for Water and Wastewater (HCWW) oversees the potable water and sanitation companies established in each governorate.

In line with the adoption of the public corporation model, the potable water and sanitation companies are required to achieve higher levels of efficiency. Based on this background, JICA implemented the Project for improvement of management capacity of operation and maintenance for Sharkiya potable water and sanitation company (2006~2009) (hereafter referred to as the previous project), entailing the formulation of the Standard Operation Procedure (SOP) for facilities and the capacity development for Non-Revenue Water (NRW) reduction. The effect of the project was confirmed in terms of higher efficiency. The nationwide dissemination of the technology, however, has been still an issue to be overcome.

HCWW developed a plan to transfer the know-how which learned in the previous project and expand similar improvement programs throughout the Nile Delta. This entails transferring the technology nurtured in Sharkiya potable water and sanitation company (SHAPWASCO) to the potable water supply and sanitation companies in neighboring Gharbia Governorate (GHAPWASCO) and

Minufia Governorate (MCWW). HCWW developed, further, another plan to improve skills of Water Distribution Management (WDM) in SHAPWASCO, and this is how they requested a technical cooperation to the Government of Japan.

2. Approach to Solve Problems

The Project consists of three components. The first one is called as SOP, which aims at improving operation and maintenance for GHAPWASCO and MCWW. The second one is the capacity development within the companies for NRW reduction. Technical transfer from SHAPWASCO is incorporated in those activities, as the skills of SHAPWASCO have been further developed for SOP and NRW since the previous project. JICA expert team, therefore, assisted them for realizing the inter-company cooperation. The third one is the improvement of WDM for SHAPWASCO. It aims at developing the management system to integrate water production and distribution controls.

Technologies and skills to be nurtured in the three companies should be disseminated / deployed in the whole Nile Delta. The human resources development and a system of inter-company cooperation are necessary.

【Super Goal】
Management capacity of operation and maintenance of water supply facilities is improved in Nile Delta Area.

【Overall Goal】
Management capacity of operation and maintenance of water supply facilities is improved in Sharkiya, Gharbia and Minufia Governorates.

【Project Purpose】
Management capacity of operation and maintenance of water supply facilities is improved at model areas/ facilities in Sharkiya, Gharbia and Minufia Governorates.

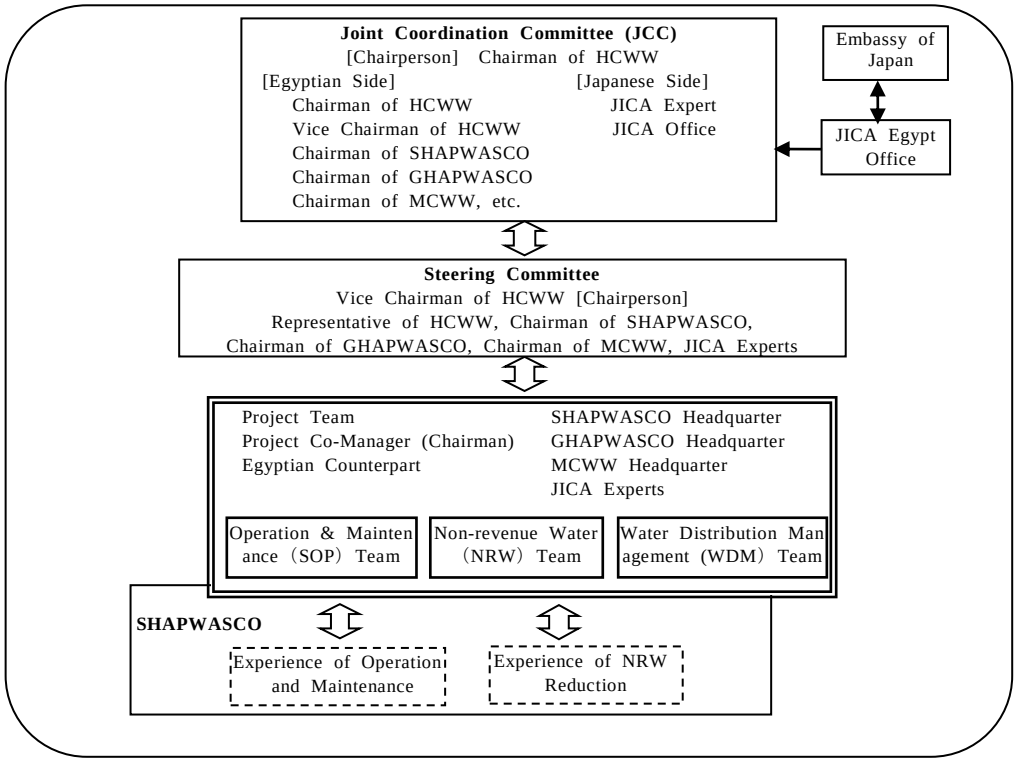
【Output-1】
Human Resource Development through collaboration among water supply companies in Sharkiya, Gharbia and Minufia Governorate is strengthened.

【Output-2】
Based on the experiences of SHAPWASCO, SOPs are developed and utilized at the model facilities in Gharbia and Minufia Governorates.

【Output-3】
The institutional skills and experiences of SHAPWASCO for NRW reduction are transferred to NRW teams at the model areas in Gharbia and Minufia Governorates.

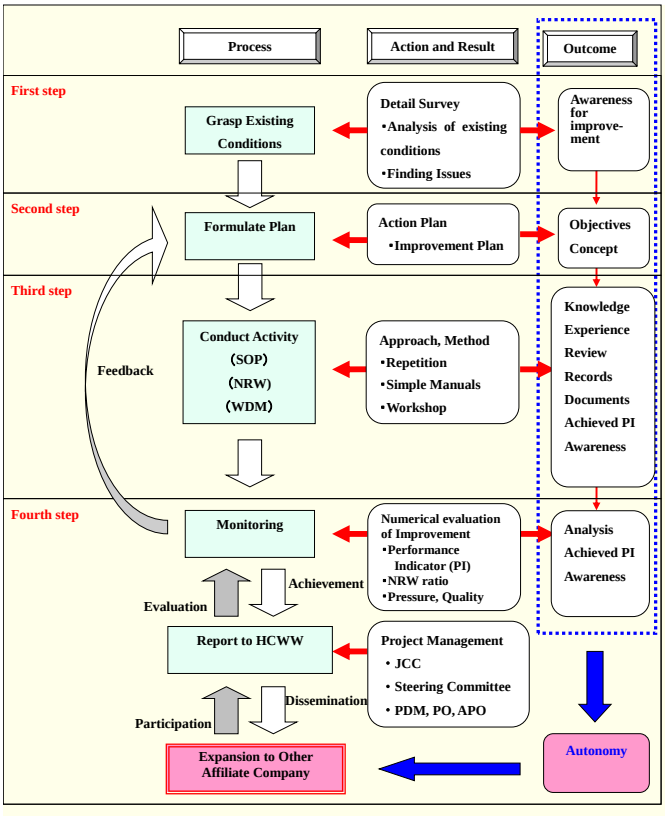
【Output-4】
The water distribution management capacity is improved in Sharkiya governorate as an advanced model.

【Output-0】
The project is managed and coordinated properly.



JICA expert team, therefore, assist them for strengthening the inter-company communication and staff training.

Following is a basic procedure of the Project.



And the following four (4) points are emphasized on each activity.

a) To acquire data, and to operate / evaluate according to measured data.

b) To have a success at model, and expand it to other areas.

c) To disseminate the skills to the whole Nile Delta, eventually.

d) To train younger persons by the Project team.

(1) SOP Activities

1) Formulation of Action Plan

SOP activities consist of six steps.

【Formulation of Action Plan】
【Review of SOP in SHAPWASCO】
【Preparation of SOP】
【Trial of SOP through OJT】
【Monitoring of Effectiveness】
【Plan of expansion in Governorate】

Since it is difficult to commence SOP activities at a same time in all facilities of the governorate, the Project team selected three model facilities for SOP in each of GHAPWASCO and MCWW. Appropriate facilities were selected for future expansion of technology / skills to the others. The action plan, aiming to improve operation and maintenance, was formulated for the Project in parallel of the model facilities selection.

2) Review of SOP in SHAPWASCO

SOP is required to be reviewed / revised in accordance with the aging of facilities and increase / decrease of water demand. SHAPWASCO who established the bases of SOPs in the previous project has been improving and disseminating them in the governorate. Nevertheless, a new issue which is the preparation for emergency cases was raised recently. JICA expert team, therefore, reviewed and improved the SOPs together with SHAPWASCO. Results of the review were shared among the three companies and fed back to development of SOP for GHAPWASCO and MCWW.

3) Preparation of SOP

SOP for GHAPWASCO and MCWW were prepared based on experience of SHAPWASCO. Besides, SOP team drew P&ID (Piping and Instrumentation Diagram) and SLD (Single Line Diagram) for all the model facilities to understand treatment process. It is an indispensable process to commencing SOP. In parallel, the Project team prepared standard formats for data recording.

Although operation data used to be recorded simply in most of water facilities, the recorded data have not been reviewed / analyzed to be utilized for improvement of performance. Recognizing the usefulness of data for improvement, the team members for SOP were motivated for routine works of data acquisition. After then bases of SOP were established.

4) Trial of SOP through OJT

SOP is not a simple manual for equipment usage, but a work process manual how to treat the water. In order to have enough knowledge for water treatment and site practice, trials of SOP were conducted in the Project.

One example is hereby presented. In a treatment plant of GHAPWASCO, which has 16 sand filters, the filtering loss and the effectiveness of filter-wash were different by filter. Since it was one of inefficient cases for operation, the Project team adjusted the thickness of sand filters and heights of troughs / weirs to be same for all filters. The duration of filter-wash, accordingly, decreased from 15 - 30 min. to 10 - 15 min. It was a visible accomplishment as "reduction of working time". Such experience triggered their positive actions for improvement.

Photo-1: Adjustment of Trough Height

5) Monitoring of Effectiveness

Target of OJT is to learn the SOP based operation and maintenance, and to formulate the best operation procedures. The effectiveness of SOP can be monitored and evaluated by Performance Indicator (PI). PI is one of tools to verify the effectiveness and efficiency of water supply.

In the circumstances, GHAPWASCO and MCWW determined targets of PIs and have struggled to achieve their targets of PIs on effective water utilization and consumptions for chemicals and energy in their model facilities; Water Treatment Plant (WTP) and Iron Manganese Removal Plant (IMRP).

6) Dissemination Plan in Governorate

Dissemination of the SOP in the Governorate will be effective to improve the operation and maintenance of water supply business. The Project team prepared, therefore, a dissemination plan of SOP to share widely experiences and outcomes of the Project in the governorate. And the counterpart team commenced the dissemination activities of SOP to other facilities than models.

(2) NRW Reduction Activities

1) Formulation of Action Plan

NRW reduction activities consist of six steps.

【Formulation of Action Plan】
【Information Exchange with SHAPWASCO】
【Water Balance Analysis】
【Training on Leak Detection】
【Monitoring of Effectiveness】
【Plan of expansion in Governorate】

NRW reduction activities are also conducted through model / pilot areas. The Project team selected the model / pilot areas and prepared the action plan through discussions and site surveys.

2) Technical Exchange with SHAPWASCO

In the previous project, SHAPWASCO built a training yard for leak detection by their budget. It gave impacts to the other Egyptian water companies in a sense of dissemination of leak detection technology in the governorate and to other governorates.

In the project, GHAPWASCO and MCWW exchanged technical information with SHAPWASCO through seminars and leak detection trainings in the above mentioned training yard.

GHAPWASCO, which was stimulated by the information exchanges, organized a seminar to disseminate nationwide leak detection methodology.

3) Water Balance Analysis

Water balance analysis is to compare incoming water flow with the consumption for an isolated area. It was conducted before and after leakage repairs and NRW reduction activities to know the NRW ratio and effectiveness of the activities.

In the beginning of analysis, the Project team conducted an accuracy test of customer meters. According to the test, the Project team found that many of the meters indicate larger figures than real consumptions (over-registration). The over-registration volume will be

inappropriately accounted as consumptions. Since the over-registration will be a serious cause to lose reliability of customers, the Project team recommended replacing / repairing the inaccurate meters.

In the circumstances, the Project team conducted cleaning and maintenance of meters to obtain more accurate figures for NRW volumes.

4) Training on Leak Detection

Leak detection training was conducted, aiming at not only explaining usage of equipment but also promoting application capability in different sites of various leaks. Detection of invisible leak is a visible outcome, and it accelerated the Project progress. It was good to motivate the counterpart members for more training.

Photo-2: Leak Detection at House Connection

At the beginning stage of the Project, JICA granted listening sticks to GHAPWASCO and MCWW for trainings. During the Project, the counterpart members recognized the effectiveness of the listening sticks. The two companies, therefore, bought the same equipment and commenced disseminating the leak detection activity in the governorate.

5) Monitoring of Effectiveness

NRW reduction team also selected PI to evaluate the Project quantitatively as well as SOP. The both companies determined a target NRW reduction ratio depending on the existing conditions for NRW.

6) Dissemination Plan in Governorate

The Project team recognized that the measurement of NRW is difficult due to inaccuracy of water meters and difficulties of arrangement of metered area (difficulties of network isolation and construction metering chambers). The Project team, therefore, selected “leak detection and repair” as an item to be disseminated rather than the accurate measurement of NRW.

GHAPWASCO and MCWW continue the activity in accordance with the dissemination plan of NRW reduction, which were prepared in the Project for focusing on leak detection and repair. The leakage surveys and the records are presently well managed by newly developed filing systems for documents and data.

(3) WDM Activities

1) WDM Method and Formulation of Action Plan

WDM activities consist of five (5) steps.

【Discussion on WDM Method and Formulation of Action Plan】
【Installation of Equipment and Trial of System】
【Formulation of SOP】
【Monitoring of Effectiveness】
【Evaluation of System and SOP】

SHAPWASCO believes that the water is sufficiently distributed. Nevertheless, many of complaints indicate insufficient volume and pressure of the water. To clarify causes and to solve the problems, they drafted a concept of WDM.

Introduction of monitoring system for water flows and pressures is costly. It is difficult to commence the WDM system having real time monitoring for whole Sharkiya immediately. The pilot system was, therefore, also adopted for WDM activities.

Zagazig City, the capital of Governorate, was selected as the target area. Analyzing the water distribution networks and methodology of WDM, the Project team divided the city into six metering zones. And one of them was nominated for a detail monitoring zone.

After then, the Project team commenced the pilot activities, aiming at analyzing uneven distribution and demand fluctuation of water and controlling distribution flow.

2) Installation of Equipment and Operation

SHAPWASCO constructed a central monitoring room,

feeder pipes for pressure measurement and chambers for flow meters to install WDM equipment. Equipment, procured by JICA, was installed by SHAPWASCO according to instructions provided by the equipment supplier.

Monitoring and analyzing continuously the conditions of water production, flows, network pressures, demand fluctuation, etc., the Project team improved operation modes of Zagazig water treatment plant (WTP) and wells. And it also commenced necessary rehabilitation of facilities to maintain the sufficient water distribution.

Since the WDM system enabled the Project team to monitor the conditions at real time basis, the awareness of operators in WTP and wells were much improved to maintain the water flow / pressure. The operation, accordingly, improved to be demand-oriented.

3) Development of SOP for WDM

In the process of operation of WDM, the Project team prepared SOPs. It is mainly for data analysis on water demand and pressure as well as forms for calculation. As for the operation and maintenance of equipment, the manuals provided by the equipment manufacturer cover the usage and daily operations.

Through the development of SOP, the counterpart members deepened their knowledge for WDM, and they were motivated to full-fledged operation.

4) Monitoring Effectiveness

“Number of complaints on water suspension and low service pressure per 1000 customer” and “Low service pressure ratio” were determined as PIs for WDM. The Project team commenced the activity to improve the water distribution conditions related to these PIs.

The data collected for operation were analyzed by the Project team. The results of the analyses are well organized and utilized for modifications of operation procedure of WTP and well stations.

5) Evaluation of SOP and System

In the limited Project terms, the number of complaints and low service pressure ratio have not yet reached "Zero". Through the Project, awareness of operators of WTP and wells was, nevertheless, promoted to maintain the water pressure. Data-based operation has been consequently realized.

WDM Department, which was established in the Project period, obtained enough skills to operate the monitoring system and to analyze collected data. Their skills will be further matured through the continuous monitoring.

A fact, that water distribution capacity was not sufficient for the maximum demand in summer season due to insufficient capacity of water reservoir and distribution facilities, were brought by the analyses. Related issues were reported to managements of SHAPWASCO from the Project team, and the improvement of facilities was commenced.

As for inspection and maintenance required in the operation stage, SHAPWASCO made a contract with a local service provider. Accordingly, more stable operation is expected for the future as well as expansion of system to the whole governorate.

3. Review of Approach and Results

1) Achievement of SOP

Ability and configuration are different per water treatment facility. The SOP was accordingly prepared by each facility.

As a result of SOP and its related activities, PIs for Water Treatment Plant (WTP) and Iron Manganese Removal Plant (IMRP) were improved as shown below (monitoring term: September 2012 – June 2014).

Table-1 Tanta El Teraa El Melahia SWTP

	Effective utilization Ratio of Water (%)	Unit consumption of Chemicals		Energy Consumption (kWh/m^3)
		Gaseous Chlorine (g/m^3)	Liquid Aluminum Sulfate (g/m^3)	
Initial Value	85.0	8.87	38.45	0.39
Target Setting	90.0	8.00	35.00	0.35
Achievement level	87.2	7.78	37.20	0.36
Achieved		○		

* The average of the latest three months (April-June, 2014) is shown as achievement.

Table-2 Mahlet Marhoom IMRP

	Effective utilization Ratio of Water (%)	Unit consumption of Chemicals		Energy Consumption (kWh/m^3)
		Gaseous Chlorine (g/m^3)	Liquid Aluminum Sulfate (g/m^3)	
Initial Value	93.7	7.05	3.04	0.76
Target Setting	96.0	6.00	2.00	0.60
Achievement level	95.7	2.87	1.89	0.62
Achieved		○		○

* The average of the latest three months (April-June, 2014) is shown as achievement.

Table-3 Mahlet El Sadat El Satheya WTP

	Effective utilization Ratio of Water (%)	Unit consumption of Chemicals		Energy Consumption (kWh/m^3)
		Gaseous Chlorine (g/m^3)	Liquid Aluminum Sulfate (g/m^3)	
Initial Value	88.0	9.20	26.00	0.45
Target Setting	92.0	6.50	18.00	0.36
Achievement level	93.8	6.47	25.30	0.36
Achieved	○	○		○

* The average of the latest three months (April-June, 2014) is shown as achievement. However, the data of February-April, 2014 for the effective utilization ratio and ones of January-February, 2014 for the Liquid Aluminum Sulfate are indicated due to inappropriateness of obtained data in April-June, 2014.

Table-4 Gezy IMRP

	Effective utilization Ratio of Water (%)	Unit consumption of Chemicals		Energy Consumption (kWh/m^3)
		Gaseous Chlorine (g/m^3)	Liquid Aluminum Sulfate (g/m^3)	
Initial Value	84.0	3.50	2.00	0.80
Target Setting	92.0	6.50	1.00	0.50
Achievement level	89.3	6.65	0.95	0.79
Achieved			○	

* The average of the latest three months (April-June, 2014) is shown as achievement.

Although some PIs were not achieved for the target, they are expected to be achieved in the near future since they tend to be improved.

2) Achievement of NRW

Non-revenue water ratios of the model areas before and after activity are shown in Table-5.

Table-5 Achievement of NRW reduction

Model Area	NRW ratio			Reduction Ratio	
	Before	Target	After	Target	Achieved
【GHAPWASCO】					
Tanta	40.1%	28.0%	24.7%	30.0%	38.4%
El Mahalla El Kobra	27.1%	20.3%	22.0%	25.0%	18.8%
Zefta	21.2%	15.9%	21.0%	25.0%	0.0%
【MCWW】					
Shebeen El Kom	19.6%	14.7%	16.5%	25.0%	15.8%
Quesna	29.8%	22.3%	22.5%	25.0%	24.5%
Barket El Sab'a	27.1%	20.3%	20.2%	25.0%	25.4%

Reduction Ratio (%) =
("NRW ratio before improvement (%)" - "NRW ratio after improvement (%)) / "NRW ratio before improvement (%)"

The target was achieved in 2 model areas out of 6 areas. In 3 areas out of the remaining 4 areas, the reductions of NRW were confirmed obviously.

After the activities in the model areas, the Project team commenced the dissemination of NRW reduction activity in the Governorate. The estimated leak volume, which was found and repaired in each of GHAPWASCO and MCWW, is 2,200,000m^3 per year until February 2015. This is almost same as the production volume of a normal well station (70L/s). It is, accordingly, evaluated that the leak detection gives a large impact for NRW reduction.

3) Achievement of WDM

The target of low service pressure ratio was not achieved in higher demand season (summer). In winter (from November 2014 to March 2015), the improvement appeared obviously. The low service pressure in summer was caused by insufficient water flows due to insufficient capacity of water reservoir and distribution facilities.

The baseline and the achievement are shown in Table-6 and Figure-1.

As for the number of complaints per 1,000 connections, it was increased due to frequent electricity interruptions occurred in the whole Egypt. According to the electricity interruptions, operations of the water distribution facilities were also suspended. The baseline and the obtained data are shown in Table-7 for the number of complaints.

Table-6 Low Pressure Ratio

Area	Baseline March, 2014	Target March, 2015	Achieved March, 2015
Whole Zagazig	8%	7%	4%
A-4 area	1.4%	1.3%	0.3%

Low service pressure ratio =
("Total hours of low pressure recorded at all continuous monitoring points" / ("Number of points for continuous pressure monitoring" x 365days x 24hours)
*The reference for low pressure is 1 bar. (0.1MPa)

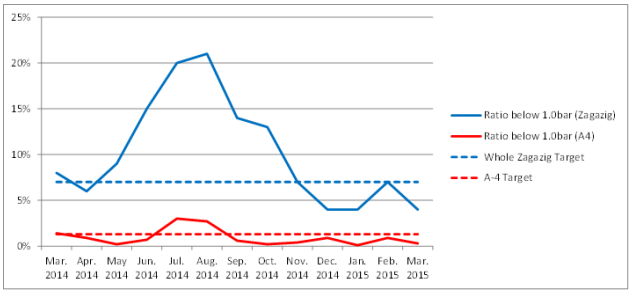


Figure-1 Tendency of Low Pressure

Table-7 Complaints per 1000 houses

Area	Baseline (2011/2012)	Target	Achieved (Estimated)
Whole Zagazig	13.92	20%	42.67
A-4 area	13.52	30%	28.06

Number of Complaints per 1000 customers = "Number of complaints on water suspension and low pressure" / 1000 connections
*The achieved figure is estimated, converting 10 months' records.

4. Devices and Lessons

1) Counterpart's Initiative

SHAPWASCO is ahead for several years on the experience of SOP and NRW reduction. During the previous Project, they promoted skills and awareness on the activities according to the cooperation with the Japanese experts. SHAPWASCO took an important role to transfer this experience to GHAPWASCO and MCWW in the Project. JICA experts place themselves in a position to support SHAPWASCO in addition to assist GHAPWASCO and MCWW to clarify visions and strategies for the development. This training structure brought the initiatives of the counterpart members and contributed to development of counterpart's autonomy and continuity of the Project.

2) Principle of Competition

GHAPWASCO and MCWW implemented almost the same programs simultaneously. They were, accordingly, motivated to compete with the other. The sense of rivalry contributed well to the Project progress and achievement. Even for SHAPWASCO, the competitiveness of the counterpart members were stimulated in development of the Project activities through frequent exchange of progress information.

3) Original Training by Counterpart

The counterpart teams of GHAPWASCO and MCWW provided trainings internally for site members of model facilities / areas. It is the beginning of the dissemination activities, and it contributed to promotion of their motivation for the Project and the awareness of site members.

As an example for leak detection trainings, the NRW reduction team organized leak detection trainings at Hihya training yard of SHAPWASCO for the members of branch offices. It was also a good example of inter-company cooperation.

4) Visualized Performance Indicator (PI)

The Project team selected the visible performance indicators (PIs) for the Project evaluation. Since the outcomes were indicated by numerical figures, PIs motivated the counterpart members to improve the operation efficiency. And it also brought the improvement of information exchanges with the top management of each company. PIs led the top management to proper commitment for developing SOP, NRW and WDM as well as improving facilities.

5) Motivative Factor for the Project

Other motivative factors are summarized as follow:

- The improvement and reduction of chemicals, NRW, etc. were converted into the reductions of costs. They were good indicators for the counterpart members to recognize the improvement and publicize the results of the activities, so that the motivations of counterpart members were promoted.
- The trainings in Japan and the information exchange with Water Authority of Jordan stimulated interest of the counterpart members in development / improvement of water supply business.
- Since inter-company cooperation and plans to disseminate to other governorate are incorporated, the counterpart members had occasions (or will have occasions) to train staff members of other governorates. The counterpart members are proud to be trainers.

6) External Conditions

Although the Project team tried to improve water supply service to achieve the targets, it was difficult to reach targets in several months due to external conditions such as electricity interruption and seasonal fluctuation of water demand / raw water quality.

Since there are difficult cases to obtain proper evaluation within a short period, it is recommended to evaluate the efficiency of water supply service in later stage after sufficient monitoring periods.

7) Effectiveness of Monitoring System

It was confirmed that insufficient facilities hinder in appropriate WDM. The monitoring system is not a tool to solve the fundamental problems such as insufficient capacity of facilities. The Project team confirmed, nevertheless, that the monitoring system is effective to improve the water distribution conditions through demand-oriented operations of WTP and wells. Visualization of water distribution in flows and pressures assisted the counterpart members in appropriate operation of pumps.

(Project period: 2011-2014)