

**Republic of Sudan  
State Government of Kassala**

**Capacity Development Project  
for the Provision of Services  
for Basic Human Needs in Kassala,  
the Republic of Sudan**

**Final Report  
Volume 2: Water Cluster**

**April 2015**

**Japan International Cooperation Agency (JICA)**

**International Development Center of Japan Inc.  
Earth System Science Co., Ltd.  
System Science Consultants Inc.**

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**Capacity Development Project for the Provision of Services for Basic Human Needs  
in Kassala, the Republic of Sudan (K-TOP)**

Final Report  
Agriculture and Livelihood Cluster

**Table of Contents**

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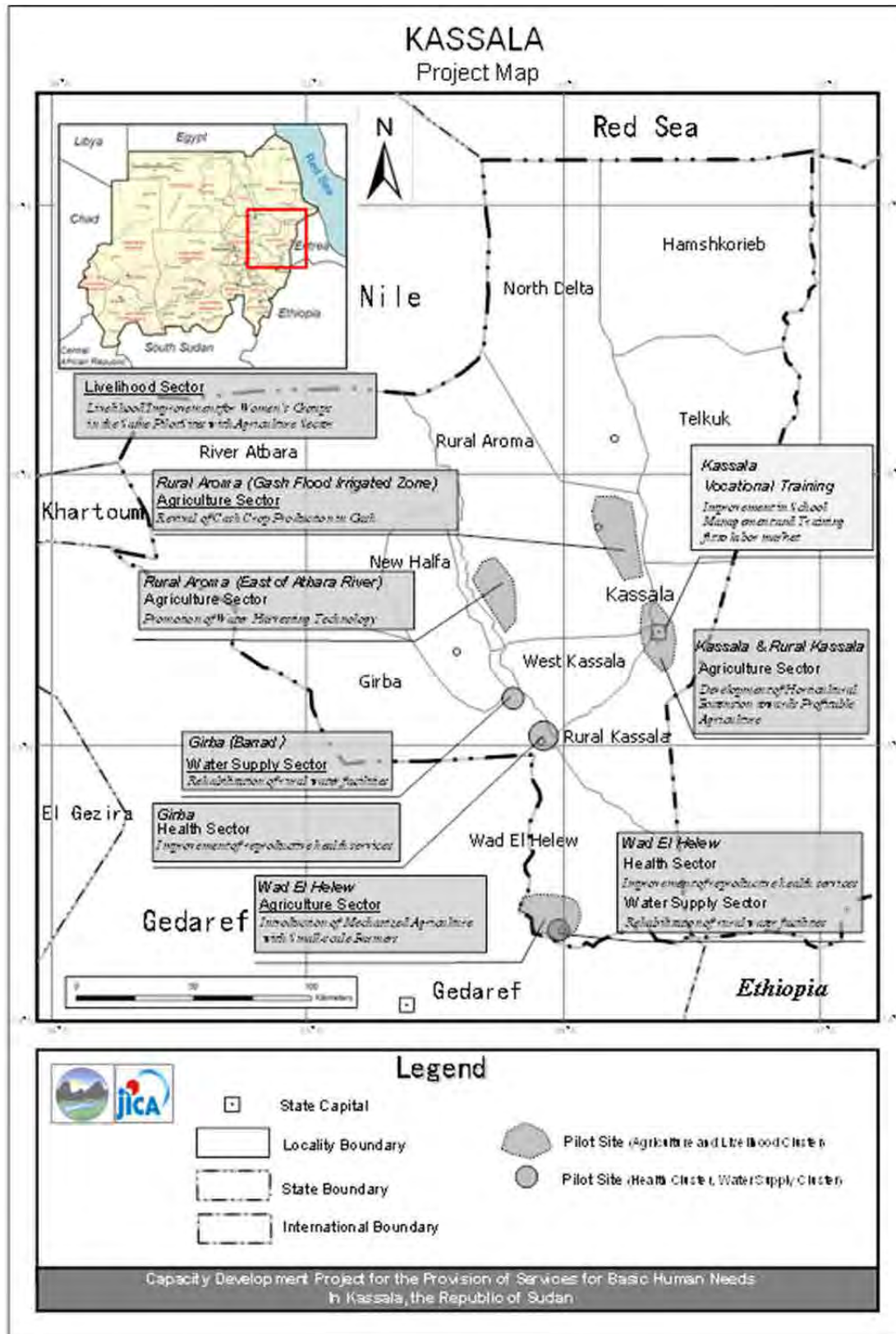
**Map of the Project Area**  
**List of Abbreviations**  
**Highlights**

<b>1. OUTLINE OF THE WATER CLUSTER.....</b>	<b>1</b>
1.1 BACKGROUND OF THE WATER CLUSTER .....	1
1.2 OBJECTIVES OF THE WATER CLUSTER (PROJECT PURPOSE AND OUTPUTS) .....	2
1.3 TARGET PEOPLE AND TARGET AREAS IN THE WATER CLUSTER .....	2
1.4 SUDANESE COUNTERPARTS FOR THE WATER CLUSTER .....	4
1.5. ORGANIZATION TO PROCEED WITH THE WATER CLUSTER ACTIVITIES.....	4
<b>2. BASIC PRINCIPLES TO IMPLEMENT THE WATER CLUSTER .....</b>	<b>7</b>
2.1 TECHNICAL PRINCIPLES TO IMPLEMENT THE WATER CLUSTER .....	7
2.2 ADMINISTRATIVE PRINCIPLES TO IMPLEMENT THE WATER CLUSTER.....	7
2.3 KEY POINTS FOR IMPLEMENTATION OF THE WATER CLUSTER.....	7
<b>3. PROGRESS OF THE ACTIVITIES IN THE WATER CLUSTER .....</b>	<b>9</b>
3.1 FLOW OF ACTIVITIES IN THE WATER CLUSTER .....	9
3.2 SUMMARY OF PROGRESS OF THE ACTIVITIES IN THE WATER CLUSTER (FROM MAY 2011 TO MARCH 2015).....	10
3.3 ACTIVITIES IMPLEMENTED IN THE WATER CLUSTER FROM MAY 2011 TO MARCH 2015.....	17
3.4 CORRESPONDENCE SITUATION FOR PROPOSAL OF FINAL EVALUATION.....	45
3.5 PROGRESS TO ACHIEVE THE PROJECT PURPOSE AND OUTPUTS IN THE WATER CLUSTER.....	46
3.6 COORDINATION WITH OTHER DONORS IN THE WATER CLUSTER .....	48
<b>4. TRAINING IN JAPAN, OUTSIDE SUDAN, EQUIPMENT SUPPLY, FACILITIES REHABILITATION/CONSTRUCTION IN THE WATER CLUSTER.....</b>	<b>51</b>
4.1 TRAINING IN JAPAN.....	51
4.2 THIRD COUNTRY TRAINING.....	52
4.3 PROGRESS OF EQUIPMENT PROCUREMENT IN THE WATER CLUSTER .....	53
4.4 . FACILITIES' REHABILITATION AND CONSTRUCTION PLAN IN THE WATER CLUSTER .....	53
<b>5. CONCLUSION AND RECOMMENDATIONS IN THE WATER CLUSTER.....</b>	<b>55</b>
5.1 CONCLUSION.....	55
5.1.1 CAPACITY DEVELOPMENT OF SWC .....	55
5.1.2 SWC OWNERSHIP DEVELOPMENT AND ACTIONS .....	55
5.2 RECOMMENDATIONS .....	57

## **Appendix**

Appendix 1. Project Design Matrix ver. 4.0

Map of the Project Area  
(Location of State of Kassala)



## List of Abbreviations

C/P	Counterpart
DP	Distribution Point
DPD	Directorate of Planning and Development, , Kassala State Ministry of Finance
DWST	Drinking Water and Sanitation Training Center
DWSU	Drinking Water and Sanitation Unit
ERDP	Eastern Recovery and Development Programme
FAO	Food and Agriculture Organization
GIS	Geographic Information System
GPS	Global Positioning System
G.S.Pipe	Galvanized Steel Pipe
HCDG	Higher Council for Decentralized Governance
IOM	International Organization Migration
JCC	Joint Coordination Committee
KVTC	Kassala Vocational Training Center
MIC	Ministry of International Cooperation
MoFNE	Ministry of Finance and National Economy
NTU	Nephelometric Turbidity Unit
OJT	On-the-Job Training
O&M	Operation and Maintenance
PVC	Polyvinyl Chloride
PWC	Public Water Corporation
PWCT	Public Water Corporation Training Center
DWST	Drinking Water and Sanitation Training Center
PWT	Public Water Tap
SRC	Sudan Red Crescent
SWC	State Water Corporation (Kassala)
TOT	Training of Trainers
TQM	Total Quality Management
UNOPS	United Nations Office for Project Services
WES	Water and Environmental Sanitation (UNICEFF Program)

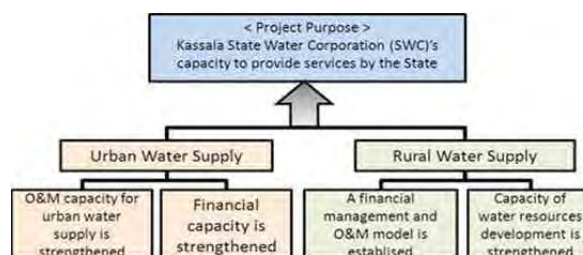
# Water Cluster Highlights

## Cluster purpose:

Kassala State Water Corporation (SWC)'s capacity to provide service for water supply is strengthened.

Kassala state consists of urban and rural water supply areas. While the urban water supply in Kassala town has its own water resource, underground water of the Gash river basin, the Kassala State Water Corporation (SWC) faced some management issues at the start of the Project: water leakage due to obsolete pipes, frequent water suspension due to insufficient operation and maintenance of the water purification plant, low collection rate of revenues, water tariffs that is not based on water production costs, and others. Empowerment of the SWC staff and organizational management was essential to address those issues.

On the other hand, the Law of Drinking Water Corporation (1996) stipulates: "Specification and power of SWC" includes "plan, design and construct water infrastructures in Kassala State and manage, operate and rehabilitate with high level of technical and administrative competence" and "supervise all water infrastructure such as boreholes and haffirs (small ponds)". However, some donors and NGOs, assisted for well construction and operation in rural areas, it is recognized that "communities or localities were responsible for rural water supply". In actual practice, some communities or localities have not been able to properly operate and maintain those rural water facilities. It has been necessary for SWC to operate and maintain rural water supply facilities, as well as, to develop new water resources for villages without any resource.



	Issues	Major activities and outputs
Urban Water Supply	<ul style="list-style-type: none"> <li>● Frequent water leakage due to obsolete pipes</li> <li>● Widespread suspension due to insufficient operation and maintenance (O&amp;M)</li> <li>● Lack of water distribution network map in Kassala town</li> <li>● Obsolete customer database system by MS DOS</li> <li>● Low rate of revenue collection</li> <li>● Insufficient cash flow</li> <li>● Centralization of information and decision- making of the General Director</li> </ul>	<ul style="list-style-type: none"> <li>● Have updated water distribution network data in Kassala town by using GIS to improve the water supply and maintenance system</li> <li>● Have established a "Maintenance Department" to conduct a regular maintenance work</li> <li>● Have formulated an asbestos pipe replacement plan to be implemented with a bank loan</li> <li>● Have formulated a new customer database system with Visual Basic</li> <li>● Have increased the rate of revenue collection by entrusting the Electricity Corporation with the water revenue collection</li> <li>● Have prepared a tentative tariff revision to obtain approval from Kassala State Government</li> <li>● Have continued KAIZEN meetings to empower organizational management, without depending on the General Director</li> </ul>
Rural Water Supply	<ul style="list-style-type: none"> <li>● Low ratio of rural water supply facilities functioning in Kassala State, due to insufficient O&amp;M experience and expertise of local people.</li> <li>● Unsafe and insufficient water supply due to limited water resources in dry areas of the northern Kassala State</li> <li>● Low ratio of Kassala SWC staff attending PWCT programs, lower scores than average and a poor reputation as a result</li> </ul>	<ul style="list-style-type: none"> <li>● Have brought the O&amp;M responsibility of rural water supply facilities (level 2) back to SWC</li> <li>● Have established "large village water supply model" and "small village water supply model"</li> <li>● Have dispatched SWC staff to large villages to operate and maintain rural water supply facilities in cooperation with the Water Committees.</li> <li>● In small villages, the Water Committee members are responsible for operation and maintenance with SWC support and monitoring</li> <li>● Have organized a Maintenance Team at SWC to provide repair service.</li> <li>● Have trained local residents on operation and routine maintenance of rural water supply facilities.</li> <li>● Have conducted geophysical surveys for ground water resources in northern Kassala state.</li> <li>● Have established and operated a Training Unit</li> </ul>



## K-TOP Water Cluster Highlights 1

Realization of asbestos pipe replacement using GIS pipe network map in the urban water supply.

### 1. Background

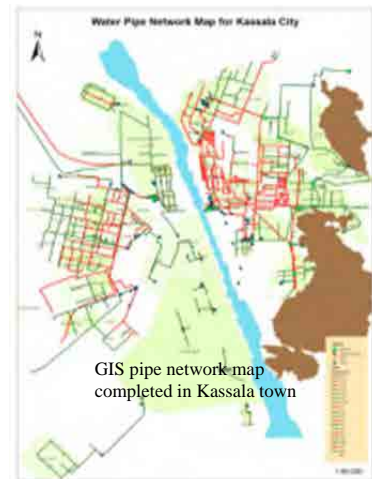
The total length of water pipes in Kassala town is 306km. Among them, 140km (46%) consist of old asbestos pipes. Water leakage occurred mostly in the asbestos pipes, and SWC received many customer complaints. The SWC coped with those customer complaints, but it was insufficient due to shortage of engineers, workers, materials, and equipment. Moreover, SWC has not conducted a regular or preventive maintenance, but repair work responding to customer complaints. Many water supply facilities such as h well pump, electric facility, and flush tank of the water treatment plant, had become obsolete. It was, thus, necessary to build an effective operation and maintenance system and replace the obsolete facilities.

### 2. Activities

The first year: To proceed with pipe network facility management, the JICA expert carried out technical training, basic GIS course and GPS course, then formulating a GIS/GPS data updating manual and conducting a practical GIS/GPS training course.

The second year: SWC established a "GIS Team" to assign a data updating to some staff. They conducted a monthly meeting to renew the pipe network data and formulate a GIS map. Those members and the JICA expert formulated a "facility maintenance management manual" and "equipment management manual" in cooperation with the "Maintenance Team" which was newly established.

The third year: The GIS team, by using GPS, checked the location of wells and pipes which were newly installed. The JICA expert gave technical guidance of GIS data updating. Moreover, the JICA expert supported an asbestos pipe replacement plan formulation. With the plan, SWC requested a loan of the pipe replacement project by themselves.



### 3. Outputs

- SWC has established a "GIS Team" and "Maintenance Team" to conduct data updating and regular maintenance work, respectively.
- The GIS Team has clarified pipe network data with the GIS map formulation and updating: whole pipe diameter, pipe quantity by classification and location of underground pipes. The JICA expert helped SWC formulate the replacement plan of asbestos pipe. As a result, a bank loan was authorized in November 2013 to finance the replacement. The construction work started on January 19, 2014.
- SWC maintenance capability has improved by training with the practical manuals including the "manual of updating GIS/GPS data", "facility maintenance management manual", and "equipment management manual".



### 4. Recommendations to the counterpart for future actions

- SWC needs to supervise the pipe replacement works and to conduct operation and maintenance of the water supply plant.
- The drinking water in Kassala depends on underground water of the Gash river basin. However, the wells for agriculture have continued to increase in number, thereby totalling about 2,000 or more. According to estimation of the Kassala Groundwater office, under supervision of the Ministry of Water Resources and Electric Power, the annual pump discharge for agricultural use and drinking water is approximately 100 million m<sup>3</sup> and 13 million m<sup>3</sup>, respectively. The annual well water consumption might exceed the annual recharge of rainfall and others, which will lead to exhaustion of Gash river basin water resources. It is, thus, necessary to conduct integrative water resource management in cooperation with concerned organizations, such as the Kassala Groundwater office, State Ministry of Agriculture, Kassala SWC, and others.

**Water Cluster Highlight 2**  
***SWC management improvement by tariff revision***

**1. Background**

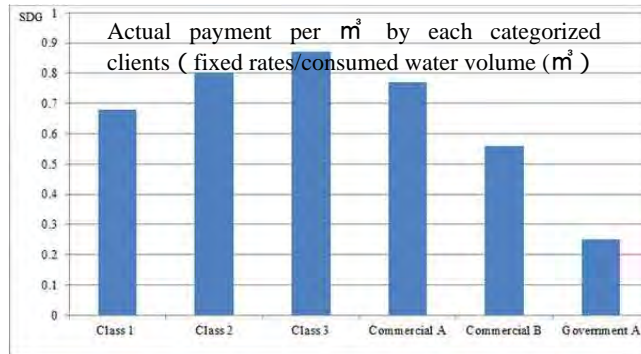
Kassala residents pay bills for water every month. The tariff is a fixed rate, not a rate in proportion to their consumption volume. The fixed rates for households vary according to their water pipe diameters: class 1, 2 and 3. Restaurants, hotels, offices have different fixed rates, according to their business. SWC had not, thus, installed water meters to measure how much water each client consumes a month. As a result, the more volume clients consume the lower rates per m<sup>3</sup> they seem to pay. The SWC, thus, revised the current tariff to obtain a more appropriate pricing in proportion to water consumption volume of each categorized client.

**2. Activities**

The first year: some SWC staff installed 55 water meters to measure how much water those clients consume a month. The second year: An analysis of the consumption data was reported to the General Director in February 2012 and to many staff at a KAIZEN meeting in September 2012. The third year: The Director, Assistant Director of the accounting department and others worked together to formulate a tentative tariff revision. They explained the revision to the Kassala State Government to obtain an approval from the Governor and Minister of Finance in December 2013.

**3. Outcomes**

- SWC was able to realize how much water each categorized client consumes a month.
- It is found that large volume consumers, such as restaurants/hotels/ offices, pay lower rates per m<sup>3</sup> than households do.
- SWC staff share information, discuss issues, formulate a tentative tariff revision to bill clients for water in proportion to their consumption volume. SWC obtained approval for the revision from the State Government.
- The revised tariff has been applied since February 2014. SWC would get a revenue increase by 20% to improve its management.

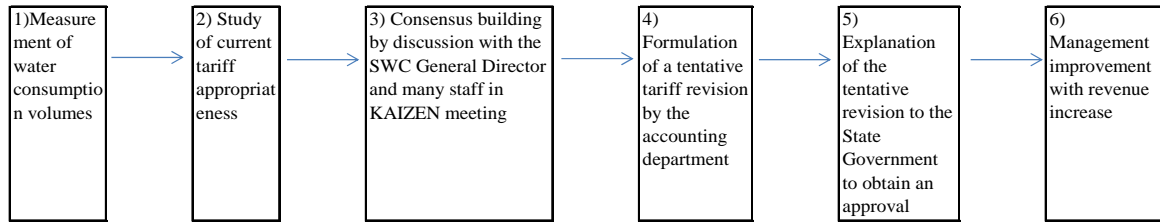


**Table Tariff Revision (SDG)**

	Class 1	Class 2	Class 3	Commercial A	Commercial B	Government A
Year 2013	40	35	20	280	80	80
Tentative plan	55	40	20	390	180	950
Year 2014 revision	45	40	25	350	120	100

**4. Management improvement model with tariff revision**

The fixed tariff rates have been applied in many states of Sudan. Some of the fixed rates are unfair. The K-TOP model is, thus, effective to revise the unfair tariff and improve SWC management: 1) Measurement of water consumption volume by each categorized client with meter installation, 2) Study of current tariff appropriateness, 3) Consensus building by discussion with the SWC General Director and many staff in KAIZEN meetings, 4) Formulation of a tentative tariff revision by the accounting department, 5) Explanation of the tentative revision to the State Government, 6) Management improvement with revenue increase by approval of the revision



#### 5. Recommendations to the counterpart for future actions

- 1) The SWC should install water meters at the water intake, distribution and supply to accumulate data to proceed with water balance analysis.
- 2) It is necessary to build a MIS (Management Information System) with the water balance analysis.

**Water Cluster Highlight 3**  
***Establishment of a financial management and O&M model for rural water supply facilities in the pilot areas***

**1. Background**

The Law of Drinking Water Corporation (year 1996) stipulates that SWC plan, design and construct water infrastructures in Kassala State to manage, operate and rehabilitate them. However, as some development partners, donors and NGOs assisted directly in construction and operation of water supply facilities in rural areas, it is widely recognized that thereby implying widely “communities or localities were responsible for rural water supply”. As a result, the responsibilities of SWC concentrated on only the urban water supply. However, the localities and water committees do not have expertise for financial management and O&M of water works, thereby decreasing the functioning ratio of those facilities. As a result, the percentage of households who have access to safe water in Kassala State in 2006 was 38.7% which was lower than the average of the whole Sudan. The Kassala State returned the responsibilities of rural water supply facility maintenance and operation to SWC in 2011.

**2. Activities**

- The first year: The JICA Expert Team transferred, to SWC staff, planning and construction technology of well rehabilitation in Wad El Helew (large village). After the construction, the JICA Expert Team helped establish a financial management and O&M model in Wad El Helew.
- The second year: The JICA Expert Team transferred, to SWC staff, planning and construction technology of pumping water with solar energy in Banard Village (small village). After the construction, the JICA Expert Team helped conduct training of daily maintenance and accounting for local operators there.
- The third year: The JICA Expert Team continuously supported to establish the large and small village water supply models through dispatching SWC staff, revising tariff and auditing their bookkeeping.

**3. Outcomes**

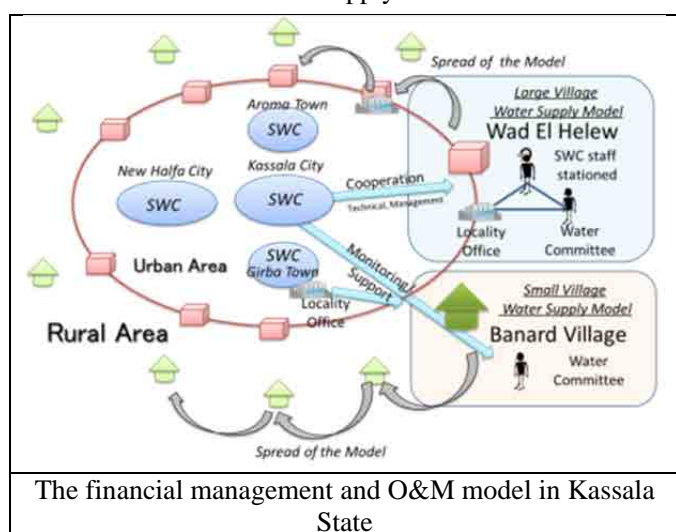
- SWC has mastered well rehabilitation technology through the pilot projects. Then, SWC has proceeded with, by themselves, new well development and well rehabilitation in the urban and rural areas in Kassala State.
- After the well rehabilitation work in Wad el Helew, SWC commenced water supply for a part of the residents and local hospital. It is found the well rehabilitation work is effective in reducing the hospital visit frequency of the local residents there.
- The JICA Expert Team and SWC established “large village water supply model” and “small village water supply model” in the two pilot project sites. Through the pilot project, the JICA Expert Team and SWC clarified the roles and responsibilities among localities, water committees and SWC.

**4. Establishment of a financial management and O&M model for rural water supply facilities**

- The large village water supply model would be applied to large villages like Wad El Helew. The small village water supply model would be applied to small villages like Banard Village.
- SWC gives technical and accounting training for large village people to empower them.
- Small villages and their water committees in rural areas would obtain support and monitoring from localities and SWC.

**5. Recommendations to the counterpart for future actions**

- SWC should spread the two models to other areas in cooperation with those localities.
- SWC should establish maintenance centers in rural areas and increase staff in the Team. Because the Team has consisted of one group to monitor the water facilities in urban and rural areas where sometimes it takes a lot of time to access remote areas it is difficult to cover the whole area by the Team only.



## 1. Outline of the Water Cluster

### 1.1 Background of the Water Cluster

JICA conducted a preparation survey to formulate a detailed plan of the Project. Table 1.1 is an overview of water supply sector in Kassala State. Table 1.2 shows the current problems and necessary countermeasures to solve these problems, which are based on the results of discussion with the SWC.

**Table 1.1: Overview of Water Supply Sector in Kassala State**

Indicator		Current situation	Remarks
Kassala State	Population in Kassala State	1,789,086	Census Data in 2008
	The number of water yard	128	Kassala State
	Rate of breakdown	25%	2009
	Percentage of Household Members using improved drinking water sources ( % )	38.7%	2006 56.1% ( Sudan )
	Percentage of water on premises (%)	29.0%	2006 30.1% ( Sudan )
Kassala town	Population in Kassala town	298,529	Census Data in 2008
	Target water supplied population in Kassala town	East Bank Area : 165,915 persons West Bank Area : 132,614 persons	Census Data in 2008
	The number of customers in Kassala town	East office : 20,848 West office : 14,247 Total : 35,095	March 2011
	The number of claims in Kassala town	East office : 400 claims/month West office : 141 claims/month Total : 541claims/month	Dec. 2010 – Feb. 2011
	The collection rate of the water tariff in the SWC	Kassala East 67%, West 58%, totaling to 64% (May 2011)	2011
	The length of transmission and distribution pipe Asbestos Cement Pipe Rigid Polyvinyl Chloride Pipe Steel Pipe	82.5km (55.9%) 64.2km (43.9%) 0.3km (0.2%)	2010
	The number of leakages in East Bank Area	6.09 places/day	Jan.2010 - May.2010

Source : The number of customers in Kassala town is from “ 5th Sudan Population and Housing Census 2008”, Source of number of customers/ customer complaints in Kassala town is hearing from SWC East/ West offices. The collection rate, the length of transmission/ distribution pipe and number of leakages are from “Kassala City Water Supply Facility Improvement Preparatory Study, Site Survey Result, year 2010, by Tokyo Engineering Consultant International”. The indicators related to rural water supply are from “Water and Sanitation Strategic Plan, year 2009, PWC”, “Sudan Household Health Survey 2006”.

**Table 1.2: Current Problems & Countermeasures in Water Cluster**

Category	Current problems in the counterparts' primary works	Countermeasures to solve these problems (“Activities No.” in the PDM)
Urban Water Supply	<ul style="list-style-type: none"> <li>● Poor water supply service such as water leakage, widespread suspension of supply, etc.</li> <li>● Updating of old customer database formulated by MS-DOS</li> <li>● Low collection rate</li> <li>● Financial difficulties of the SWC due to</li> </ul>	<ul style="list-style-type: none"> <li>● Update the inventory of water distribution network in Kassala town by using GIS to improve the water supply and maintenance system</li> <li>● Respond to non-revenue-water problem by making non-payment customers visible through building a customer database that</li> </ul>

	much non-revenue-water	<ul style="list-style-type: none"> <li>monitor actual water use volume of each customer, and charge payment</li> <li>Study and propose a new water charge system</li> </ul>
	<ul style="list-style-type: none"> <li>The ratio of functioning rural water supply facilities in Kassala State decreased, because the locality office and the water committee in rural area didn't have the technical knowledge for O&amp;M, and the experience of financial management.</li> </ul>	<ul style="list-style-type: none"> <li>Provide policy options to bring the responsibility of major repair work of rural water supply facilities (level 2) back to the SWC and organize a maintenance team in the SWC to provide remote repair service.</li> <li>Train local residents on operation and routine maintenance of rural water supply facilities.</li> </ul>
Rural Water Supply	Many towns and villages not having safe water supply due to limited water resources in dry areas of the northern Kassala State	<ul style="list-style-type: none"> <li>Conduct the geophysical survey for ground water resources in northern Kassala state.</li> </ul>
	Low attendance of Kassala SWC to PWCT programs and below average scores of their performance, thereby having a poor reputation	<ul style="list-style-type: none"> <li>Assist the SWC to establish the training unit in cooperation with PWCT(Public Water Corporation Training center in Khartoum )</li> </ul>

### 1.2 Objectives of the Water Cluster (Project Purpose and Outputs)

The SWC, a counterpart of the Water Cluster in Kassala State government, recognizes that the basic human needs of the people in Kassala State are not ensured. The SWC had no suitable countermeasures against the current problems shown in Table 1.2. The JICA Expert Team assisted the SWC to find and solve current problems based on the counterpart's ownership so that the SWC will supply safe and sufficient water to the customers at an appropriate tariff. The project purpose, output, and indicators are shown in Figure 1.1.

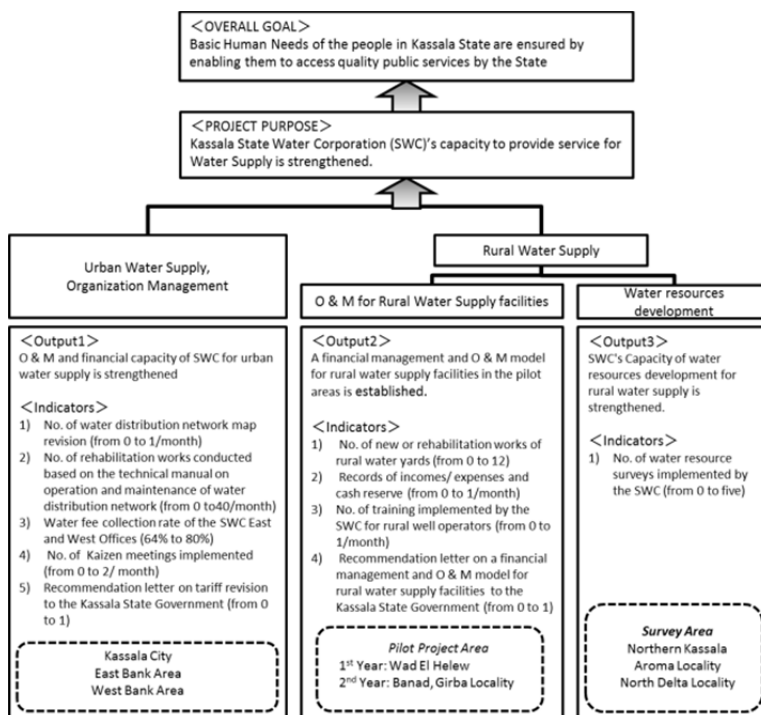


Figure 1.1: The Flow Chart of project propose and outputs in the Water Cluster

### 1.3 Target People and Target Areas in the Water Cluster

The target people of the project are residents of Kassala State (population: 1,800,000). The Water Cluster focuses on human resource development of the SWC staff as counterparts, thus giving

technical guidance. The target urban area is Kassala town. The target rural areas are Wad El Helew and Banard village, Girba Locality, as the pilot areas. The organization chart of Kassala SWC is shown in Figure 1.2.

The geophysical survey area for the development of water resources is northern Kassala State (shown in Figure 1.3).

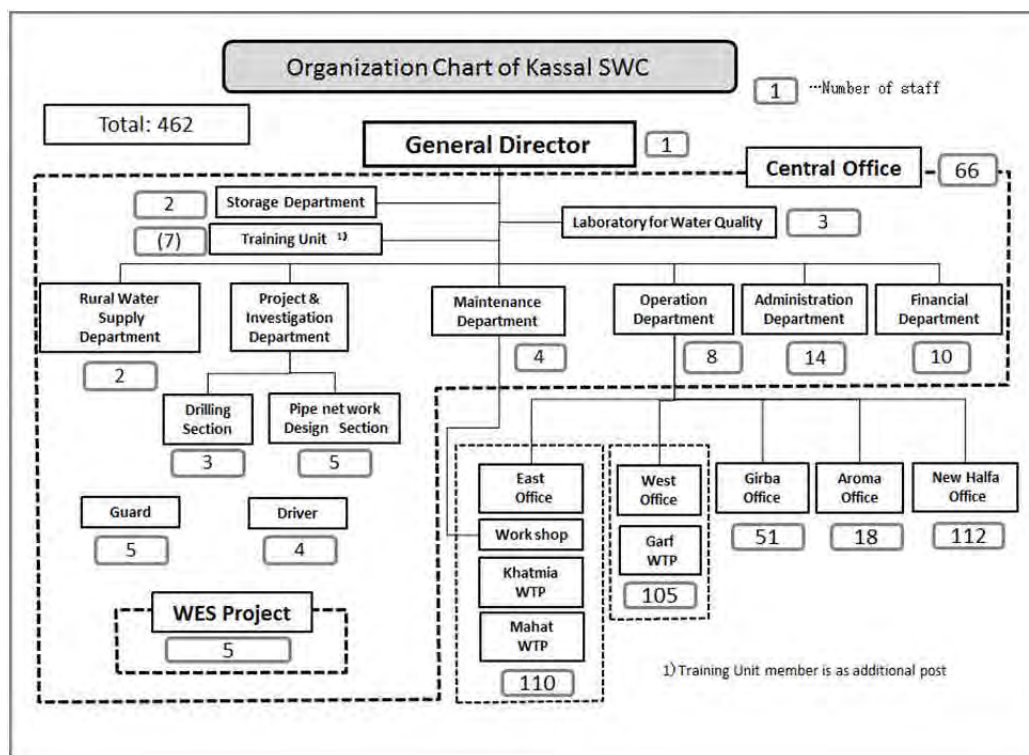


Figure 1.2: Organization Chart of Kassala SWC

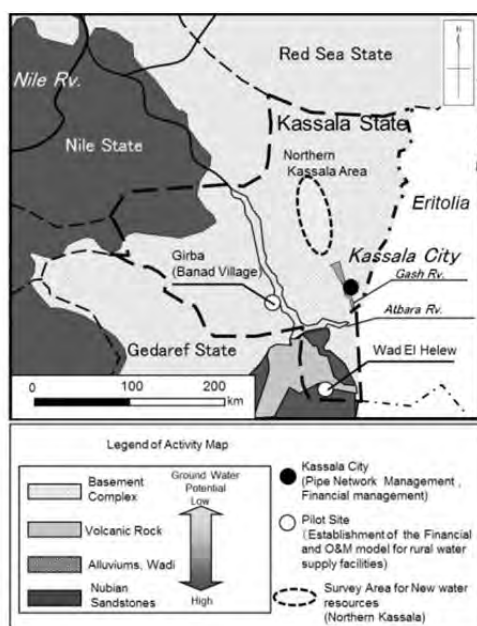


Figure 1.3: Target Areas in the Water Cluster

## 1.4 Sudanese Counterparts for the Water Cluster

The SWC is a counterpart of the Water Cluster in Kassala State Government. At the federal level, DWST gives advices and assists SWC’s activities.

## 1.5. Organization to proceed with the Water Cluster activities

This sub-section outlines organizational arrangements for the Project as a conglomeration of the five clusters.

### (1) Joint Implementation Team

The C/Ps for the Project are State Ministry of Finance, Economy and Labor Force (SMoF), State Water Corporation, State Ministry of Agriculture, Forestry, Irrigation, Animal Resources and Fishery (SMoAFIAF), State Ministry of Health, and Kassala Vocational Training Center (KVTC) in Kassala State Government. At the federal level, The Higher Council for Decentralized Governance (HCDG) is the coordinator for the Project, and other relevant ministries/organizations (Ministry of International Cooperation, Ministry of Finance, Ministry of Agriculture, Ministry of Health, Public Water Corporation, and Supreme Council for Vocational Training and Apprenticeship) provide technical support to the state-level C/Ps.

In order to facilitate the capacity development of the C/Ps, the Project needs to be implemented jointly by the C/Ps and JICA experts. Figure 1.4 shows the Joint Implementation Team between the Sudanese C/Ps and JICA experts in the five clusters, who plan, implement, monitor and evaluate the Project, based on the C/Ps’ initiative and ownership.

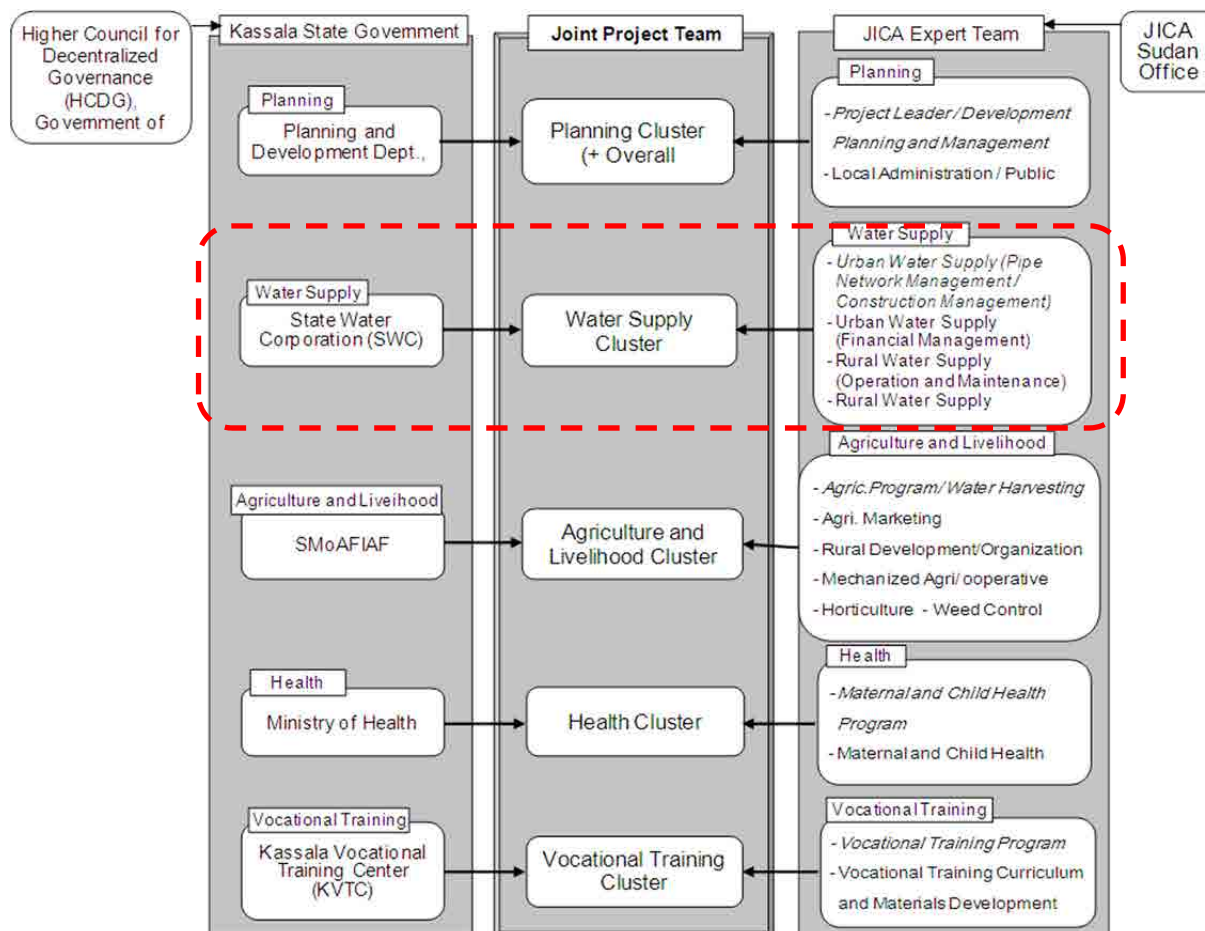


Figure 1.4: Joint Implementation Team for the Project



## (2) Regular Meetings

Since the Project covers five clusters and operates in five different offices, it is important for the Project to have good coordination among them to create synergy impacts. So the regular meetings (basically bimonthly), in which all C/Ps from five clusters participate, are organized to facilitate joint monitoring of the Project and exchange ideas to promote collaboration among various clusters. The joint field visits or other joint events by all five clusters were also organized.

## (3) Joint Coordinating Committee (JCC)

At the Kassala State level, a Joint Coordinating Committee (JCC) was organized to coordinate activities and make necessary decisions on the Project. The major roles of JCC are as follows:

- 1) To discuss and approve the annual work plan and the report of the Project.
- 2) To understand the progress of the Project based on the Joint Implementation Team's reports, and take necessary actions to solve problems, if any. (JCC will also discuss the possible change of the work plan and revision of the PDM of the Project.)
- 3) To share the achievements of and lessons from the Project and arrange activities to disseminate them to the whole Kassala state.
- 4) To coordinate the Kassala State Government to secure the local component budget for the Project and arrange timely disbursement of it to the counterparts

Members of JCC are shown in Table 1.3, which are the same as in the Preparation Phase of the Project. JCCs were organized two or three times a year when the Project submits the report.

**Table 1.3: Members of Joint Coordinating Committee (JCC)**

Chairperson of JCC		Director General (DG), State Ministry of Finance, Kassala
Members of JCC	Kassala State Government	- Director of Planning and Development (DPD), SMoF - Representative(s) of State Ministry of Health - Representative(s) of SMoAFIAF - Representative(s) of KVTC - Representative(s) of State Water Corporation - Others appointed by SMoF
	Federal Government	- Representative(s) of Ministry of International Cooperation - Representative(s) of Ministry of Finance and National Economy - Representative(s) of HCDG
	Japanese Members	- JICA Experts of the Project - Representative(s) of JICA Sudan Office - Others appointed by JICA Sudan Office

**Table 1.4: JCC Meetings during the Implementation Phase of the Project**

Project Year	JCC	Date	Main issues
First Project Year	1st JCC	June 5, 2011	Discussion of the work plan for the 1 <sup>st</sup> project year
	2nd JCC	November 3, 2011	Discussion on the progress of the Project based on the draft Progress Report No.1
	3rd JCC	March 6, 2012	Discussion of the progress in the 1 <sup>st</sup> project year based on the draft Progress Report No.2
2 <sup>nd</sup>	4th JCC	June 26, 2012	Discussion of the work plan for the 2 <sup>nd</sup> project year

Final Report (Water Cluster)

Project Year	5th JCC	December 20, 2012	Discussion of the results of Mid-Term Review
	6th JCC	March 14, 2013	Discussion of the progress in the first half of the 2 <sup>nd</sup> project year based on the draft Progress Report No.3, and report of Mid-Term Review to the Federal Government
	7th JCC	July 3, 2013	Discussion of the progress of in the second half of the 2 <sup>nd</sup> project year based on the draft Progress Report No.4
3 <sup>rd</sup> Project Year	8th JCC	September 29, 2013	Report of activities until 2 <sup>nd</sup> project year and discussion of the work plan for the 3 <sup>rd</sup> project year
	9th JCC	January 20, 2014	Discussion of the results of Terminal Evaluation
	10th JCC	April 28, 2014	Discussion of the outputs of K-TOP based on the draft Progress Report No.5

## **2. Basic Principles to Implement the Water Cluster**

### **2.1 Technical Principles to Implement the Water Cluster**

The following basic principles were emphasized during implementation of the Project as a common strategy among all JICA experts.

- 1) Respect and foster Kassala State Government's ownership and initiatives for the Project
- 2) Bring visible impacts of the Project at the early stage of the Project, so that the local population can enjoy the "fruits of the peace"
- 3) Improve the counterparts' primary works through the Project so that they can use their improved capacity sustainably and self-reliantly in their work

The following technical principles were emphasized in the Water Cluster:

- 1) Conduct training for SWC staff to enhance their capacity.
- 2) Strengthen practical technique through pilot projects.
- 3) Collaborate with PWCT and other state SWCs.

### **2.2 Administrative Principles to Implement the Water Cluster**

This project has the following two principles as operational strategy.

- 1) Strengthen communication among the Project team members to generate synergy effects among sectors
- 2) Implement the Project in cooperation with the JICA headquarters and the JICA Sudan Office

### **2.3 Key Points for Implementation of the Water Cluster**

It is necessary for the SWC to continue the efforts and achievement of PDM, especially in the second half of the Project period, so the SWC shall build a system to plan, do, and see their activities by themselves. SWC carries out the following tasks by the Project end.

- 1) Establish a team to update GIS maps and maintain facilities within SWC.
- 2) Recommend water tariff revision and organizational management improvement for the urban and rural water supply to Kassala State government:
- 3) Implement the following tasks (1) to (5) in sequence.
  - (1) Conduct an inventory survey, (2) plan a suitable design of construction based on the survey, (3) prepare bidding documents, and contract with contractor, (4) supervise the construction, and (5) assist communities to operate and maintain water supply facilities.
- 4) Establish financial and O&M models in Wad El Helew and Banard, Girba Locality.
- 5) Identify test drilling points for alternative water resource development based on the survey analysis by a geophysical survey team.
- 6) Implement planning and monitoring to solve management issues through Kaizen activities.



### 3. Progress of the Activities in the Water Cluster

#### 3.1 Flow of Activities in the Water Cluster

The figure below illustrates the work flow of the Water Cluster from the beginning to the end of the Project.

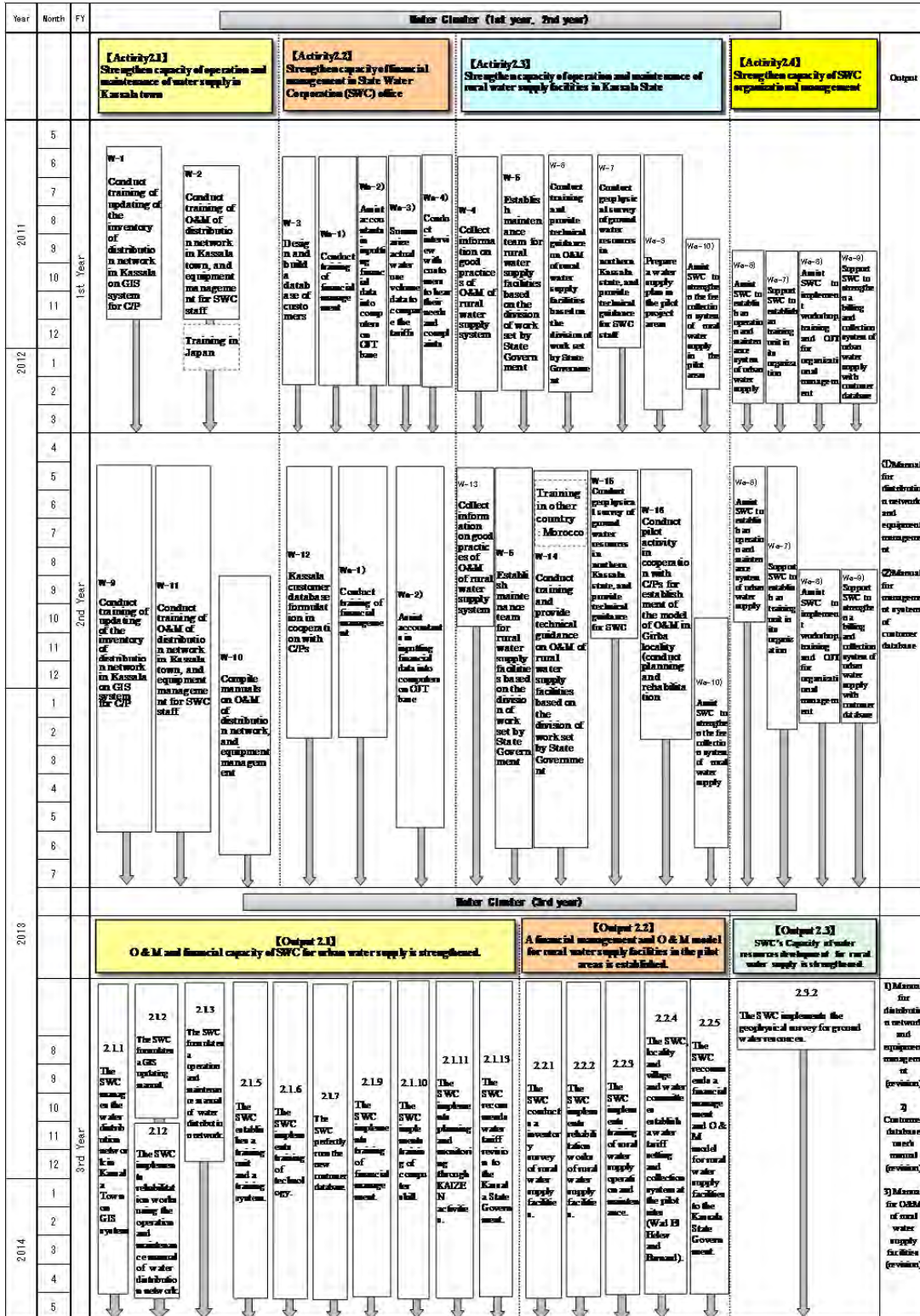


Figure 3.1: Work Flow of 1st Year Activities in Water Cluster

### 3.2 Summary of Progress of the Activities in the Water Cluster (from May 2011 to March 2015)

Project activities from the beginning to the end of the Project are illustrated below.

**Table 3.1: Summary of Progress of each activity**

<b>Cluster purpose:</b> Kassala State Water Corporation (SWC)'s capacity to provide service for Water Supply is strengthened.			
Output, Activity		Period	Progress of each activity
<b>Output 1</b>	O&M and financial capacity of the SWC for urban water supply is strengthened.		
<b>Activity 1.1</b>	The SWC manages the water distribution network in Kassala town on GIS system	Oct.9-20, 2011 Nov.13-Dec.1, 2011 Oct.9-20, 2011 Sep.30, 2012  Oct.24, 2012 Nov.28, 2012 Dec.5, 2012  Jan.20, 2013 Feb.20, 2013 Mar.6-20, 2013 Apr.3-17, 2013 May.1-22, 2013 Nov.25,2013  Jan.27,2014  Jan.27,2014  Jun.8,2014 Jun.15,2014  Aug.3,2014  Aug.5,2014  Aug.6,2014  Aug.7,2014 Aug.1-13,2014  Aug.14,2014  Aug.16-17,2014  Aug.20,2014  Aug.21.24,2014	Conducted GIS training, Beginner Course (12persons). Conducted GIS training, Intermediate course (14persons).  GPS/OJT (2persons) Completed inputting the GIS data for the western new town. Updated the GIS data for the northern new town in east bank. Made a training plan based on "GIS/GPS updating manual". Two GIS operators were selected in Kaizen meeting. 1 <sup>st</sup> meeting was held among GIS team. The GIS updating system started. GIS team updated 1 <sup>st</sup> pipe network inventory. 6 <sup>th</sup> GIS team meeting 7 <sup>th</sup> , 8 <sup>th</sup> GIS team meeting 9 <sup>th</sup> , 10 <sup>th</sup> GIS team meeting 11 <sup>th</sup> , 12 <sup>th</sup> GIS team meeting To replace AC pipes, AC pipe drawing classified by diameter was printed to be submitted to the farmers' bank (13 <sup>th</sup> , 14 <sup>th</sup> meeting). Implementation of the updating work by a GIS team, GPS data extraction of a 12 inch pipe position, and renewal of GIS data (15 <sup>th</sup> meeting). Implementation of the updating work by a GIS team, GPS data extraction of a 12 inch pipe position, and renewal of GIS data (15 <sup>th</sup> meeting). Mr.Isam conducted progress check of pipe renewal work. The pipe renewal work finished 32km(33%),total length is 97km . Mr.Amaru of DWSU director general and Mrs.Etidal of center of chief consented to hold K-TOP seminar in November. Confirmed the operational status in Khatmiyya and Mahata treatment plant and the water supply amount. Supported repair construction of ductile cast iron pipe of damaged 500. Conducted well management/ OJT(2persons). Conducted new well position mapping by the GIS (Ms.Atika, staff of West office). Attended the operation starting ceremony in the Khatmiyya water treatment plant. Conducted well management for valve control, water level check and data management by PC / OJT. Conducted management of quantity of water supply and valve control of main pipe line 500 /OJT(3persons). Assisted construction management for pipe renewal project. Conducted management of works progress and have a meeting for management.

<b>Cluster purpose:</b> Kassala State Water Corporation (SWC)'s capacity to provide service for Water Supply is strengthened.			
<b>Activity 1.2</b>	The SWC formulates a GIS updating manual	Sep.30, 2012 Nov.6-29, 2012	The updating manual (ver.1.0) was completed. Conducted the GIS training (practical course) by using the updating manual (8persons, the staff of East and West office).
<b>Activity 1.3</b>	The SWC formulates an operation and maintenance manual of water distribution network	Oct.31,2012 May.26,2013	The manual (ver.1.0, Arabic) of O&M for the water facilities was completed. Made a construction recording form. The maintenance department started to construction record.
<b>Activity 1.4</b>	The SWC formulates an equipment management manual	Aug.31, 2012 Sep.3-12, 2012 Oct.24, 2012 Nov.4-15, 2012 Feb.17-21, 2013 Mar. 16, 2013 Mar 24-28, Mar 31-April 2 Oct.16,2013 Feb.16-20,2014	The manual of the equipment management was completed. The equipment management training (19persons) Made a plan of the equipment management training for New Halfa branch office. Conducted equipment management training for New Halfa staff (21 persons). Conducted equipment management training for Girba staff. Conducted practical course "How to operate a crane truck" in collaboration with KVTC for SWC staff (5persons). Conducted equipment management training for Aroma staff branch office. The database of the supplied equipment which was shown in the equipment management manual was transferred to Mr. Isam who is the head of the Planning Department and is in charge of equipment. "Equipment management ledger creation" training was carried out in the New Halfa office.
<b>Activity 1.5</b>	The SWC establishes a training unit and a training system	Jul., 2011 Oct.10, 2012 Dec.9-13, 2012 Dec.12&13, 2012 Jan.2, 2013 Apr, 2013 May, 2013 Jun.19, 2013 Oct.27, 2013 Nov.17, 2013 Nov.23-24, 2013 Dec.4-5, 2013 Jan. 26-27, 2014	The training center was constructed in the east office. The 7 coordinators of training unit were selected. The periodic meeting was held among the members of training unit. The members made a plan of training. Conducted the O&M (electric engineering ) course (23persons) ONEP experts visited Kassala SWC. The periodic meeting (3 <sup>rd</sup> ) was held among the training unit members. They revised the training plan. Made a training plan of 2 <sup>nd</sup> water quality control course. Made a training plan of "PC network course" and "O&M, electric engineering and pump maintenance course" Discussed and authorized the next training curriculum Discussed and authorized the next training curriculum Participated in a joint seminar at Sennar State, targeting SWC training unit directors in all Sudan. Kassala SWC presented Kassala training curriculum. A manager at the accounting section presented a Kassala SWC experience of tariff revision at training of revenue collection at the White Nile SWC. Formulated training curriculum of the year 2014 at a training unit meeting. Implemented training of customer database input and management.
<b>Activity 1.6</b>	The SWC implements training technology	Sep.26-Nov.24, 2011 Sep.28-Oct.27, 2011 May., 2012 Jun.10-18, 2012 Nov.25, 2012 Dec.9-13, 2012	Conducted the training for the Leakage detector / OJT (7persons) Conducted the training for water flow measure instrument by ultrasonic wave method (2persons) Conducted the practice of the hydric calculation for pipe network design (1person) Conducted the training of geophysical survey analysis (15persons). The training unit members planned O&M (electric engineering) course. Conducted the training of O&M (electric engineering) course (Technician, 12persons) by SWC training unit.

<b>Cluster purpose:</b> Kassala State Water Corporation (SWC)'s capacity to provide service for Water Supply is strengthened.			
		Feb.3-7,2013 May.26-30, 2013 Jan. 23-25, 2013 Oct.7-10, 2013 Oct.21-24, 2013 Nov.3-7, 2013 Feb.16-Mar.13, 2014	Conducted the training of water quality control course (bacterially examination, sterilization method) (10persons). Conducted the training of water quality control course (Management of treatment plant) for SWC staff in New Halfa (10persons). Implemented training of "Primary course of CAD operation" for SWC engineers (participants: 7) Implemented training of "AURIS" for SWC engineers (participants: 4). Implemented training of "EPANET" for SWC engineers (participants: 7). Implemented training of "Construction management "for SWC engineers (participants: 3). Implemented training of "GPS and GIS" for SWC engineers at the SWC New Halfa office.
<b>Activity 1.7</b>	The SWC perfectly runs the new customer database	Jul., 2012 Aug., 2012 Sep., 2012 Nov., 2012 Dec., 2013 Jan.,2014	The SWC made a contract with a Sudanese IT company to formulate a new Customer Database with Visual Basic (software). The Customer Database has been run at the SWC East and West offices. Both SWC East and West offices have already transferred the customer data from the old database (MS-DOS) to the new database (Visual Basic). Water fee collection by the Electric Company started. The Customer data Service Department of the SWC East office started to compare the SWC customer data with those of the Electricity Corporation as a KAIZEN activity, thereby completing three (3) districts among the total, 52 districts. The West office also started to compare the customer data.
<b>Activity 1.8</b>	The SWC implements training of the new customer database	June 2013 Jan., 2014 Apr., 2014	The SWC formulated a Customer Database Operation Manual, thereby, giving training to four (4) staff in charge of database at the SWC East office. The SWC gave training to four (4) staff in charge of database at the SWC East office. The SWC gave training to two (2) staff in charge of database at the SWC West office.
<b>Activity 1.9</b>	The SWC implements training of financial management	Jun.12-16, 2011 Jun.26&27, 2011 Nov.22-24, 2011 Feb.26, 2012 May.21&22, 2012 Aug.14&15, 2012 Sep.16, 2012 Oct.7, 2012	Conducted a lecture of "Basic Financial Management: the first half" for Central, East and West office accountants (13 persons). Conducted a lecture of "Basic Financial Management: the first half" for Girba, New Halfa office accountants (10 persons). Conducted a lecture of "Basic Financial Management: the last half" for Central, East and West office accountants (6 persons). Conducted a lecture of "Basic Financial Management" for West office accountants (3 persons). Lecture: Mr. Abdallah Ahmed, chief of the financial department. Conducted a lecture of "Basic Financial Management" for TTEA extension officers (12 persons). Conducted an a lecture of "project evaluation " for DPD staff, Ms. Nawal, Ms. Amani, etc. (6 persons) Conducted a lecture of "Basic Financial Management" for New Halfa office accountants. Lecture: Mr. Abdallah Ahmed, chief of the financial department. Conducted a lecture of "How to prepare the trial balance sheet & the financial statement "for Girba office accountants.



<b>Cluster purpose:</b> Kassala State Water Corporation (SWC)'s capacity to provide service for Water Supply is strengthened.			
		Dec.17, 2012  Jan.21, 2013  Feb.9-21,2013  Mar.27-28, 2013  Jun.2, 2013  Jun.17, 2013  Apr.28, 2014	Lecture: Mr. Abdallah Ahmed, chief of the financial department.  Conducted a lecture of "How to prepare the trial balance sheet & the financial statement "for Aroma office accountants.  Lecture: Mr. Abdallah Ahmed, chief of the financial department.  Conducted a lecture of "Records of incomes/ expenses and cash reserve" for village operators at Banard village in Girba Locality (3persons).  Conducted a lecture " Internal auditing" course for SWC staff  Conducted financial training in cooperation with the "Agriculture and Income Generation Activities" for the women groups involved with biscuit making and restaurant business  Mr. Abdra, chief accountant, gave guidance of water tariff in Banard village, Girba Locality.  Conducted a lecture of finance to a farmer growing onions, agricultural extension officers and women of the "Income Generating Activities" in the Agriculture Cluster.  Conducted a follow-up lecture of finance to women of the "Income Generating Activities" in the Agriculture Cluster.
<b>Activity 1.10</b>	The SWC implements training of computer skill	Jul., 2011  Jul.7-Sep.29, 2011  Sep.25-Oct.27, 2011  Oct.2011  Jun.-Jul, 2012    Jan.9-24, 2013    May 19-30, 2013    Oct. 27-29, 2013	Conducted PC training (Windows, Word, Excel, and Power Point).  Central office accountants (7persons)  Central office administration staff (8persons)    East office staff (4persons) West office staff (7persons) New Halfa office staff (18persons) Girba office staff (20persons) Aroma staff (20persons)  Conducted a lecture "Data management (PC maintenance)" course  Lecturer: a professor at Kassala university  Conducted a lecture "Data management (PC network)" course.  Lecturer: a professor at Kassala university    Conducted a course of "Internet". Lecturer: Mr.Edres, JICA Team, three (3) participants
<b>Activity 1.11</b>	The SWC implements planning and monitoring through KAIZEN activities	May.31, 2012- Jun., 2013 May.24,2013 2013/5/24-06/07	SWC staff held Kaizen meeting every Wednesday (Total 32 times from May 2012 to January 2013).  Mr. Isam, manager of planning department participated KAIZEN training in Bangladesh.
<b>Activity 1.12</b>	The SWC implements rehabilitation works using the operation and maintenance manual of water distribution network	Sep.20, 2012  Oct.24, 2012  May.31,2013  Nov.19,2013  Jan.26,2014	Collected the number of customer complaints of End and West offices from January to August, 2012.  Collected the number of customer complaints of East and West offices in September, 2012.  Collected the number of customer complaints of East and West offices in May, 2013.  Collected of the complaint number data by the end of October.  Updated of collection data of the complaint and measure data by the end of December
<b>Activity 1.13</b>	The SWC recommends water tariff revision to the Kassala State Government	Jul., 2011  Feb., 2012	The SWC installed fifty-five (55) water meters in houses, offices, hotels restaurants and others to make a survey of their individual water use volume.  The JICA Team explained actual water consumption measured by the meters, to the SWC General Director. The Director understands the current tariff is unfair among

<b>Cluster purpose:</b> Kassala State Water Corporation (SWC)'s capacity to provide service for Water Supply is strengthened.			
		Sep., 2012, June 2013  Dec.-Jan., 2013 Jun.10,2014	<p>“Households (Class 1, 2, 3)”, “Commercial” and “Governments”.</p> <p>The JICA Team explained actual water consumption measured by the meters, in the KAIZEN meetings in Sep.2012, and June 2013. SWC staffs understand the current tariff is unfair among “Households (Class 1, 2, 3)”, “Commercial” and “Governments”.</p> <p>SWC formulated a tariff revision and obtained an approval by the Kassala State Council.</p> <p>Confirmed the collection rate based on the new tariff table. (79% in East office,68% in West office on May,2014)</p>
<b>Output 2</b>	A financial management and O&M model for rural water supply facilities in the pilot areas is established.		
<b>Activity 2.1</b>	The SWC conducts an inventory of rural water supply facilities.	Feb. to Jun., 2012  Sep. 1-25, 2012  Dec.5, 2013  Feb.2014	<p>Completed an inventory survey of rural water supply facilities in Wad El Helew Locality and Girba Locality.</p> <p>Ratio of functioning the rural water supply facilities in Wad El Helew and Girba localities Wad El Helew Locality: 66% Girba Locality: 57%</p> <p>Completed an inventory survey of rural water supply facilities in Rural Kassala Locality Rural Kassala Locality : 57%</p> <p>Started to carry out an inventory survey of water supply facilities at Rural Aroma Locality</p> <p>Implemented an inventory survey of water supply facilities at West Kassala Locality</p>
<b>Activity 2.2</b>	The SWC implements rehabilitation works of rural water supply facilities	Nov., 2011-Mar., 2012 Mar.12, 2012  Apr., 2012  Jun.to Oct., 2012  Sept.11, 2012  Jan.22, 2013  May.15,2013  May.22-23,2013  Feb. 1 <sup>st</sup> , 2014  Jun. 9 <sup>th</sup> , 2014  Jan.-Aug., 2014  Dec., 2013 – Nov., 2014	<p>Rehabilitation and construction of the Water Supply Facilities in Wad El Helew Locality</p> <p>The SWC and the locality commenced water supply for residents in Wad El Helew.</p> <p>SWC staff commenced the well rehabilitation in Kassala town.</p> <p>Rehabilitation and construction of the Water Supply Facilities in Banard village, Girba Locality</p> <p>The SWC completed a well rehabilitation (WES project) in Gamman, Aroma Locality.</p> <p>The SWC and the community commenced water supply for residents in Banard village, Girba Locality.</p> <p>Updated the inventory in Wad El Helew Locality and Girba Locality. Thereby, selected villages to install solar pumping systems.</p> <p>Rehabilitated of a well, constructed by Red Cross in Tahajir village, Telkuk Locality.</p> <p>Construction of the solar pumping system in Hamshkoreib town, Hamshkoreib locality</p> <p>Maintenance department conducted the monitoring of water supply facilities.</p> <p>Construction of the solar pumping system in 5 villages (Jirra village in Wad El Helew locality, Um-yoi village in Aroma locality, Hamshkoreib town in Hamshkoreib locality: 2 sites, Awad village in Rural Kassal locality)</p> <p>The SWC rehabilitated 27 wells and cleaned the 7 new wells by the mobile workshop, which JICA procured.</p>
<b>Activity 2.3</b>	The SWC implements training if rural water supply operation and maintenance	Jun. to Aug., 2011	<p>The training in PWCT</p> <p>SWC engineers participated the training for water supply engineering in PWCT.</p> <p>In 2011, 10 courses, 19persons</p> <p>In 2012, 9 courses, 16 persons</p>

<b>Cluster purpose:</b> Kassala State Water Corporation (SWC)'s capacity to provide service for Water Supply is strengthened.			
		<p>Mar.7&amp;8, 2012</p> <p>Oct., 2012</p> <p>Dec.24-27, 2012</p> <p>Dec.25&amp;26, 2012</p> <p>Jan.9, 2013</p> <p>Jan.24, 2013</p> <p>Jan.12-18, 2013</p> <p>Oct.2013</p> <p>Apr. 27, 2014</p> <p>Feb.- Nov., 2014</p>	<p>Conducted training of "O&amp;M for water supply facilities" and a lecture of "Records of incomes/ expenses and cash reserve" for village operators (9persons).</p> <p>The manual (ver.1.0, Arabic) of O&amp;M for the water facilities was completed.</p> <p>Conducted training of "O&amp;M for water supply facilities" for village operators (4persons).</p> <p>SWC staff conducted training of "O&amp;M for water supply facilities" in Abosher, Jira and Magareb, Wad El Helew...</p> <p>Conducted lecture of "Water quality and Hygiene" for teachers, locality officers, and hospital staff (20persons.)</p> <p>Conducted a lecture "O&amp;M for the solar pumping system" for village operators (3persons).</p> <p>Conducted a training "well management" for White Nile SWC staff.</p> <p>Lecture: Mr. Abdulsalam, Kassala SWC staff</p> <p>SWC staff and Barnard Village water committee members instructed practical operation and maintenance manner for people of Tahajir where solar pumping system will be installed.</p> <p>The director of maintenance department gave technical guidance of O&amp;M to the water committee member in Awad village in Rural Kassala locality.</p> <p>Maintenance department gave periodically technical guidance of the O&amp;M to the operator in Wad El Helew town.</p>
<b>Activity 2.4</b>	The SWC, locality and village and water committees establish a water a water tariff setting and collection system at the pilot sites (Wad El Helew and Banard).	<p>Wad El Helew</p> <p>Nov.30, 2011</p> <p>Aug.27-Sep.2, 2012</p> <p>Oct., 2012</p>	<p>Proposed a financial management and O&amp;M model at Wad El Helew (Small Town Model) will be sustainable system over 10 years.</p> <p>In order to know the benefits of rehabilitation of water yards, an impact survey was conducted for 100villagers in Wad El Helew.</p> <p>The SWC and locality opened a bank account.</p> <p>The SWC staff dispatched at Wad El Helew commenced managing the cash reserve.</p>
		<p>Banard in Girba Locality</p> <p>Oct., 2012 &amp; Jan., 2013</p> <p>Jan.21, 2013</p> <p>Feb.-May, 2013</p> <p>June 25, 2013</p> <p>Oct.28, 2013</p> <p>Jan., 2014</p>	<p>The SWC held a meeting about a water tariff system in Banard.</p> <p>Conducted a lecture of "Records of incomes/ expenses and cash reserve"</p> <p>SWC periodically carried out monitoring in rural area.</p> <p>Mr. Abdra and Mr.Ali Hassan, accounting section, visited Banard Village to examine, with the accounting book, revenues and expenses of the water supply and received cash of SDG 2,325 from the Committee.</p> <p>Mr. Abdra, a manager of the accounting section, visited Banard Village to examine, with the accounting book, revenues and expenses of the water supply and received cash of SDG 1,400from the Committee.</p> <p>Mr. Abdra, a manager of the accounting section, visited Banard Village to propose a tariff revision (SDG 12/month→ SDG 15/month. The village implemented the tariff increase, up to SDG 15/month.</p>

<b>Cluster purpose:</b> Kassala State Water Corporation (SWC)'s capacity to provide service for Water Supply is strengthened.			
<b>Activity 2.5</b>	The SWC recommends a financial management and O&M model for rural water supply facilities to the Kassala State Government	Mar., 2012 to Jan., 2013  Jan.-Feb., 2014	1) Supported the locality and community to establish a financial management and O&M model for rural water supply facilities in the pilot areas (Wad El Helew & Banard)  2) Discussed a financial management and O&M model for rural water supply facilities between the SWC and JICA team. They consented that the model at middle population town like Wad El Helew should be distinguished from small villages like Banard.  Formulated a role demarcation chart of the two (2) models with SWC staff and prepared a recommendation for the Kassala State Government. -SWC and the JICA Expert Team explained the models to the Commissioner of the New Halfa Locality -The director of SWC rural water supply department explained the models for representatives of Rashaida tribe and State council men from Telkuk Locality.
<b>Output 3</b>	SWC's Capacity of water resources development for rural water supply is strengthened.		
<b>Activity 3.1</b>	The SWC conducts training of geophysical survey for ground water resources	May.16-21, 2012 Jun.10-18, 2012 Jul.1-5, 2012 Jul.8-12, 2012 Dec.16-24, 2012	Conducted a lecture of "geophysical survey method" for SWC engineers (1person). Conducted a lecture of "Analysis method of 2D electrical sounding" for the SWC engineers (9persons). Conducted a practice "Field survey on site" for SWC engineers (8persons). Conducted a lecture "Geophysical survey" for other states SWC engineers (12persons). Lecture: Mr. Moutaz, Kassala SWC geological engineer. Conducted a lecture "Geophysical survey" for three Darfur states SWC engineers (15persons). Lecture: Mr. Moutaz, Kassala SWC geological engineer.
<b>Activity 3.2</b>	The SWC implements the geophysical survey for ground water resources	Implementation of the geophysical survey Oct.4-7, 2011  Oct.19-Nov.3, 2011  Nov.15-Dec.1, 2011  Oct.7-10, 2011  Nov.20-29, 2012  Mar.23-28, 2013 Apr.1-24, 2013  May 22-29, 2013	Location: Mecali, Aroma Locality Number of survey lines: 3 lines Total length of survey lines: 930m The survey was stopped by local problems. Location: Gamman, Aroma Locality Number of survey lines: 14 lines Total length of survey lines: 5,005m Location: Degin, North Delta Locality Number of survey lines: 7 lines Total length of survey lines: 3,260m Location: Awaetara, Kassala town Number of survey lines: 5 lines Total length of survey lines: 1,280m Proposed two test boring point based on the result of survey. Location: Wagger North Delta Locality Number of survey line: 10 lines Total length of survey line: 4,100m Conducted a resurvey around Wagger area. SWC staff analyzed the result of geophysical survey. Thereby, SWC staff proposed test drilling points to North Delta Locality and Red Crescent. Conducted a test drilling at Southern Wagger with a budget of North Delta Locality. It was difficult to discharge enough water. However, the actual geological formation indicated mostly the same as one expected in the analysis data. Thus,

<b>Cluster purpose:</b> Kassala State Water Corporation (SWC)'s capacity to provide service for Water Supply is strengthened.			
		Oct.27-31, 2013	the drilling data proved that the result of SWC's analysis was highly accurate.
		Nov.7-11, 2013	Conducted additional five (5) test drillings at Jamam, Aroma Locality.
		Jan.-Nov., 2014	SWC staff and the JICA Expert made a survey of prospective test drilling points. The SWC staff took an initiative to conduct an analysis of geological formation to select better testing points.
			Planning and investigation department in SWC conducted the geophysical survey in 27 sites in order to develop the water resources.

### 3.3 Activities Implemented in the Water Cluster from May 2011 to March 2015

The following is a brief summary of activities from the beginning to the end of the Project.

#### Output 1: O&M and financial capacity of SWC for urban water supply is strengthened.

##### (Activity 1.1) The SWC manages the water distribution network in Kassala Town on GIS system




The Project implemented "GIS and GPS beginners' class course training" (attendance: 12 staff) from October 9 to 20, 2011, and then "GIS and GPS intermediate course training" (attendance: 14 staff) from November 13 to December 1, 2011.

The SWC assigned: one staff and another in charge of GIS data input and on-site information gathering, respectively, in each East and West office, on November 28, 2012, thereby establishing "GIS team" to update the pipe network institution map. The GIS team held the first meeting on January 20, 2013, starting the pipe network institution map update. The GIS meeting was held twice a month.



In November, 2013, upon request by the Director General of SWC, the JICA expert assisted SWC staff by OJT to formulate an asbestos pipe replacement plan to submit to a farmers' bank. As a result, the bank authorized the loan and the replacement construction started on January 19, 2014. SWC aims to complete approximately 130km asbestos pipe replacement in the east area at the end of August 2014.

		
OJT for GPS at a site (July 6, 2011)	Checking the GIS pipe network map at the East office (January 3, 2013)	The GIS team is checking a 12inch, new pipe line location using GPS (January 27, 2014)

According to the pipe replacement plan, the new distribution pipe total length is 98.2 km in the east Kassala town area. Until now, The SWC did not have experience in large-scale renewal construction. Therefore it was necessary to support construction management of this large-scale renewal works smoothly. On August 21, 2014, The JICA expert had a meeting with SWC staff, a farmers' bank consultant and a contractor (MMC) and held a supervision of works meeting using a pipeline GIS map. The SWC has decided to check the electric laying of the pipes in the constructing location, the quantity and a road crossing point, the telephone cable and the telecommunication cable. They discussed this with a related company. They agreed to have a supervision of works meeting regularly. The SWC established a construction management system of the pipe renewal work.

		
The SWC supervision of works meeting using the GIS map: Implementation of a renewal construction meeting by a bank consultant and a contractor. (August 21, 2014)	The SWC supervision of works meeting using a GIS map: Mr.Isam (SWC) explained the renewal construction plan. (August 21, 2014)	The SWC supervision of works meeting using a GIS map: Mr.Isam (SWC) explained the renewal construction plan. (August 21, 2014)

On August 24, 2014, The farmers’ bank consultant requested for SWC to present a pipeline installation schedule and process. The SWC project director explained them using a pipeline map. The pipeline map is shown in Fig. 3.2.

	
A supervision of works meeting : SWC Director General,Mr.Hashim explained phase II, a new additional construction point and a priority construction point using GIS pipe network map. (August 24, 2014)	Supervision of works meeting: A farmers’ bank consultant questioned the phase II SWC Director General, Mr. Hashim and project director, Mr. .Isam answered the questions. (August 24, 2014)

The SWC had begun pipe renewal construction on January 19, 2014. They have finished renewal construction of 51.1 km on December 31, 2014. The progress ratio was 52% as shown in Table 3.2. 51.1 km of pipe was constructed in 11 months. According to this time period, experience of construction firm was 4.645 km/a month. It takes more than 10 months for 45.9 km of pipe setting. The pipe replacement work will be finished at the end of October, 2015. The SWC has to construct an every house connection pipe in a new water supply area after the renewal construction. The house connection costs will be shared by SWC and customers. The pipeline map is show in Figure 3.3.

**Table 3.2 Actual Pipe replacement work progress**

Pipe Diameter ( inch )	Plan of Project	Phase I	Phase II	Total	Progressive rate (%)
	Pipe Length (km )	From 19 Jan 2014 to 20 May 2014	From 21 May 2014 to 31 Dec 2014	Length ( km )	
		Length(km)	Length(km)		
12	1.4	2.7	0.0	2.7	192
10	14.3	5.4	1.3	6.7	47
8	6.4	2.0	2.0	4.0	63
6	26.9	6.0	6.0	12.0	45
4	49.2	15.7	10.0	25.7	52
<b>Total</b>	<b>98.2</b>	<b>31.8</b>	<b>19.3</b>	<b>51.1</b>	<b>52</b>

The plan was changed about the length of 12inch, so it increased.



Figure 3.2: Pipeline Map in Kassala town

**(Activity 1.2) The SWC formulates a GIS updating manual.**

The GIS team completed formulation of "manual of GIS data update (Ver.1 Arabic version)" on September 30, 2012, thereby conducting a practical training course from November 6 to 29, 2012. The team has carried out updating work every month with this manual since January, 2013. The JICA expert assisted for SWC to input data and make a graph of customer complaints and revise the GIS updating manual.

**(Activity 1.3) The SWC formulates an operation and maintenance manual of water distribution network.**

The Project completed formulation of a "facility maintenance management manual (Ver.1 Arabic version)" on October 31, 2012. In addition, the JICA expert supported, by OJT, formulation of the construction record book (repairmen record) which will be applied to maintenance management. In May, 2013, the SWC maintenance section started to record maintenance works. Some veteran engineers are able to transfer their expertise to young engineers, with the construction record book.

<p>Completion of the GIS data update manual (October 31, 2012)</p>	<p>Revision of the GIS data update manual (November 4, 2012)</p>	<p>Completion of the facility maintenance management manual Arabic version (October 31, 2012)</p>

**(Activity 1.4) The SWC formulates an equipment management manual.**

In October 2011, the JICA supplied SWC with equipment required for leakage control and well repair work. In November 2011, the JICA expert instructed how to properly arrange and manage the equipment in the SWC East office workshop and container house provided by the local component. The JICA expert supported attachment of the ID number to the equipment, and formulation of the equipment list formulated by Excel so that SWC staff understand it quickly. In addition, the Project completed formulation of an "equipment management manual (Ver.1 English-language edition)" on August 31, 2012, thereby implementing "equipment management manual training" (19-person attendance) from September 3 to 12, 2012. Because SWC staff in charge of equipment management are required to use spreadsheet software, the Project conducted Excel training for them.

Since establishment of the SWC training unit in October 2012, the unit has conducted equipment management training as a part of "equipment management/ operation course (heavy industrial machine), as described below.




The database of the supplied equipment, shown in the equipment management manual, was transferred on November 16, 2013 to the head of the Planning Department, Mr. Isam who is in charge of equipment management. Then, SWC started the equipment management for all the equipment.



To begin with, the Project implemented "equipment management manual training" for New Halfa office staff from February 16 to 20, 2014 (attendance: 10 staff). The equipment management training track record by the SWC training unit is as shown in Table 3.2.

**Table 3.3: Equipment management training track record by a SWC training unit**

No.	Date	Course	Lecturer	Trainee	Location
1	Oct.24,2012	Equipment management manual training (implementation plan)	Mr.Anis National staff of K-TOP	SWC staff in	New Halfa office
2	Nov.4-15,2012	Equipment management manual training (SWC staff)	Mr.Anis National staff of K-TOP	SWC staff (21persons) in New Halfa office	New Halfa office
3	Feb.17-21,2013	Equipment management	Mr.Anis National staff of K-TOP	SWC staff in Girba office	Girba office
4	Mar.16,2013	Operation of Heavy Equipment Course	Mr. Kimura, JICA expert, Lecturer KVTC	Drivers of SWC (5 persons)	KVTC
5	Mar.24-28,2013 Mar.31-Apr.2,2013	Equipment management	Mr. Anis National staff of K-TOP	SWC Aroma office staff (5 persons)	Aroma office
6	Feb.16-20,2014	Equipment management book creation course	SWC staff: Mr.Jafar, Mr. Anis National staff of K-TOP	SWC New Hala office (10 persons)	New Halfa office

		
Supplied equipment which is stored in a container (November, 2011)	Attachment of equipment ID number (November, 2011)	Equipment management manual training course (September 3, 2012, SWC Central office)

**(Activity 1.5) The SWC establishes a training unit and a training system.**

The JICA Expert Team supported a SWC training unit which was established in October, 2012 to conduct training and lecture. The following table shows the training schedule of the SWC from December 2012 to March, 2014. The black bar chart indicates the training that has been conducted. The training unit members have held unit meetings once a month. They decided future training schedule in this meeting. The members will conduct the planning and implementation of each course, as coordinators.

The JICA Expert Team and Training Unit Director agreed in middle of January 2014 that SWC implement its training with a budget prepared by SWC, such as lecturer fees, transportation expenses.

Actually, SWC paid a lecturer fee, 2000 SDG, to the instructor of the “Organizational Management Course” conducted in February 2014.

**Table 3.4: Actual Training by the Training Unit**

No.	Course	2012	2013												2014			
		12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	
1	O&M/Electrical and Mechanical Engineering Course	■		■	■													
2	Survey Equipment Course	■						■						■				
3	Equipment Management/Operation of Heavy Equipment Course			■		■							■	■				■
4	Data Management Course		■	■				■										■
5	Organization Management Course													■		■		■
6	Financial Management Course		■		■			■	■									
7	Water Quality Control Course			■									■					
8	Rural Development Course		■	■				■										

**(Activity 1.6) The SWC implements training of technology.**

**1) Technical training in Kassala SWC**

Much technical training has been carried out by the JICA Expert Team and the SWC staff since the Project start in May 2011. The typical training is described below.

a) training of construction supervision

The JICA Expert Team and SWC staff carried out training of construction supervision for SWC engineers from July 11 to 19, 2011. In this training, the participants formulated a Wad El Helew water supply facility construction plan as an example.

b) training of GIS and GPS

The JICA expert carried out GIS training and GPS by OJT from October to December 2011. As a result, the SWC staff were able to operate GIS by themselves for the first time, and understood GIS’s function and usefulness. Moreover, those participants have mastered technology at actual practice level of position data collection and pipe network distance calculation to formulate a West area pipe network management map by GIS and update the existing GIS East area pipe network map.

c) OJT of the leakage detector and the ultrasonic flow meter

The JICA expert carried out OJT on the leakage detector and the ultrasonic flow meter. The leakage detector is used for leakage investigation and existing pipe position. The participants, therefore, were very eager to learn and were able to master the fundamental operation method in a short period of time.

d) Training of “the water quality control in treatment plant”

The training unit conducted a training of water quality control in atreatment plant from May 26 to 30, 2013. This training program took up the problem of water quality in New Halfa town. Before the training, Ms. Amal, the laboratory manager of SWC, took samples of water in some points along the canal from Girba town to New Halfa town. Ms. Amal reported on the problem of water quality in New Halfa. In the last day of the training, the participants clarified the issues in New Halfa town and discussed the causes of these issues at a workshop.

		
The SWC staff took a sample of water from canal	The Khartoum SWC staff conducted a lecture for Kassala SWC staff	All participants clarified the issues in the process of treatment water.

**Table 3.5: Problem of water quality and the result of cause analysis in New Halfa town**

No.	Issues		
1	The Ministry of Health reported many cases of water related diseases in New Halfa town. (see Fig.4.2)		
2	Coliform bacteria were found at all sampling point in the canal and treatment water.		
3	Turbidity after treatment indicates more than 5NTU, standard of water quality in Sudan.		
Analysis			
No.	Treatment Process	Causes	Related Issue
	Raw water transmission – Intake point (canal)	<ul style="list-style-type: none"> <li>The livestock excretion contaminated the canal water, because the canal wasn't protected.</li> <li>Agricultural chemical and household drainage water might contaminate the canal water in rain season.</li> </ul>	1 , 2
	Pretreatment (Sedimentation basin)	<ul style="list-style-type: none"> <li>Sedimentation basin does not function due to high water demand.</li> </ul>	1 , 2 , 3
	Suspended solid contact clarifier	<ul style="list-style-type: none"> <li>Suspended solid contact clarifier isn't functioning.</li> </ul>	1 , 2 , 3
		<ul style="list-style-type: none"> <li>Amount of coagulant in the clarifier is not enough.</li> </ul>	1 , 2 , 3
		<ul style="list-style-type: none"> <li>Sludge isn't removed due to the mechanical trouble.</li> </ul>	3
	Rapid sand filtration	<ul style="list-style-type: none"> <li>Filter media doesn't fill a standard spec.</li> </ul>	1 , 2 , 3
	Chlorine treatment	<ul style="list-style-type: none"> <li>Chlorine injection was not installed.</li> </ul>	1 , 2

## 2) Cooperation with other donors

The SWC training unit cooperated with KVTC and planned technical training and put it into effect. The following table shows actual technical training with the KVTC for SWC staff.

**Table 3.6: Actual technical training for SW staff in cooperation with other clusters**

Date	Organization assisting SWC	Technical training program	Outputs
March 16, 2013	KVTC	Implementation of "Crane truck operation" training by a KVTC instructor	Five (5) driver candidates improved their technical capacity.
December 8-12,	KVTC	Implementation of "Operation and maintenance of generators and pumps" by two (2) KVTC instructors	15 technical staff understand basic operation and maintenance manners

### **3) Cooperation with DWST**

The Project implemented special technical training for the Kassala SWC in cooperation with DWST, from September to November, 2011. The SWC and project team made training courses for the 15 SWC staff mainly consisting of young engineers.

Afterward, the SWC dispatched its staff to DWST, having paid the training fee and expenses every time to DWST. Those participants started to offer training of trainers (TOT) at the Kassala SWC Training Unit.

Mr. Moutaz, an SWC engineer, received an invitation to give a lecture at the PWCT for geophysical survey (2D electrical sounding). From November 20 to 29, 2012, Mr. Moutaz conducted training of geophysical surveying for three (3) Darfur SWC staff. The content of the lecture is: method of 2D electrical sounding for water resource development. He already conducted the same training in July 2012. This is the second time.

### **4) Cooperation with other state SWCs**

SWC staff are using a mobile workshop truck with a crane, air lifting, a borehole camera, and other tools and equipment to carry out rehabilitation work at not only the pilot project areas but also other areas. In January 2013, Mr. Abdulsalam, SWC staff, obtained an invitation to give a lecture of well rehabilitation. In February 2013, he conducted the training in Sennar State as well as in White Nile State.

From June 3-5, 2013, the JICA Expert team planned and conducted a study tour to Gedaref SWC and Hawata SWC in order to exchange information about rural water supply and learn know-how.

GIZ implemented a technical transfer for the Hawata SWC from 1983 to 1998. As a result, the Hawata SWC was able to establish an advanced O&M system in Sudan. The Hawata SWC is currently supplying the water for Hawata town and 49 villages. One of two SWC staff first visited Hawata town. The advanced management of water works in Hawata, Gedaref State impressed the two SWC staff participating in this study tour. The following points show the advantage of Hawata SWC over the other SWC organizations.

#### **(a) The policy of management autonomy for water works**

The Hawata SWC has autonomy of management. Before the GIZ started the project, the German government reached an agreement with Sudan government about the autonomy of the Hawata SWC management. No organizations could, thus interfere in the decision of Hawata SWC according to the agreement. The board of directors, which consists of the water committee representative in each area, the director general of the Gedaref SWC, the director general of the Sennar SWC and the representative of operators, have been able to make a decision concerning the personnel affair, the water tariff setting and financial management.

#### **(b) Water Tariff rate**

The water tariff rate is equally 4.4SDG/ m<sup>3</sup> in the water supply area. The Hawata SWC reviews every year the rate based on the water production cost. After approval of the board, the Hawata SWC would revise the water tariff for the SWC accountant staff station in each area. The accountants calculate the total volume of sales based on the sales record. The Hawata SWC pays 0.24 SDG for 1 m<sup>3</sup> sales volume to each operator in addition to their monthly salary as an incentive fee.

### (c) Water balance management

The Hawata SWC installed one thousand four hundred (1,400) water meters at the water intake, distribution and supply. The operators report monthly data to the manager of O&M, planning department. The manager accumulates the data and makes an analysis of the water balance. Through this management, the Hawata SWC could obtain data of Revenue water, water volume for billing to clients among total water distribution volumes.

**Table 3.7: Advantages of the Hawata SWC over the other SWC organization**

Advantages of the Hawata SWC		
No.	Category	advantages
1	Management of Organization	<ul style="list-style-type: none"> <li>Hawata SWC/ the board of directors have management autonomy, without political interference.</li> </ul>
		<ul style="list-style-type: none"> <li>The each manager in the departments has a responsibility.</li> </ul>
		<ul style="list-style-type: none"> <li>The Hawata SWC has an information sharing system among managers.</li> <li>Each manager has to make a monthly report to the general director.</li> </ul>
		<ul style="list-style-type: none"> <li>Water committee leaders (“watermen”) conduct monitoring and reporting.</li> <li>The Hawata SWC chooses some members in the board of directors from watermen...</li> </ul>
2	Financial Management	<ul style="list-style-type: none"> <li>Hawata SWC set water tariff based on water production cost.</li> </ul>
		<ul style="list-style-type: none"> <li>The Hawata SWC pays an incentive for operators, 0.24SDG / m<sup>3</sup>.</li> </ul>
		<ul style="list-style-type: none"> <li>The Hawata SWC prepares a financial report every six (6) months.</li> </ul>
3	Maintenance	<ul style="list-style-type: none"> <li>The Hawata SWC conducts a Water Balance Management by water meters installed in 1,400points.</li> </ul>
		<ul style="list-style-type: none"> <li>The Hawata SWC conducts a standby maintenance system.</li> </ul>
		<ul style="list-style-type: none"> <li>The Hawata SWC conducts a preventive maintenance</li> </ul>
		<ul style="list-style-type: none"> <li>SWC responds quickly to customer complaints. As result, the number of complaint is few (0-1 complaint/month).</li> </ul>



The Hawata SWC staff explained to the Kassala SWC staff, how to control pumps that are located about 30km away from Hawata town.



The Kassala SWC staff interviewed a financial manager in the Hawata SWC.



The Kassala SWC staff visited main raw water transmission line from the well field to Hawata town.

### 5) Cooperation with Japan's grant aid project

The Project carried out training of construction management in November 3-7, 2013 at the site of Japan's grant aid project of Khatmiyya Water Treatment Plant pipe installation under construction, targeting SWC three (3) engineers. Some Japanese experts of the grant aid project explained pipe materials, installation methods of construction management.

From August 16 ,2014 to August 21, 2014, The JICA expert instructed about well management , operation/maintenance and water distribution at the Khatmiyya water treatment plant. The JICA expert carried out this instruction by collaboration with the Japanese engineer of the grant aid project.

		
Well management: Checking distribution water and valve control	Khatmiyya water treatment plant: Joint training of operating and maintenance	Quantity control of water supply: Main control valve opened from 10% to 20%

**(Activity 1.7) The SWC perfectly runs the new customer database.**

With the new Customer Database, the Electricity Corporation in Kassala has been started collection of water tariff as well as electric charges since November 2012. Customers using both electricity and water would pay water fees to the Electricity Corporation. Two (2) SWC staff have been assigned to work for the Electricity Corporation to assist water fee collection and cope with customer complaints. Issues were:

Customers who is registered in the database of SWC does not necessarily as same as those of the Electricity Corporation. Customers of electricity and water are approximately 60,000 and 40,000, respectively. Some of the 40,000 water users do not use electricity. It is thus necessary to collect water fees from those customers with the SWC customer database.

- 1) The data contents of the SWC database are different from those of the electricity customer database, such as pipe diameters in the former and kWh in the latter.
- 2) The SWC will proceed with customer management, increases and deletion of its customers, with the SWC current database. SWC only needs to outsource water fee collection to the Electricity Company.
- 3) The SWC will proceed with customer management, increase and deletion of its customers, with the SWC current database. What the SWC will request for the Electric Company would be only water fee collection.

It is thus necessary for the SWC to build and maintain its own customer database. The SWC made contract with a Sudanese IT company to formulate a new Customer Database with Visual Basic (new Visual Basic Customer Database), in July 2012, based on the action plan discussed in the “KAIZEN meeting”. Both SWC East and West offices have already transferred the customer data from the old database (MS-DOS) to the new Visual Basic Customer Database. From then, the SWC could operate and maintain the new database, without depending on the Indian Company. Moreover, the SWC could consult the IT Company, not the Indian Company, to solve day-to-day technical issues.

The revenue collection rate has increased with water fee collection by the Electric Corporation. The rate was 64% in May 2011, at the Project start, increasing to 81% from January to December 2013 and 78% from January to September 2014.

**(Activity 1.8) The SWC implements training of the new customer database.**

In June 2013, the SWC formulated a Customer Database Operation Manual, thereby, giving training to four (4) staff in charge of the database at the SWC East office. The lecturer was Mr.Edres, one of the national staff in the Project. In April 2014, Mr.Mohammed Abdul Baset, one of SWC staff, gave training together with Mr. Edres, to two (2) staff at the West office in charge of the database.

**(Activity 1.9) The SWC implements training of financial management.**

It was found by the site survey after the Inception Report that some SWC accountants do not have enough accounting knowledge. The JICA Team thus conducted a lecture of “Basic Financial Management: in the first half” for Central, East, West, Girba, New Halfa and Aroma office accountants, totaling twenty- three (23), in June 2011. The lecture included: financial report formulation exercises including Profits/Losses (P/L), Balance Sheet (B/S), Cash Flow (C/F), analysis of these reports and breakeven point analysis exercises.

They received a test of “journalizing”, twice, before and after the lecture, which showed a large increase in their scores. The average of the first and last exams were 18 and 58, respectively, thereby much improved. It is found that those SWC staff have been substantially empowered with the training. The JICA Team thus conducted a lecture of “Basic Financial Management: the last half” in November 2011 (6 participants).

**Table 3.8: Scores of the Exams in June 2011**

	Particip ant 1	Particip ant2	Particip ant3	Particip ant4	Particip ant5	Particip ant6	Particip ant7	Particip ant8	Particip ant9	Particip ant 1 0	Particip ant 1 1	Particip ant12	Particip ant13	Averag e
The first	50	30	30	20	20	15	15	15	10	5	0	0	N/A	18
The last	54	40	38	40	76	46	66	65	68	68	70	64	83	58
Difference	4	10	8	20	56	31	51	50	58	63	70	64		40

Following the lecture of “Basic Financial Management”, Mr. Abd Allah Mohamed Alamin prepared a textbook, thereby giving a lecture of “Financial Management” for accountants of the SWC West office in February 26, 2012, then for the Girba, New Halfa and Aroma offices.




		
Mr. Abd Allah Mohamed Alamin gave a lecture for accountants (February 26, 2012).	The accountants of the SWC West office are eager to learn from the lecture.	Mr. Abd Allah Mohamed Alamin explained a trial balance, income statement and balance sheet.

In addition, he taught book-keeping for local staff in charge of accounting at Wad El Helew and Banard village pilot projects.

In March and June 2013, the JICA Team conducted financial training in cooperation with the “Agriculture cluster” for the women groups involved with biscuit making, restaurant business and farmers growing onions. In this training, the instructor and participants clarified how much revenue, expenses and profits have been generated and discussed how to increase their profits.

**(Activity 1.10) The SWC implements training of computer skill.**

Computer skill is essential for customer database building and accounting of data input. The JICA Team thus started to conduct a computer skill training in July 2011. Participants in the first year were SWC staff from the Central office (15 people), the East office (4 people) and the West office (7 people), learning Windows, Excel, Power Point. Those in the second year were twenty (20) staff at each office of the New Halfa, Girba and Aroma offices, totaling to fifty-eight (58) staff.

		
<p>Computer skill training” at the Training Center (July- December 2011)</p>	<p>Participants listening to the lecture “how to operate WORDS/ EXCEL (December 2011)”</p>	<p>The first completion ceremony of the “Computer skill training” (December 7, 2011)</p>

The JICA Team discussed how to replace hand-writing documents by inputting data into computers, with the General Director and accountants. Those accountants thus began to input data into computers on November 27, 2011.

The SWC has started new computer training, as one of curriculum at the SWC Training Center. In January 2013, the Training Unit planned and implemented “Data management/ PC maintenance” lectured by a professor of Kassala University. In addition, the Training Unit conducted training of “Internet” in October 2013.

**(Activity 1.11) The SWC implements planning and monitoring through KAIZEN activities.**

The SWC commenced the 1st Kaizen meeting on May 31, 2012. In the end of December, 2013, the number of Kaizen meetings held by the SWC staff totaled 50 times. From April 28 to May 2 and May 5 to May 9, 2013, India-based consultants of Kaizen Institute facilitated the KAIZEN training in DPD. Three engineers and a laboratory manager participated in the KAIZEN training. The SWC staff learned business process mapping in this training. Finally, the SWC staff analyzed a procedure of registration for new customers in SWC by making process mapping during this training.



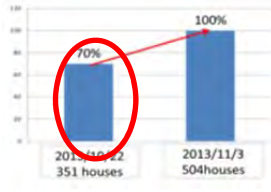



The SWC chief engineer participated in training “Application of Total Quality Management for improving public services course” in Bangladesh. After the TQM lecture, the SWC staff made an action plan to proceed with KAIZEN activity in SWC.

The SWC staff is starting to solve various management issues through the KAIZEN meeting. The JICA Expert Team continues to support the SWC in addressing the issues in SWC by themselves. It is a good opportunity for SWC staff to exchange the information, because the staff from the central office, East office and West office gather at the training center, East office.

The SWC selected three (3) teams at a workshop on October 9, 2013 to proceed with SWC organizational KAIZEN activity. Afterward, those teams implemented KAIZEN to present its outputs at the second workshop on November 26, 2013. The Administration group was awarded “the best KAIZEN team”. The following table shows activities of the three (3) teams. In December 2013, the SWC established “Publicity activity department” in December 2013, starting their activities to improve public information.



**Table 3.9: SWC KAIZEN Agenda**

	Name of Team	Agenda	Before Kaizen	After Kaizen
1	Administration	-Administraion Dept. lost some document due to improper filing. -They prepared a neat filing, format of document lent outside.		
2	Customer	-Customer comparison of water and electricity has not been completed. -The members went to three (3) blocks, completing the comparison of these blocks.		
3	Engineer	-The SWC has not shared information of digging, water quality analysis and pipe network since the central office and East office was separated. -They formulated and share a flow chart of digging, water quality analysis and evaluation of well use.		

**(Activity 1.12) The SWC implements rehabilitation works using the operation and maintenance manual of the water distribution network.**

SWC receives and records customer complaints at a department dealing with those complaints. These are categorized: water leakage, suspension and shortage. The JICA expert supported the data management of the complaint minute book in the SWC East and West office. The complaint number is shown in Figure 3.3.

The east area has many complaint numbers compared with those of the west area. Moreover, the JICA expert assisted to record actual works responding to those complaints. The countermeasure implementation rate is shown in Figure 3.4. Although there was a seasonal variation, the east and west areas have improved the implementation rate, up to 82%, 55%, respectively. A temporary countermeasure, such as leakage prevention with rubber tube, would not be a permanent one. Replacement of asbestos pipes is essential and urgently necessary to reduce the number of complaint. On January 19, 2014, SWC started the replacement works of asbestos pipes at the east area with the farmers' bank loan. From now on, reduction of the complaint number can be expected.

On January 19, 2014, the asbestos pipe replacement construction of the Kassala east area started by the financing of the farmers' bank. The pipe replacement construction became 52% of the progress at the end of December, 2014. In addition, the construction is going to be completed at the end of October, 2015.

After completion of the pipe replacement construction, quantity of leakage water will be decreased and also the water supply will increase. As a result, customer's complaints decreased, and we can expect an improvement in the degree of satisfaction about the water service.

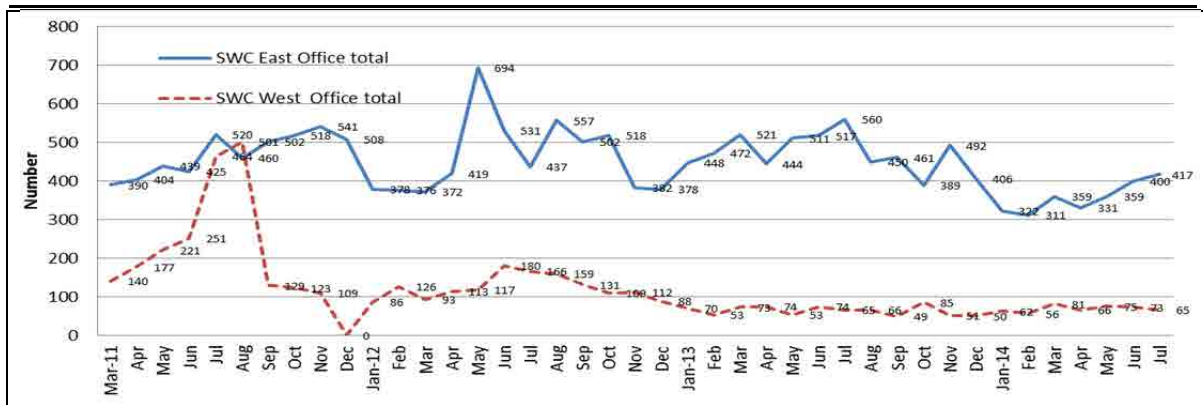


Figure 3.3: The complaints number in the East and the West office

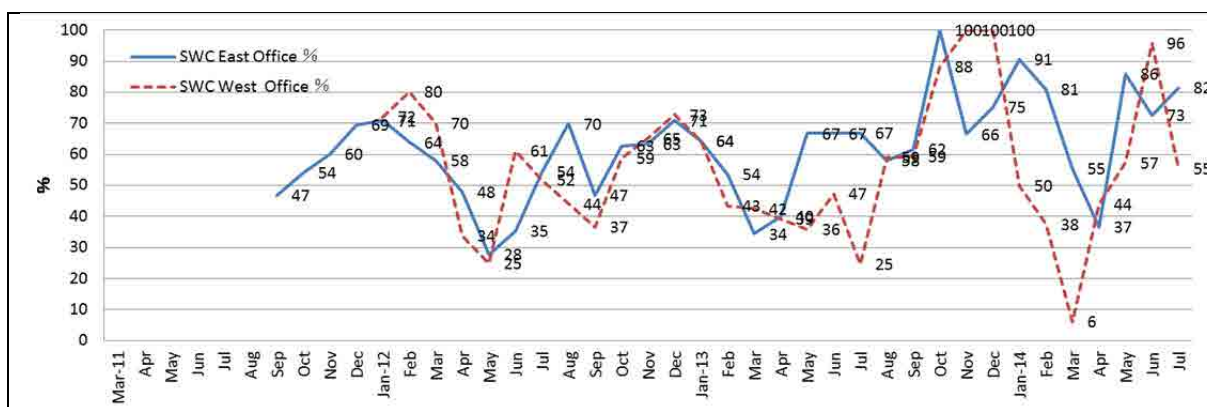


Figure 3.4: The measure rate of complaints in the east and the West office



A meeting to discuss the pipe replacement plan with head of the SWC Planning Department and an adviser (November 21, 2013)



A meeting to discuss the complaints data management and renewal of the pipe network map at the West office (January 15, 2014)



The ground-breaking ceremony of the pipe replacement. Attendant: State government, Ministry of physical planning, SWC Director General, JICA evaluation team (January 19, 2014)

**(Activity 1.13)The SWC recommends water tariff revision to the Kassala State Government.**

**1) Tariff: fixed rate system applied in many states of Sudan**

Kassala residents pay bills for water every month. The tariff is a fixed rate, not a rate in proportion to their consumption volumes. The flat rates for households vary according to their water pipe diameters: class 1, 2 and 3. restaurants, hotels, offices have different fixed rates, according to their business fields. SWC had not installed water meters to measure how much water each client consumes a month. As a result, the more volume clients consume, the lower rates per m<sup>3</sup> they seem to pay. The SWC, thus, revised the current tariff to obtain a more appropriate pricing in proportion to water consumption

volume of each categorized clients.

## 2) Current tariff, customer numbers and monthly revenues

The following table shows: categories, current tariff, customer number and monthly revenues. The monthly revenues present an income amount if all the customers pay their tariffs.

**Table 3.10: Current tariff, customer number and monthly revenues**

Categories	Inch's	Current tariff	Customer number as of Dec.2012			Monthly revenue (SDG)	
			East Office	West Office	Total		
Households							
Class 1	1	40	286	97	383	15,320	1.8%
Class 2	3/4	35	3,352	250	3,602	126,070	14.4%
Class 3	1/2	20	16,263	12,428	28,691	573,820	65.7%
Commercial A	chicken & cow farmers, small water shops, factories	280	6	14	20	5,600	0.6%
B	restaurants, hotels	80	387	349	736	58,880	6.7%
C	small juice shops	45	719	518	1,237	55,665	6.4%
Government A	government buildings	80	180	160	340	27,200	3.1%
B	schools which do not have commercial buildings	45	191	58	249	11,205	1.3%
Total			21,384	13,874	35,258	873,760	100.0%

The Class 3 customers in SWC East and West offices accounted for 81.4% and 65.7% in terms of customer numbers and revenues, respectively, thereby being main customers as of December 2012. A tariff rate increase of the Class 3, 2, Commercial A, B, C, Government A customers would generate a substantial revenue increase.

## 3) Actual average monthly consumption during one year measured by water meters

Every month, SWC staffs monitor to keep records of each customer's water consumption volume of private houses, offices, hotels, restaurants and others. The following table shows a part of the actual average monthly consumption volumes during one year from July 2011, water tariff rates (fixed amounts) and actual unit payment per m<sup>3</sup> (tariff rates/ average monthly use volumes). It is found that the more they consume, the lower rates per m<sup>3</sup> they pay. An ideal tariff would be: the more they consume, the higher rates per m<sup>3</sup> they pay. Such a tariff would promote larger volume consumers to conserve water resources, as well as offer lower rates for smaller volume consumers.

**Table 3.11: Monthly average consumption of each category and actual payment per m<sup>3</sup>**

Category	Class	Number of meters	Monthly average consumption (M3)	Fixed rates (SDG): average	Actual payment per M3 (SDG/M3)
Household	Class 1	13	59	40	0.68
	Class 2	9	44	35	0.80
	Class 3	16	23	20	0.86
Commercial	A	5	346	265	0.77
	B	6	165	93	0.56
Government	A	6	815	80-550	0.25

## 4) Unfair Tariff of the Class 2, Class 3

The actual average monthly consumption volumes during one year were 23 m<sup>3</sup>, 44 m<sup>3</sup>, 59 m<sup>3</sup> in Class 3(tariff: 20SDG), Class 2(35 SDG) and Class 1(40 SDG), respectively. Actual unit payments per m<sup>3</sup> thus decrease: 0.86SDG ( Class 3 ) , 0.80SDG ( Class 2 ) , 0.68SDG(Class 1).

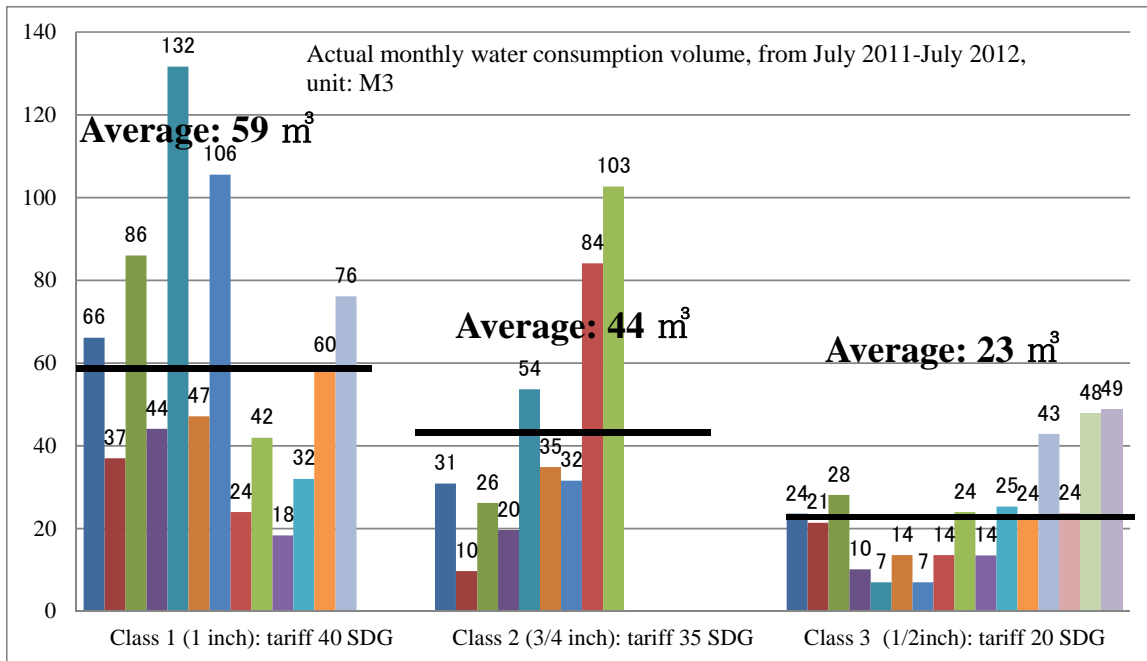


Figure 3.5: each customer’s actual water consumption volumes of the Class 1, 2 and 3

The current tariff rates are not fair among Class 1, 2 and 3, in consideration of the Class 3 actual unit payment per m<sup>3</sup>, 0.86SDG. In addition, The Wad El Helew and Banard people pay 5SDG and 1.27 SDG per m<sup>3</sup>, respectively, thereby paying at higher unit payments per m<sup>3</sup> than urban people do.

### 5) Necessity of Water conservation

Some private households consume more than 200 liters per day per person. Others use more than 600 liters. It is necessary to increase awareness of water conservation.

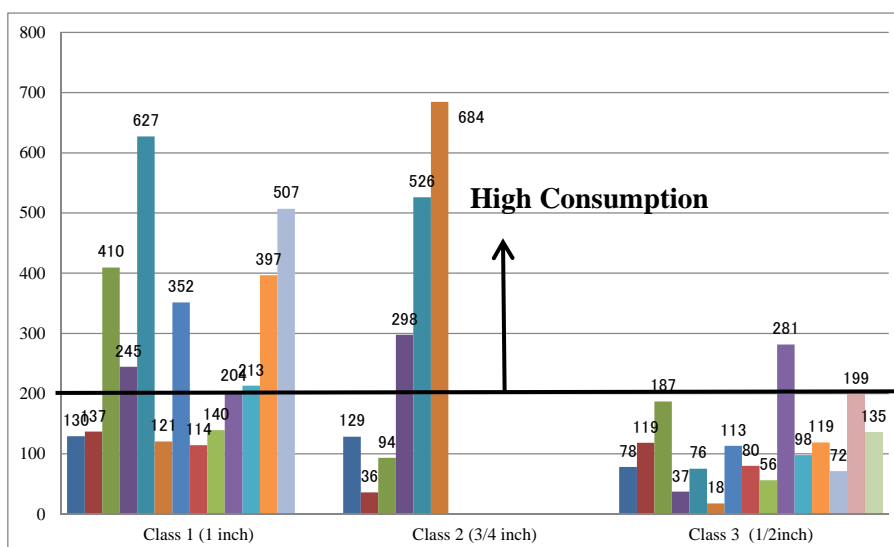


Figure 3.6: One day one man water consumption average of “Domestic” Class 1, 2, 3 units: liter

## 6) Unfair tariff rates of the Commercial, Government

The following table shows actual average monthly consumption volumes during one year from July 2011 of Commercial A (chicken & cow farmers, small water shops, factories), Commercial B (restaurants, hotels) and Government A (government building).

Actual unit payments per  $m^3$  of the Commercial A, B, and Government A were from 0.25 to 0.77SDG. These current tariff rates are not fair, compared to the Class 3 rate. The following table shows actual average monthly consumption volumes during one year from July 2011, water tariff rates and actual unit payment per  $m^3$ .

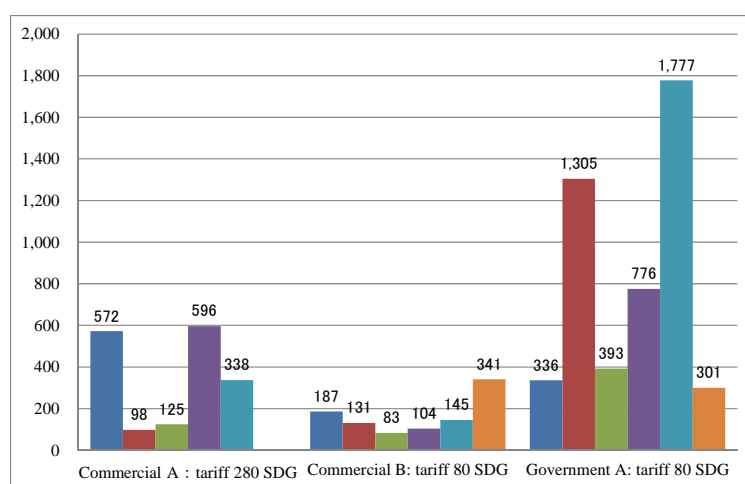


Figure 3.7: Actual monthly consumption of “Commercial” and “Government”, unit:  $m^3$

Table 3.12: Payment per  $m^3$  of “Commercial” and “Government”

East side of Gash River	Acutal Monthly Use:M3	Tariff	Acutal unit payment (Tariff/M3)	West side of Gash River	Acutal Monthly Use:M3	Tariff	Acutal unit payment (Tariff/M3)
No.11 Almergani foot ball club	572	280	0.49	No.8 Kamal Aldin sharaf, Hotel	125	280	2.25
No.23 Mobel Obel, gas station	98	280	2.86	No.19 Kassala technical colledge	596	205	0.34
				No.27 Ibrahim Osman, cow farmer	338	280	0.83
No.14 Babikir Mohamed Salih, restaurant	187	80	0.43	No.5 Hassan Abdalah, small hotel	145	80	0.55
No.25 Yassin Salih, restaurant	131	80	0.61	No.26 Ibrahim Osman, restaurant	341	157	0.46
No.27 Mamon Yousif, small hotel	83	80	0.96				
No.28 Abdul jalil , small hotel	104	80	0.77				
No.12 Bet Alshabab	336	80	0.24	No.1 Kuwait Hospital	1,777	550	0.31
No.16 Osman Digna hall	1,305	160	0.12	No.18 Kassala University Colledge of Engineering	301	280	0.93
No.17 Mokram High Shool	393	80	0.20				
No.18 Omer Alhaj Mousa School	776	80	0.10				

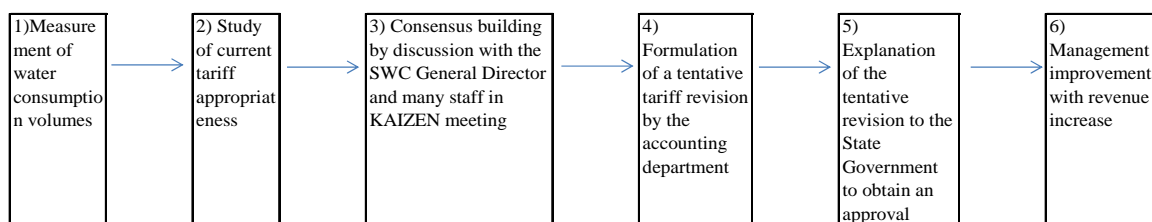
The following SWC income statement in recent six (6) years shows that SWC continuously obtains a profit except in the year 2010. However, the “Commercial” and “Government” unit payment rates per m<sup>3</sup> should be equal or more than that of the Class 3, 0.86 SDG.

**Table 3.13: SWC income statement from year 2006 to 2011**

	year 2006	year 2007	year 2008	year 2009	year 2010	year 2011
<b>Income</b>						
water sales earnings	6,675,634	7,649,710	8,343,533	16,923,252	12,761,607	15,624,342
<b>Expenditure</b>						
salary, maintenance, electricity and others	5,807,386	6,690,793	7,029,666	11,100,563	12,971,214	13,039,472
depreciation	31,338	31,338	94,006	454,064	590,801	1,079,391
provision for bad debit	207,493	375,792	446,659	352,877	419,186	474,603
total expenditure	6,046,217	7,097,923	7,570,331	11,907,503	13,981,201	14,593,466
<b>Profit</b>	629,417	551,787	773,202	5,015,749	-1,219,594	1,030,876
<b>Profit/ revenue ratio</b>	9.4%	7.2%	9.3%	29.6%	-9.6%	6.6%

### 7) Tariff revision process

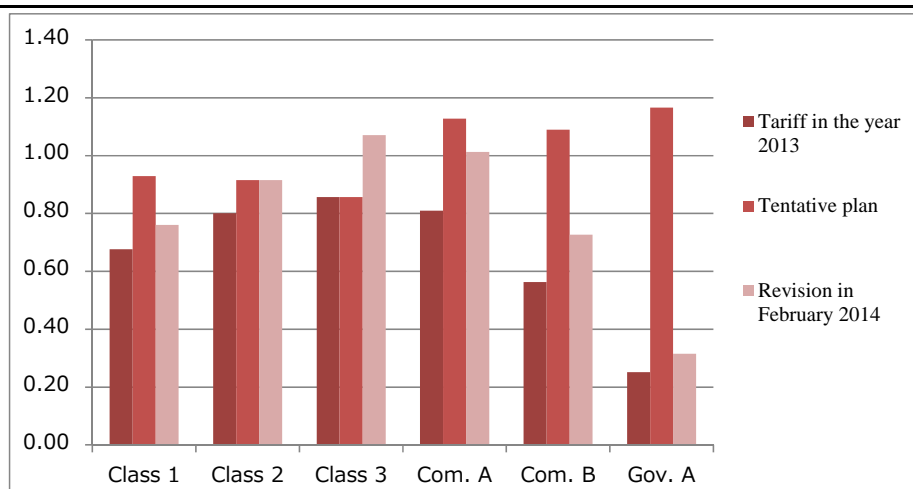
The flat tariff rates have been applied in many states of Sudan. Some of the fixed rates are unfair. The K-TOP model is, thus, effective to revise the unfair tariff and improve SWC management: 1) Measurement of water consumption volume by each categorized clients with meter installation, 2) Study of current tariff appropriateness, 3) Consensus building by discussion with the SWC General Director and many staff in KAIZEN meeting, 4) Formulation of a tentative tariff revision by the accounting department, 5) Explanation of the tentative revision to the State Government, 6) Management improvement with revenue increase by approval of the revision



The tentative revision was: the more they consume, the higher rates per m<sup>3</sup> they pay. Such tariff would promote larger volume consumers to conserve water resources, as well as offer lower rates for smaller volume consumers. The following table shows tariff rates in the year 2013, tentative plan and the year 2014 revision authorized by the Kassala State Council. The revision has been applied since February 2014.

**Table 3.14: Tariff Revision (SDG)**

	Class 1	Class 2	Class 3	Commercial A	Commercial B	Government A
Year 2013	40	35	20	280	80	80
Tentative plan	55	40	20	390	180	950
Year 2014 revision	45	40	25	350	120	100



**Figure3.8: Comparison of payment per m<sup>3</sup>, unit: SDG**

**Output 2: SWC's capacity of water resource development and operation/ maintenance of rural water supply is strengthened.**

**(Activity 2.1) The SWC conducts an inventory survey of rural water supply facilities.**

The SWC staff completed an inventory survey for rural water supply facilities in the Girba Locality, the Wad El Helew Locality and the Rural Kassala Locality from February to September, 2012. The SWC selected villages to install 5 solar pumping systems based on the inventory survey result.

**(Activity 2.2) The SWC implements rehabilitation works of rural water supply facilities.**

The JICA Expert Team and the SWC conducted the well rehabilitation in Wad El Helew as a pilot project from 20<sup>th</sup> Nov. to 3<sup>rd</sup> Dec, 2011.

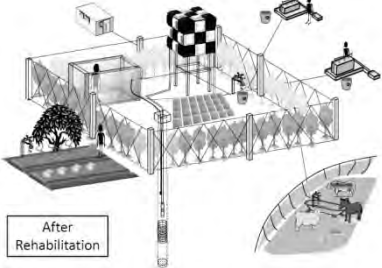


Three (3) young engineers in SWC trained for fourteen (14) days from November 20-December3, 2011. They observed the situation inside wells by borehole camera, a pumping test and rehabilitation of the wells by air lifting for three wells.

Some SWC staffs have mastered well rehabilitation hardware technique through the Pilot Projects in Wad El Helew. SWC staff has preceded with, by themselves, new well development (16wells) and well rehabilitation (29 wells) in other regions.

The SWC rehabilitation team installed a solar pumping system in Banard village, a pilot site in its second year, after rehabilitation of the well and the water supply facilities. On January 21, 2013, the rehabilitation team conducted a test operation. Then, on January 22, 2013, the team commenced supplying water to residents in Banard village. SWC staff conducted lectures for village operators on income/expense record keeping, cash reserves, as well as, on O&M for the solar pumping system.

To protect the solar panels against sand storms, the SWC staff and residents planted 150 trees along the fence of the well. Water Committee members, playing a role of operators, will manage the water facility. The SWC and JICA team enabled the residents to have a sense of ownership by improvement of the environment around the water supply facility by themselves.

The residents would like also to start agriculture by using surplus water. The JICA team will give them technical guidance in cooperation with the Agriculture Sector people of the Project. Figure 3.6 shows a future plan after rehabilitation.

		
<p>The future plan after rehabilitation The water supply facilities will become a common property of the village. In addition, the residents will start small farming with surplus water, thereby growing value – added agricultural products.</p>	<p>The 150 trees planted along the fence of the water yard</p>	<p>The sorghum cultivated in the water yard by using surplus water.</p>

**Figure3.9: The image of future plan after rehabilitation of the water yard (water supply facilities)**

**(Activity 2.3) The SWC implements training of rural water supply operation and maintenance.**

The SWC staff gave technical guidance through OJT to the local operators in Wad El Helew and Banard. In Wad El Helew, it was found the drainage around the water supply point didn't work. In February, 2013, the SWC staff who stationed there improved the drainage system with the local operators.

The SWC staff continued to monitor whether the water committee implemented appropriate management in Banard. In June 2, 2013, Mr. Abdra, a chief accountant, visited Banard to give financial guidance, how to keep records of revenues and expenses, to the members of the water committee.

		
<p>Before the improvement for drainage system in the water point (P-5), (Dec.25,2013)</p>	<p>After the improvement for drainage system in the water point (P-5), (May,2013)</p>	<p>Mr. Abdra gave financial guidance to the members of water committee. (June 2, 2013)</p>

The Director of SWC maintenance department and Banard village water committee instructed how to operate and maintain solar panels and water supply facility, to village people in November 12, 27, 2013.

Mr. Ali Haji, the director of SWC maintenance department, gave technical guidance of O&M for the water yard and the solar panel to the water committee member in Awad village, Rural Kassala locality (November 12, 2013) and in Tahajil village, Telkuk locality (April 27, 2014) .



		
The SWC staff exchanged the raiser pipe in Assalam village. (November 12, 2013)	Mr. Ali Haji, the director of SWC maintenance department, conducted the training for water committee member (November 27, 2013)	Mr. Amir, the chief of water committee in Banard village, explained about the O&M method.(November 27, 2013)

**(Activity 2.4)The SWC, Locality and village and water committees establish a water tariff setting and collection system at the pilot sites (Wad El Helew and Banard).**

### 1) Pilot project in Wad El Helew

#### (Consumption volume based tariff or flat rate tariff)

The Project implemented a well rehabilitation in Wad El Helew in the year 2011 as a pilot project. These rehabilitated wells have a limited capacity of water resources, thereby not being able to supply all of Wad El Helew consumers, 15,000 people, but only 3,000 inhabitants. These consumers include donkey-water-sellers. There is a large difference of water consumption between residents and donkey-water-sellers. It thus makes sense to apply a consumption volume based tariff in Wad El Helew. The Project set a price for a barrel or bucket.

#### (Pricing calculation manner)

All the initial costs at Wad El Helew were: 741,000 SDG including equipment 220,000 SDG plus construction 521,000 SDG. The tariff calculation includes equipment replacement, large maintenance, operation, and small maintenance costs, excluding the construction costs, as described below. Including the construction costs, the price would be too high for some residents to afford. In other words, State Government or donors shall shoulder the construction expenses to rehabilitate the wells in the future. The total of the equipment replacement, large maintenance, operation, and small maintenance costs was SDG 6,600 a month. Monthly water production was 840 tons. It is necessary to set a tariff, SDG 7.9/ ton (SDG 6,600/ 840 ton). Current price is SDG 1.5 / barrel (SDG 7.5/ ton, as of December 2014). However, the monthly water production varies from season to season. There is much Non-Revenue Water. It is thus hard to collect a water fee of SDG 6,600.

**Table 3.15: Water tariff calculation in Wad El Helew**

Replace ment cost	Pumps and Generators	24,000 SDG (Pump) x 5 Pumps = 120,000 SDG 20,000 SDG (Generator) x 5 Generators = 100,000 SDG Total Facility Cost 220,000 SDG 220,000 SDG/ 8 years = 27,500 SDG/ year 27,500 SDG/12 months = 2,300 SDG/ month
Big mainten ance	Well Rehabilitation	2,000SDG/ well x 4 wells = 8,000 SDG/ 2 years, 4,000 SDG/year, 333 SDG/month
	Tank repair	9,000 SDG x 4 tanks =36,000 SDG/ 5 years 7,200 SDG/ year, 600 SDG/ month
Sub-Total		3,300 SDG/ month
Operati on Cost	Fuel: usual case	Daily Fuel (Electricity): 4 hours 5 SDG/ well x 4 wells =20 SDG, 20 SDG/ day x 30 days = 600 SDG
	Fuel: emergency case	Daily Fuel (Oil): 6 litter/ well, 1.7 SDG/ litter x 6 litters x 4 wells=40 SDG, 40 SDG/day x 30 days = 1,200 SDG
	Salary	200 SDG x 9 operators= 1,800 SDG
Small Mainten ance		Maintenance: 220,000 SDG x 5% = 11,000 SDG/ year 11,000 SDG/ 12 months = 917SDG/ month
Monthly cost total		3,300 + 600 + 1,800 + 917= 6,600 SDG/ month
water production volume		4 wells: 7 ton/ hour, 4 hours/ day, 7 x 4 =28 ton/day 28 ton/day x30 days = 840 ton/ month

**(Affordability of residents)**

According to residents in Wad El Helew, their monthly incomes were SDG400-800 (November 2011). Their monthly expenses to buy water were SDG 130, before the well rehabilitation in 2011, however decreased to SDG 68, after the rehabilitation, according to the impact survey in September 2012. The water price was 0.5SDG/ barrel (2.5SDG/m<sup>3</sup>) in 2012. The current price in December 2014, 1.5SDG/ barrel (7.5SDG/m<sup>3</sup>), might be thus near to the limitation that many residents can afford. It is difficult to raise the Wad El Helew water price because it is much higher than the urban water price class 3 (pipe diameter 0.5 inch), 1.07SDG/m<sup>3</sup>.

**(Management system formulation )**

Some SWC staff and the JICA team explained an outline of the pilot project to resident representatives in November 15, 2011. They requested the SWC and JICA Team to hold a mass meeting and workshops to discuss the management system after the well rehabilitation completion. The Project thus proceeded with such meetings as described below.

**Table 3.16: Resident participatory process to handover**

	Date	Conducted by	Contents
Mass meeting	November 30, 2011, 11:00-13:00, participants 60	Conducted by the Wad El Helew locality with the SWC and JICA Expert Team	1) Speech by the Deputy commissioner 2) Speech and explanation by an SWC manager 3) Questions and answers with residents
Workshop	The first workshop: December 2011, The second workshop: December 2012, Ten (10) local leaders participated.		Agenda: water tariff after the rehabilitation, water fee collection, operation & maintenance system ( A water committee was founded after the workshops )
Handover	March 2012		

Mr.Abdel Nasir Seif Eldi, Deputy Commissioner, was assigned by the Commissioner to coordinate the mass meeting and workshops.

		
Some SWC managers explained the Pilot Project and answered questions from participants (November 30, 2011).	Some SWC managers discussed with local leaders in workshops (December 4, 2011).	Local leaders presented their plans and answered questions (December 4, 2011).

**2 ) Pilot project in Banard Village**

**(Consumption volume based tariff or flat rate tariff)**

The Project implemented a well rehabilitation in Banard village, Girba Locality, in the year 2012 as a

pilot project. These rehabilitated wells have enough capacity to supply water for all of residents, 500 people. These residents were equally poor and there were no donkey-water-sellers. Thus, there did not seem to be a big difference of water consumption volume among those consumers. It was not difficult for water committee members to visit all houses for water fee collection. It thus makes sense to apply a flat rate tariff in Banard Village.

### (Pricing calculation manner)

All the initial costs at Banard Village were: \$38,000 including equipment \$26,263 plus construction \$11,737. The tariff calculation includes equipment replacement, large maintenance, operation, and small maintenance costs, excluding the construction costs, as described below. Including the construction costs, the price would be too high for some residents to afford. In other words, State Government or donors shall shoulder the construction expenses to rehabilitate the wells in the future. The total of the equipment replacement, large maintenance, operation, and small maintenance costs was SDG 1,920 a month. Only 104 households among 165 can afford water fee. To obtain SDG 1,920 a month, Monthly water fee shall be: 18.5 SDG (1,920 SDG/ 104 households= 18.5 SDG/ household).

<b>Replacement costs</b>		1USD=6.5SD				
	USD	Usable years	USD/yea r	USD/mont h	SDG/mont h	
Solar panels 28 pieces	7,800	30	260	22	141	
Pumps	4,700	8	588	49	318	
Inverters	3,000	5	600	50	325	
Water tank	1,500	20	75	6	41	
Pipes 900m	7,000	30	233	19	126	
Taps 10 pieces	15	1	15	1	8	
Ball valves 2 pieces	15	1	15	1	8	
Water meters 2 pieces	650	3	217	18	117	
Gate valves 2 pieces	833	10	83	7	45	
<b>Total</b>	<b>25,513</b>		<b>2,086</b>	<b>174</b>	<b>1,130</b>	

<b>Big maintenance costs</b>	USD	Usable years	USD/yea r	USD/mont h	SDG/mont h
Well rehabilitation	750	10	75	6	41

**Operation costs** Salary: 150 SDG/man x 3 operators = 450 SDG

**Small maintenance cost  
(Daily maintenance)** 300 SDG/month

**Monthly cost total** 1,130 + 41 + 450 + 300 = 1,921

**households** 165 households

**households who can pay  
water fee** 104 households

**Appropriate price** 1,921 SDG/ 104 households = 18.5SDG/ household

**Current revenues** 15 SDG/ month x 104 households = 1,560 SDG

### (Affordability of residents)

Some SWC managers and JICA team discussed with the water committee members, thereby setting a

water price, SDG 10 per household (January 2013). The current price is SDG 15 (December 2014). According to residents in Banard Village, their monthly incomes were SDG 75-200. Converting the flat rate, SDG 15, the water price a  $m^3$  would be, 2.5 SDG/ $m^3$ : 15 SDG/ (59.8 liters x30 days x3.3 people). The price might be thus near to limitation that many residents can afford. It is difficult to raise the price because it is much higher than the urban water price class 3 (pipe diameter 0.5 inch), 1.07SDG/ $m^3$ .

**(Activity 2.5) The SWC recommends a financial management and O&M model for rural water supply facilities to the Kassala State Government.**

In October 2011, the board of SWC, which consists of a governor and locality commissioners, decided that the SWC should be responsible for operation and maintenance (O&M) of water supply facilities. The SWC, not localities or villages, should be responsible for the O&M of level 2 water facilities like water yards. The SWC and JICA Expert Team have found, through the actual O&M of the Pilot Projects in Wad El Helew and Banard Village, that the O&M manner in a small urban area is different from one in a rural village. Table 3.17 explains roles/ responsibilities of the SWC, the locality, local operators and the water committees, four (4) bodies, thereby showing the difference of O&M manners between small towns and villages. The four (4) bodies have agreed with the demarcation May, 2013. The manners are thus realistic and could be O&M models of rural water supply.

On the other hand, JICA provided a development fund for the facility/ equipment procurement, well rehabilitation, the pipeline construction in the pilot areas. It is thus necessary to discuss how to secure a development fund, in addition to spread of the two (2) O&M models for rural water supply.

**Table 3.17: Standard for financial management and O&M model**

	Model	Population for water supply	Scales of facilities	Condition
1	Large Village Water supply model	More than two thousand (2,000)	<ul style="list-style-type: none"> <li>• No of source: more than three (3)</li> <li>• Total length of pipe network: total more than 3km</li> </ul>	It is realistic to SWC staffs to be stationed in such villages
2	Small Village Water supply model	Less than two thousand (2,000)	<ul style="list-style-type: none"> <li>• No of source: less than two (2).</li> <li>• Total length of pipe network: total less than 3km</li> </ul>	It is not realistic to expect SWC staffs to be stationed in such villages

**(1) The large village water supply model**

1) The SWC dispatch its staff to be stationed there to proceed with rural water supply facility operation and maintenance in cooperation with localities and water committees, thereby disseminating the SWC technology and management expertise in rural water supply management.

2) The SWC gives technical and accounting training for local operators to empower them.

3) The Water Committee conveys resident requests to improve water supply service in cooperation with the SWC.

4) The water fee should cover large repair and replacement cost of generators/ pumps as well as daily O&M cost to sustain the water yards for more than 10 years.

The above 1), 2), 3) and 4) system would be “Large village water supply model”. This model would be applied in a large village area like Wad El Helew town.

**(2) The small village water supply model**

- 1) “Small village water supply model” would be applied in a remote area where SWC couldn’t dispatch its staffs due to its environment.
- 2) The water committee members may act as local operators, thereby being responsible for the daily O&M including water fee collection.
- 3) The SWC proceeds with financial management in cooperation with water committees.
- 4) The water fee should cover large repair and replacement cost of generators/ pumps as well as daily O&M cost to sustain the water yards for more than 10 years.

The above 1), 2), 3) and 4) system would be “Small village water supply model”. This model would be applied in a small village like Banard village in Girba Locality.

**Table 3.18: Demarcation among the SWC, the locality, local operators and the water committee in two models, Kassala State**

Category		Planning and Implementation of Financial Management					Operation		
		Water Fee Setting	Financial Management	Labor Management	Information Campaign		Daily Operation	Fee Collection	Summary Account & Bank Deposit
Model	Position	Setting the water fee based on conference among the SWC, locality office and water committee	1) Revenues/expenses forecast 2) Monitoring of actual revenues/expenses	Payment for Local Operators	Hygiene Promotion	Prevention activity for Water Facility	1) Valves open/close 2) Record of water production quantity 3) Water meter reading	1) Water selling 2) Monitoring for non-payment customers 3) Sales record	1) Summary Account 2) Bank Deposit
Large village water supply Model (Wad el Helew)	SWC	Proposal	Accountant		Manager of Laboratory				Checking balance
	SWC Engineer stationed in the Town	(1)		Payment			Supervision, Instruction		1) Auditing 2) Collection 3) Bank Deposit
	Local Operator	(2)		Salary			Operation	Collection	
	Locality Office	(3)	Conference						Summary Account
	Water Committee		Conference			Prevention activity			
	State Government	Approval							
Small village water supply Model (Banad Village)	SWC	Proposal	Accountant						1) Auditing 2) Collection 3) Bank Deposit
	Head of a village	(1)							
	Water Committee (Operator)	(3)		Payment		Prevention activity	Operation	Collection	Summary Account
	State Government	Approval							

Category		Maintenance					Monitoring			
		Small Maintenance			Big repair	Training	1) Round of visit 2) Water quality check			
Model		1) Electricity Charge 2) Fuel Cost 3) Exchange of engine oil 4) Replacement of spear parts 5) Cleaning of solar panels, Fountains,	Spear parts purchase			1) leakage repair 2) Pipe replacement 3) Rehabilitation of pipes, pumps, tanks and others 4) Solar panels replacement 5) Securement of the budget and Implementation	1) O&M training 2) Financial training	Inspection of water facilities	Examination of the water quality	
Large village water supply Model (Wad el Helew)	SWC		Approval		Planning by rural water supply department	Securement of the budget and Implementation	Initial training	Rural water supply department	Manager of Laboratory	
	SWC Engineer stationed in the Town	Supervision, Instruction	Planning of procurement	Procurement	Application		OJT	Working together		
	Local Operator	Implementation	Application				Participation		Request	
	Locality Office									
	Water Committee		Application							
Small village water supply Model (Banad Village)	SWC		Planning of procurement	Approval	Procurement	Planning by rural water supply department	Securement of the budget and Implementation	Initial training, periodical training	Rural water supply department	Manager of Laboratory
	Head of a village									
	Water Committee (Operator)	Implementation	Application				Participation		Application	

**Output 3: SWC's Capacity of water resources development for rural water supply is strengthened.**

**(Activity 3.1) The SWC conducts training of geophysical survey for ground water resources.**

The JICA Team has conducted the following training. The participant lists are described below.

a) Conduct training of equipment used in geophysical survey (May 16-21, 2012)

The JICA Team offered training of operating an electrical logging probe and observation cables. Even if malfunctions of the measurement equipment occur, the SWC staff will be able to repair those malfunctions only by themselves, thereby continuing to conduct a geophysical survey.

b) Conduct training of survey analysis (June 10-18, 2012)

The JICA team gave training of survey analysis method which was planned to be implemented in the 1st fiscal year. Since this training is essential for development of water resources in the future, the participant target is set to all geologists who belong to SWC. Moreover, some young engineers, who are unemployed after their graduation from universities, joined in the training. In addition, a supplementary lesson will be done during Ramadan for the engineers who were not able to attend all lectures due to the circumstances of their work.

**Table 3.19: The list of main training participants**

No	Name	Items of training / period					Total of man-day	Affiliation
		Field survey		Analysis	Basic knowledge	Create expendable		
		2011	2012					
1	Mr. Mutaz Hassab El rasol	40	-	7	5	4	56	SWC Engineer
2	Ms. Safa Ibrahim Elhaj	3	1	6	5	-	15	SWC Engineer
3	Mr. Abubaker Mustafa	-	-	4	3	-	7	SWC Engineer
4	Mr. Anas Hamed	-	4	5	3	-	12	SWC Engineer
5	Mr. Abdal Hameed	-	4	-	4	-	8	SWC Engineer
6	Ms. Muhaj Balla	-	-	7	3	-	10	SWC Engineer
7	Ms. Enas Abdolgabar Mohamed	4	1	7	5	-	17	SWC Training
8	Mr. Mohammed Afa	-	5	7	2	-	14	SWC Training
9	Mr. Mujahed Mohammed	-	5	6	5	-	16	Training
10	Mr. Omer Okasha	-	5	7	-	-	12	Training
11	Other participants	-	5	23	-	-	28	-
Total of man-day		47	30	79	35	4	195	

**(Activity 3.2) The SWC implements the geophysical survey for ground water resources**

The SWC implemented the geophysical survey from October 2011 to November 2013. The total numbers of survey are eight (8) times. The table 3.17 shows the list of geophysical survey implemented by SWC.

**Table 3.20: The list of geophysical survey implemented by the SWC**

No.	Period	Survey Site	No. of line	Total length of survey line (m)	
1	Oct.4-7, 2011	Aroma locality, Mekali village	3	930	
2	Oct.7-10, 2011	Kassala town, Awaitala area	5	1,280	SWC proposed two test drilling point.
3	Oct.19-3, 2011	Aroma locality, Gamman	14	5,005	

No.	Period	Survey Site	No. of line	Total length of survey line (m)	
4	Nov.15-Dec. 01, 2011	North Delta locality, Degin village	7	3,260	
5	Nov. 20-29, 2012	North Delta locality, Around Wagger area	10	4,100	
6	Mar. 23-28, 2013	North Delta locality, Around Wagger area	13	5,130	Additional survey
7	Oct. 27-31, 2013	Aroma locality Gamman	6	1,580	Survey for new water resources
8	Nov. 7-11, 2013	Wad El Helew locality, Wad El Helew	6	2,100	Evaluation survey for candidate point for test drilling
Total			64	23,385	

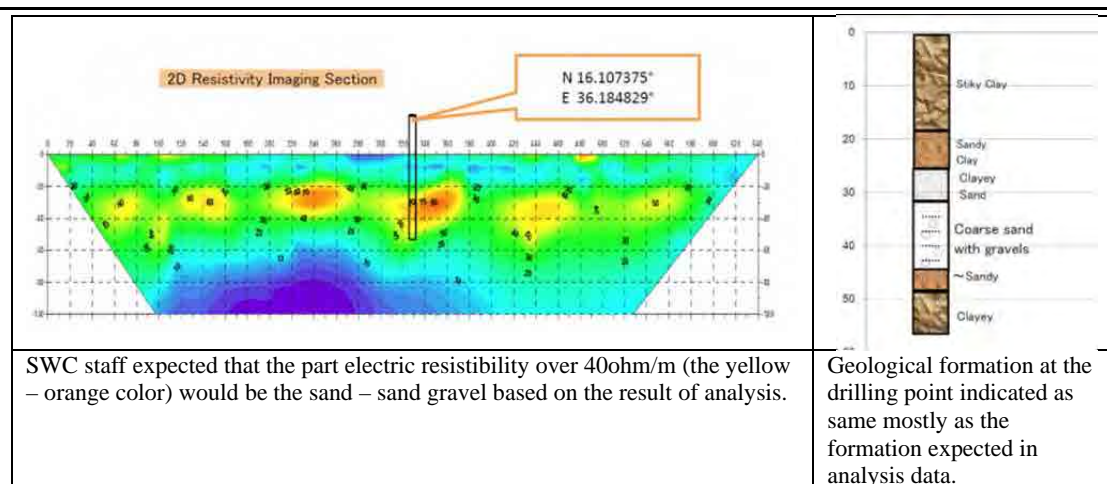
The SWC staff implemented a geophysical survey to develop groundwater in the North Delta Locality in November, 2012. There is shortage of water in the area. SWC staff implemented the entire process of a geophysical survey for the first time. The process consists of planning, implementation on the site, and analysis of the data.

The SWC staff implemented again a geophysical survey at the same site from March to April, 2013, because it was found the depth of sounding implementation was less than the depth planned. The SWC staff analyzed the geophysical data under instruction of the JICA expert in April, 2013. The SWC staff proposed a test drilling point at the North Delta Locality. The North Delta Locality implemented a test drilling from May, 22 to 29, 2013. As a result, it was difficult to discharge enough water from the test well. However, the actual geological formation at the drilling point indicated as the mostly same formation as the one predicted in the analysis data. Thus, the drilling data proved that the result of SWC's analysis was highly accurate. The comparison between the result of analysis and the actual geological structure would be the precious data on the water resources development in Kassala State.

Judging from the survey results, SWC staff acquired the basic expertise to implement a geophysical survey.







**Figure3.10: The comparison between the result of analysis and the actual geological structure**

The JICA expert evaluated SWC staff for the general skill concerning the geophysical survey. The table shows a result of the evaluation.

**Table 3.21: Evaluation of capacity level for the geophysical survey**

Name	Category				Remarks
	Planning	Measurement	Analysis	Evaluation	
Mr.Mutaz Hassab El rasoul					He participated all training in the first, and second year. He finally trained other SWC staff in DWST.
Ms. Safa Ibrahim Elhaja	-	-			She participated all training in the first, and the second year.
Mr. Abdal Hameed			×		He participated in only one training on the field in the second year.
Skill Level:		High	The trainee is able to conduct, alone.		
		Intermediate	The trainee is able to conduct with other's support.		
	×	Low	The trainee isn't able to conduct.		

The capacity level of the SWC staff depends largely on the period of training. The JICA project team finally assessed the capacity of SWC staff as quite high. The SWC staff, therefore, will be able to implement the geophysical survey. However, the consulting capacity of SWC staff concerning the water resource development isn't so high due to the shortage of experience in the field.

SWC staff needs more opportunity to implement the survey. It is, thus, important for SWC staff to implement the survey not only for SWC, but also for the other organization, e.g. the Kassala ground water office.

### 3.4 Correspondence Situation for proposal of Final evaluation

The JICA Expert Team and C/P have coped with the final evaluation recommendations to implement some countermeasures which should be done by the Project end.

**Table 3.22 Actions against the recommendation in the terminal evaluation**

Recommendations	Actions
1) Support of SWC's supervision for the pipe replacement work of the east area under construction.	On August 21-24, 2014, The JICA expert supported building of member's supervision of works system for tri-party of SWC, a farmers' bank consultant and a contractor (MMC). They confirmed the construction progress in a supervision of works meeting, and also supported it so that they could settle trouble by themselves.
2) Support of dissemination for the large and small village water supply models in Kassala state.	A JICA expert will support SWC to disseminate the large village water supply model in West Kassala and New Halfa localities in April, 2014. In addition, the SWC will install the three (3) water facilities by the solar energy in April, 2014. After installation, the JICA project team is going to support the SWC to establish the water committee and conduct financial management in the villages.
3) Technical support for the integrative water-resource management (monitoring) of the Gash river area in Kassala state.	The JICA expert visited, in January 2014, the Kassala groundwater office and discussed current situation and issues of Gash river area water resource management.

### 3.5 Progress to Achieve the Project Purpose and Outputs in the Water Cluster

The following table shows the progress to achieve the Overall Goal, Project Purpose and Outputs as of March 2015.

**Table 3.23: Progress to Achieve the Indicators**

Objectively Verifiable Indicators (Baseline Value in 2010 and Target Value in 2013)	Progress to Achieve the Indicators	Means of Verification
<b>(Overall Goal)</b> 1. Percentage of households who have access to safe water in Kassala State (from 48% in 2010 to 60% in 2016)	1. 48% (2010)	1. Kassala Water Sanitation and Hygiene Sector Strategic Plan for 2011-2016, March 2011 2. Sudan Household and Health Survey (SHHS)
<b>(Cluster Purpose)</b> 1. Percentage of SWC works to respond to customer complaint records for Kassala town urban water supply. (from 60% in March 2012 to 80%) 2. Kassala resident satisfaction degrees for urban water supply (very good 5, good 4, normal 3, bad 2, very bad, the actual average score 3.3 in November 2011 to target 4.0) 3. Ratio of functioning the rural water supply facilities in Wad El Helew and Girba localities (from 6% to 64% as of March 2012, more to 80% in Wad El Helew, from 57% in April 2012 to 80% in Girba)	1. East office: 82% (Dec. 2014) West office: 55% (Dec. 2014) 2. 3.4 (Nov. 2013) 3. Wad el Helew Locality: 72% (April 2014) Girba Locality: 80% (March 2013)	1. Complaint record in SWC 2. Customer satisfaction survey 3. Inventory survey by SWC

Objectively Verifiable Indicators (Baseline Value in 2010 and Target Value in 2013)	Progress to Achieve the Indicators	Means of Verification
<b>(Outputs)</b>		
1.1. No. of water distribution network map revision (from 0 to 1/month)	1.1. 1/month (Jan.2014)	1.1. Progress Reports (map revision record)
1.2. No. of rehabilitation works conducted based on the technical manual on operation and maintenance of water distribution network (from 0 to 40/month)	1.2. 456/month (Jan.2013)	1.2. Progress Reports (work implementation record)
1.3. Water fee collection rate of the SWC East and West offices (64% to 80%)	1.3. 81% (average, Jan.-Dec 2013)	1.3. Progress Reports (fee collection record)
1.4. No. of Kaizen meetings implemented (from 0 to 2/month)	1.4. Ave.2.9/month (Average from May.,2012-May.,2013)	1.4. Progress Reports (Kaizen record)
1.5. Recommendation letter on tariff revision to the Kassala State Government (from 0 to 1)	1.5. Submitted in Dec. 2013, and has been approved.	1.5. Progress Reports (recommendation record)
2.1. No. of new or rehabilitation works of rural water yards (from 0 to 12)	2.1. 22works (July, 2013)	2.1. Progress Reports (work implementation record)
2.2. Records of incomes/ expenses and cash reserve (from 0 to 1/month)	2.2. Recoded in Wad El Helew ( from Dec.,2012 to Nov., 2014) and in Banad village (from Mar.,2013 to Nov., 2014)	2.2. Progress Reports (book keeping record)
2.3. No. of training implemented by the SWC for rural well operators (from 0 to 1/month)	2.3. 5 times in 2012 8times in 2013 13times in 2014	2.3. Progress Reports (training record)
2.4. Recommendation letter on a financial management and O&M model for rural water supply facilities to the Kassala State Government (from 0 to 1)	2.4. Made a recommendation letter in Jan., 2014)	2.4. Progress Reports (recommendation record)
3.1. No. of water resource surveys implemented by the SWC (from 0 to five)	3.1. 4 surveys in 2012 5 survey in 2013	3.1. Progress Reports (survey record)

The Project held a seminar at Kassala town in October 28, 2014 and at Khartoum in November 04 to spread the K-TOP outputs. Some SWC staffs presented: the urban water supply tariff revision, rural water supply models, well water supply impact survey results and geophysical survey as described below.

**Table 3.24: SWC Presenters of K-TOP outputs**

No.	Presenters	Department	Presentation agenda
1	Mr. Abdalla Ahmed Mohamed	Manager, accounting department of SWC central office	Urban water supply tariff revision
2	Mr. Abuzaid. Mohamed. Ali	Head, rural water supply department of SWC central office	Rural water supply models
3	Mr. Ahmed Jafar Abdallah	Head, SWC New Halfa office	Price setting of rural water supply at Wad El Helew and Banard village
4	Mr. Moutaz hassab elrassol abdalla	Engineer, planning department of SWC central office	Geophysical survey for underground water resource development

There were forty-one (41) participants in Kassala including eighteen (18) SWC staffs and nine (9) NGO/ donor staffs. In Khartoum, found were forty-eight (48) participants including sixteen (16) SWC

general directors and seven (7) donor staffs from African Development Bank, IOM, UNOPS, Sudan University. Main questions and comments are:

Some clients consume more than 200 liters in one man one day basis. It is thus necessary to increase awareness of water conservation.

Some reports say the underground water level in Kassala is decreasing every year. It is thus necessary to conduct an integrated water resource management including agricultural and drinking water.

It is important to learn the Kassala outputs.

There is a substantial difference in terms of water tariff and other water supply services between urban and rural water supply. It is thus necessary to unify the water tariff in a State.

It is necessary to conduct a gender-care policy, e.g. including some women in a village water committee.

They have a failure experience in water supply management initiated by a water committee in Darfur region.

		
<p>In Kassala, many SWC and donor staffs listened to K-TOP outputs (October 28, 2014).</p>	<p>The seminar in Khartoum, conducted by DWSU, aims to spread nationwide the K-TOP outputs (November 04, 2014).</p>	<p>General directors of nationwide SWCs were very eager to learn and discuss the K-TOP outputs (November 04, 2014).</p>

### 3.6 Coordination with Other Donors in the Water Cluster

The JICA Expert Team informed the other donors that SWC improved the capacity of well rehabilitation, thereby requesting those donors to collaborate with the SWC maintenance team. As a result, the SWC was able to implement some well rehabilitation works in coordination with a NGO and some donors. The following table shows a list of the actual rehabilitation works.

**Table 3.25: The Implementation of well rehabilitation and survey in coordination with other donors**

	Donor	Date/Work	Locality/Village	Rehabilitation Cost
1	German Agro action (NGO)	Jan. 21-25, 2013 The SWC implemented the well rehabilitation at four (4) water yards constructed by GAA.	Hamshkorieb/ Hamshkorieb	20,000SDG (four (4) well rehabilitations)

2	FAO	May. 20-23, 2013 The SWC implemented the two (2) well rehabilitations upon request of FAO.	Aroma	10,000SDG (two (2) well rehabilitations)
3	SRC, Red Cross Nederland	May. 29, 2013 The SWC implemented the survey and well rehabilitation in Tahajir village, Telkuk Locality. As a result, the SWC proposed installation of the solar pumping system to the SRC. After construction in Sep. 2013, the SWC would support the village community for the water supply management.	Telkuk/Tahajir	35,000SDG (Control house, Fence:70m, one (1) well rehabilitation)
4	SRC, Red Cross Nederland	May.18, 2013 The SWC conducted a field survey at Hadalia village, Aroma Locality to make water supply plan in cooperation with SRC. The SWC proposed installation of the solar pumping system to the SRC, as the same plan as Tahajir one.	Aroma/Hadalia	150,000SDG (Control house, Fence:50m,two (2) distribution points, pipelines:1,000m)

		
The SWC staff had a meeting with the SRC staff.	The SWC staff implemented a well rehabilitation in cooperation with the SRC (Telkuk Locality).	The SWC staff conducted a survey to make a water supply plan for the SRC project in a rural village.

Some donors assisted water supply facility construction in the year 2014 as described below.

**(Eastern Sudan Recovery and Development Fund: ESRDF)**

ESRDF financed SDG 22.5 million for sand filter and water yard construction/ rehabilitation from January to September 2014 (55% of the annual budget in 2014)

**(Donors' assistance)**

In 2014, Japan donated SDG 15 million for the Khatmiyya treatment plant. The other donors financed SDG 10.4 million for pipeline construction in New Halfa, Girba, Kassala and others.

**(Kassala State budget and its implementation)**

Kassala State Government has authorized an annual budget of SDG 50.145 million in 2014, thereby implementing SDG 15.3 million from January to September 2014. The budget implementation is more than that of the other donors, SDG 10.4 million, while it is less than ESRDF's.

**(Construction works and well management)**

Among nationwide SWCs in Sudan, only Kassala SWC can implement air lifting, bore hole camera inspection and pumping tests and have geophysical survey expertise. No one except Kassala SWC can rehabilitate wells with a mobile workshop. Kassala SWC has improved the expertise with the pilot works in Wad El Helew/ Banard village and its experiences in 1980's and 90's.

**Table 3.26: Budget and its implementation of SWC, donors, NGO, Eastern Sudan Recovery and Development Fund (ESRDF) for rural water supply in Kassala State, Unit:SDG**

	SWC	Donors, NGO, Eastern Sudan Recovery and Development Fund (ESRDF)	Remarks
Water yards and pipelines	Budgeting, new construction, rehabilitation and management	Financing new construction, rehabilitation	Kassala State: 600 yards including 270 in trouble (repair SDG81million)
Mini water yards		Financing new construction, rehabilitation	
Hand pump wells		Financing new construction, rehabilitation	
Construction (Hardware)	Well rehabilitation, procurement of the other works	Procurement of all construction work	
Management	Water committee establishment and water fee collection in Wad El Helew and Banard village		
Budget in 2014	1) Kassala State government budget: SDG 50.145 million, thereby implementing SDG15.3 million from January to September 2014	1) ESRDF financed SDG 22.5 million from January to September 2014. 2) In 2014, Japan donated SDG 15 million for the Khatmiyya treatment plant. The other donors financed SDG 10.4 million for pipeline construction in New Halfa, Girba, Kassala and others.	

## 4. Training in Japan, outside Sudan, Equipment Supply, Facilities Rehabilitation/Construction in the Water Cluster

### 4.1 Training in Japan

A JICA expert conducted a training course in Japan "Administration and organization management of water works" for fourteen (14) days from December 11-24, 2011, with five (5) participants. The trainees visited the facilities of water works in Japan to study the O & M system in Japan. Especially at Tobu Regional Waterworks Authority in Ootsuki town, the trainees were able to learn the O & M system in a rural area. The trainees whose positions are SWC manager class made full use of their experience in Japan.

**Table 4.1: Training in Japan**

Course/Country	Administration and organization management of water works
Period	9 <sup>th</sup> – 24 <sup>th</sup> December, 2011
Trainee	5 counterparts in Kassala State Water Corporation (SWC)
Contents	<ol style="list-style-type: none"> <li>1. Yokosuka city Waterworks and Sewerage Bureau Head office               <ol style="list-style-type: none"> <li>1) Abstract of Waterworks in Yokosuka city and Japan                   <ol style="list-style-type: none"> <li>a) Abstract of Waterworks in Japan</li> <li>b) Master plan of water supply in Yokosuka</li> <li>c) Establishment of functional organization and Human Resource Development</li> <li>d) Sustainable water supply system</li> <li>e) Basic plan for Water facilities</li> <li>f) Customer Database</li> </ol> </li> <li>2) Initiatives (leakage counter measures) and leak detection training to improve customer satisfaction</li> <li>3) Visit Hemi Integrated Control Center</li> <li>4) Water Tariff and Customer Database                   <ol style="list-style-type: none"> <li>a) Customer Database</li> <li>b) Administration and management of Customer Service Center</li> </ol> </li> <li>5) Initiatives (PR activities) to improve customer satisfaction</li> </ol> </li> <li>2. Tobu Regional Waterworks Authority in Ootsuki town               <ol style="list-style-type: none"> <li>1) Operation and Maintenance for water facilities, and Customer service</li> <li>2) Management of water facilities</li> </ol> </li> <li>3. Fundamentals of Management (Lecture: Dr. Franz Waldenberger)               <ol style="list-style-type: none"> <li>1) Organizational behavior</li> <li>2) How should the SWC improve its organizational management?</li> <li>3) Job description &amp; responsibility, Motivation in Organization</li> <li>4) Performance evaluation and Team work</li> <li>5) Preparation for presentation, and evaluation meeting</li> </ol> </li> </ol>

The following Tables show the achievement they got during the training and the action after coming back to Kassala.

**Table 4.2: The point of The Achievement, the target in the training and the action after training in Japan**

	Achievements, Next targets	Actions after training
1	The SWC managers learned how to formulate a medium and long term plan.	The SWC managers prepared action plans of the East office, and West office.
2	The SWC managers studied about the organization for O&M of water facilities in Japan,	-The SWC staff started the inventory survey in Wad El Helew to make a database of water

	<b>Achievements, Next targets</b>	<b>Actions after training</b>
	and the basic plan for the water supply facilities	facilities in rural area. -The chief engineer of the East office suggested the drilling of 5wells, and the extension of 3km pipelines to the Kassala government based on his action plan. The proposal was approved.
3	The SWC managers learn how to improve the customer satisfaction at waterworks. They clarified the problems about shortage of communication with customers in Kassala.	The chief engineer of West office start to address the establishment of a communication unit based on his action plan. The unit carried out PR activities at Mosque.

#### 4.2 Third country training.

In December 2011, the JICA project team selected two young engineers and one financial officer of SWC for third country training. They visited rural and urban areas in Morocco to study administration and organization management of water works. Table 4.3 shows the outline of third country training in the second year. The table 4.4 shows the action plan of trainees.

**Table 4.3: Outline of third country training in the second year**

<b>Course/Country</b>	Financial management and O&M for water facilities in urban and rural area/ Morocco
<b>Period</b>	14 <sup>th</sup> May – 25 <sup>th</sup> May, 2012
<b>Trainee</b>	SWC engineer : 2persons, SWC accountant: 1person
<b>Contents</b>	Site : Rabat, Marrakech, Ouarzazate, Agadir  1) Ministry(Water Resources in Morocco) 2) ONEP training center (Rabat) 3) ABHT (Marrakesh) 4) Zarrar Dam (Essaouira) 5) RADEEMA sewage treatment plant (Marrakesh) 6) STEP system (Marrakesh) 7) Model Village (Ourzazate) 8) DPE,Tata branch 9) Model village (Tata) 10) ONEP, Agadir office (Agadir) 11) Tamri treatment plant (Agadir) 12) RAMSA office 13) RAMSA sewage treatment plant 14) ABHSMD 15) Model village ( Agadir )

The participants prepared an action plan which they can do in Kassala based on this training. Each action plan is shown below. After their return to Sudan, Mr. Abdallah, chief accountant, implemented his action plan most actively among the three trainees. Mr. Ahmed was chosen as engineer in charge of supervision of the pilot project in the second year. He carried out planning and construction management under supervision of Mr. Isam, a senior engineer in the SWC.



**Table 4.4: Action Plan of trainees**

	<b>Name</b>	<b>Action Plan</b>
1	Mr. Abdallah Ahamed, Director of Finance dept.	- conduct financial training for SWC staff in the East office in July. - conduct training of book keeping for the operators in Wad El Helew.
2	Mr. Ahmed A. Elamin, Engineer	- supervise the pilot project in Banard, Girba locality by using a progress control sheet - record the technical data for the establishment of solar pumping system and well rehabilitation

In April 2014, the JICA Expert Team selected two young engineers of SWC for third country training in the third year. They visited rural and urban areas in Morocco to study operation and maintenance system of rural area in Morocco. Table 4.5 shows the outline of third country training in third year.

**Table 4.5 Outline of third country training in third year**

<b>Country</b>	Training in the third country “ Operation and Maintenance system of rural area in Morocco, ”
<b>Period</b>	5 <sup>th</sup> April – 13 <sup>th</sup> April, 2014
<b>Trainee</b>	SWC engineer; 2 persons
<b>Contents</b>	Site: Agadir 1) Water resource development, management and monitoring 2) Visit the model village in rural water supply 3) Water Harvesting and Drip Irrigation 4) Management of Rural Water Supply 5) Visit Sewage Water Treatment Plant 6) Visit Desalinization Plant 7) Workshop seminar

### 4.3 Progress of Equipment Procurement in the Water Cluster

The list of procured equipment for the Water Cluster is provided in Appendix 5 of the volume 1 of the report.

### 4.4 . Facilities’ Rehabilitation and Construction Plan in the water cluster

1 ) The Project for the rehabilitation and construction of the water supply facilities in Wad El Helew

The contractor started construction 17th November 2011, completing in March 2012. Since then, SWC and the locality have supplied water for residents in Wad El Helew.

2 ) The Project for the rehabilitation and construction of the water supply facilities in Banard village, Girba locality.

SWC staff started site survey to develop design from June 2012. After bidding based on the plan, the Project made contract with the National Company, the same contractor as one for the construction work in Wad El Helew, in the first year of the Project. The rehabilitation works were carried out smoothly by the SWC maintenance team. The contractor completed the construction in January 2013.

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SWC have supplied water for residents in Banard village since the end of January 2013.

Table shows the outline of water supply facilities in each pilot site.

**Table.4.6: The comparison between two (2) models in the pilot site**

	<b>Pilot site</b>	<b>Model</b>	<b>Water Supply population</b>	<b>Outline of water supply facilities</b>
1	Wad El Helew	Large village water supply model	3,000	Water Yard: 4 WYs Well: 4 wells (Total discharging rate: 90m <sup>3</sup> /day) The total capacity of elevated tank: 150 m <sup>3</sup> The capacity of reservoir tank: 75 m <sup>3</sup> The total length of pipeline: 3km
2	Banard, Girba Locality	Small village water supply model	550	Water Yard: 1 WY Well: 1 wells (Total discharging rate: 50 m <sup>3</sup> /day) The capacity of elevated tank: 45 m <sup>3</sup> The total length of pipeline: 1.5km

## **5. Conclusion and Recommendations in the Water Cluster**

The Project aims to strengthen capacity of, SWC staff, in addition to conduct “pilot activities”, to provide tangible benefits of peace to local communities. The Project has, thus, conducted many training and OJT to develop individual capacity of the SWC staffs, along with Kaizen meetings to develop an organizational management capacity, as described below.

### **5.1 Conclusion**

#### **5.1.1 Capacity development of SWC**

##### **1) Individual capacity development of SWC staff**

In the first year, the Project provided many training programs: GIS, pipe network maintenance, financial management, computer skill training and others. The SWC General Director highly appreciated these trainings as they were as much as the training that the SWC conducted for last twenty years. Among them, the JICA team transferred their technology of well rehabilitation and geophysical survey to SWC staffs, thereby enabling the staffs to teach the technology to other state SWC staffs. Before the Project start, the Kassala SWC staff had never given a lecture to other state SWC staff. Through the technology transfer of well rehabilitation, the Kassala SWC staff obtained confidence and built a network with other state SWCs.

##### **2) Organizational management capacity development of SWC**

SWC established a “Training Unit” in December 2012 to better proceed with the training. Since then, The Training Unit has planned and implemented their curriculum. The SWC has also founded a “Maintenance Department” in charge of urban and rural water supply maintenance, and “GIS Team” to continuously update the GIS pipeline map.

Moreover, the Project started a KAIZEN meeting in May 2012 to involve SWC staffs more in management. The participants could share SWC management issues, decide staff in charge, discuss solutions, monitor to what extent they achieved the solutions. Afterward, some SWC staffs have taken responsibility for continuation of the KAIZEN meetings, holding about fifty (50) times as of December 2013.

A successful example is: SWC made a contract with a Sudanese IT company to formulate a new Customer Database with Visual Basic (new Visual Basic Customer Database), in July 2012, based on the action plan discussed in the “KAIZEN meeting” in June 2012. Both SWC East and West offices have already transferred the customer data from the old database (MS-DOS) to the new Visual Basic Customer Database.

In addition, the Director General and managers worked together in December 2013, to formulate an action plan of the year 2014. SWC will monitor progress of the activities with KAIZEN meetings.

#### **5.1.2 SWC ownership development and actions**

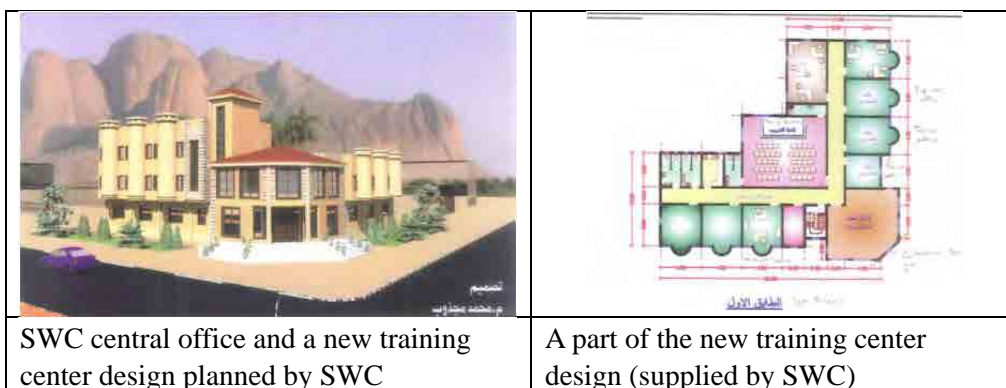
SWC has taken an initiative to plan and conduct the following activities.

##### **1) Loan from the Farmers’ Bank**

The SWC made a replacement plan of asbestos pipe 150km based on a GIS Pipeline Map in Kassala town and installed financing of 11.8 million SDG from a farmers’ bank with this plan. The SWC will supply the material and do vendor selection from now on. The construction work of eastern area 97km started on January 19, 2014 and will be completed by October 2015.

**2) Construction of a new Training Center**

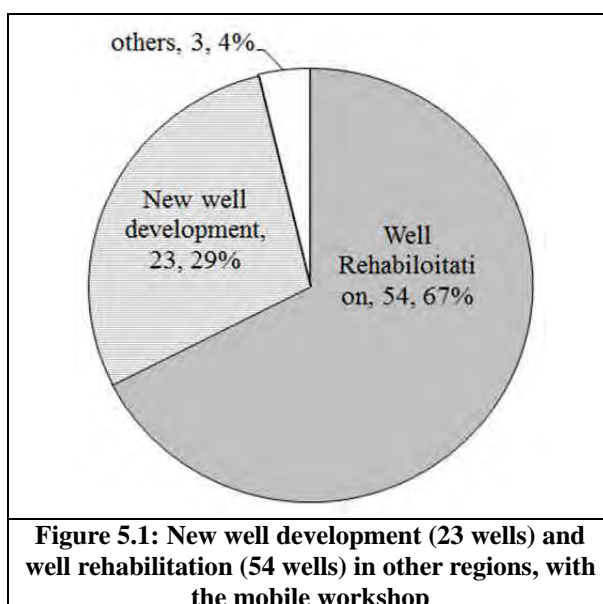
The SWC Director General announced a plan to construct a new Training Center on November 26, 2013. The members of Training Unit members formulated a training plan of the year 2014 to implement a program by themselves.



**3) Rural water supply facility construction and rehabilitation**

Some SWC staffs have mastered well rehabilitation hardware technology through the Pilot Projects in Wad El Helew and Banard Village. After the Pilot Projects, SWC has implemented, by themselves, new well development (23 wells) and well rehabilitation (54 wells) in other localities, with the mobile workshop supplied by JICA.

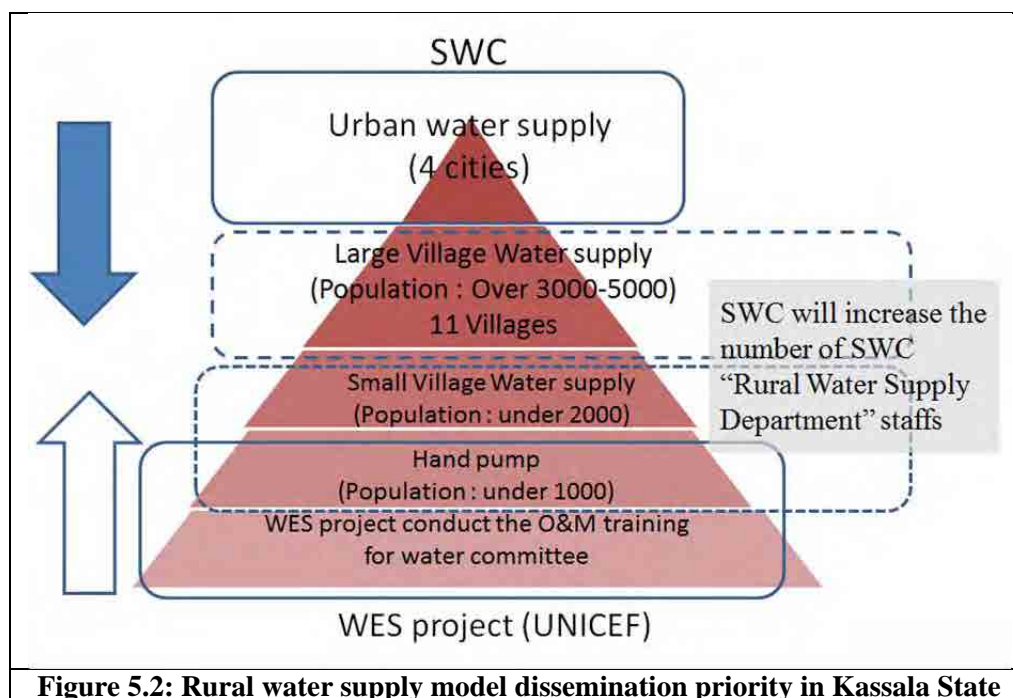
In addition, SWC implemented a large construction work in Abu Talha village with a population of 4,300 and in Nazllat Al Umuda village with a population of 3,600, West Kassala Locality. SWC conducts a technical and financial supervision every day, applying the “large village water supply model”. SWC will conduct a large rehabilitation work in New Halfa Sugar Factory Area with a population of 37,000 to supply well water in the year 2015.



### (Rural water supply model dissemination priority)

Since year 1996, SWC rural water supply department staff have been integrated into the urban water supply department. The department conducting rural water supply facility construction works was separated from SWC, thereby being replaced by a private company, a National Company. The Division was thus abolished, however, it was re-established in the year 2011, as the “Rural Water Supply Department”. The Department implements water supply works in three (3) large villages. The Department has a priority to expand rural water supply to eleven (11) large villages as shown in Fig. 5.2.

On the other hand, the UNICEF WES Project takes an initiative in villages to conduct a hand-pump well/ mini-water yard construction, and to support the village operator to conduct operation & maintenance, and management including water committee establishment. The WES’ mini-water yards cover villages with population up to 5,000. The SWC dispatches its staff to WES and needs to cooperate with WES to spread the “small village water supply model” to villages with population from 1,000 to 2,000.



#### 4) Water resource development survey and its budget

SWC proposed 2014 year budget of water resource development and new water facility construction through DPD. The proposal was approved. SWC also formulated an action plan of geophysical survey, thereby having implemented the geophysical survey, based on the action plan, at twenty-seven (27) areas in 2014.

### 5.2 Recommendations

Recommendations will be proposed, after describing management issues at the Project start and activities to solve these problems (from 2011 to 2014).

**Table 5.1: Management issues at the Project start, activities to solve these issues and recommendations**

<b>Problems in the counterparts' primary works</b>	<b>Activities and countermeasures to solve these problems (from 2011 to 2014 )</b>	<b>Recommendations</b>
<p>(I. Urban Water Supply)</p> <ul style="list-style-type: none"> <li>● Poor water supply service such as water leakage, widespread suspension of supply, etc.</li> <li>● Lack of water distribution network map in Kassala</li> </ul>	<ul style="list-style-type: none"> <li>● Update the inventory of the water distribution network in Kassala Town by using GIS to improve the water supply and maintenance system</li> <li>● Formulate an asbestos pipe replacement plan by the updated inventory of water distribution network. With the plan, request a loan for the pipe replacement project. And conduct the pipe replacement.</li> </ul>	<p>I-1. Implement water resource management in Kassala town through the ground water quantity and quality monitoring.</p> <p>I-2. Conduct O&amp;M for the new and rehabilitated treatment plants in Kassala town.</p> <p>I-3. Conduct a current sewage situation survey to formulate a new sewage and water reuse plan in Kassala town in reference to an advanced technical guidance from Morocco.</p>
<p>(II Rural Water Supply)</p> <ul style="list-style-type: none"> <li>● The ratio of functioning rural water supply facilities in Kassala State decreased, because the locality office and the water committee in the rural area didn't have the technical knowledge for O&amp;M, and the experience of financial management.</li> <li>● Many towns and villages not having safe water supply due to limited water resources in dry areas of the northern Kassala State</li> </ul>	<ul style="list-style-type: none"> <li>● Provide policy options to bring the responsibility of major repair work of rural water supply facilities (level 2) back to the SWC and organize a maintenance team in the SWC to provide remote repair service.</li> <li>● Establish a "Large village water supply model" and "Small village water supply model" in the two pilot project sites</li> <li>● Establish a maintenance department in SWC to implement the maintenance work for the water supply facilities in urban and rural area</li> <li>● Conduct a geophysical survey for ground water resources in northern Kassala State</li> </ul>	<p>II-1. Establish a rural water supply system, in cooperation with water committees, residents, locality offices and donors: a rural water facility baseline survey, prioritization, long list formulation, construction/ rehabilitation plan formulation, fund raising, operation/ maintenance and monitoring.</p> <p>II-2. Disseminate the above rural water supply models in cooperation with the stakeholders.</p> <p>II-3. Increase the number of SWC "Rural Water Supply Department" staffs to proceed with the works described in II-1, such as a rural water facility baseline survey, long list formulation, construction/ rehabilitation plan formulation.</p>

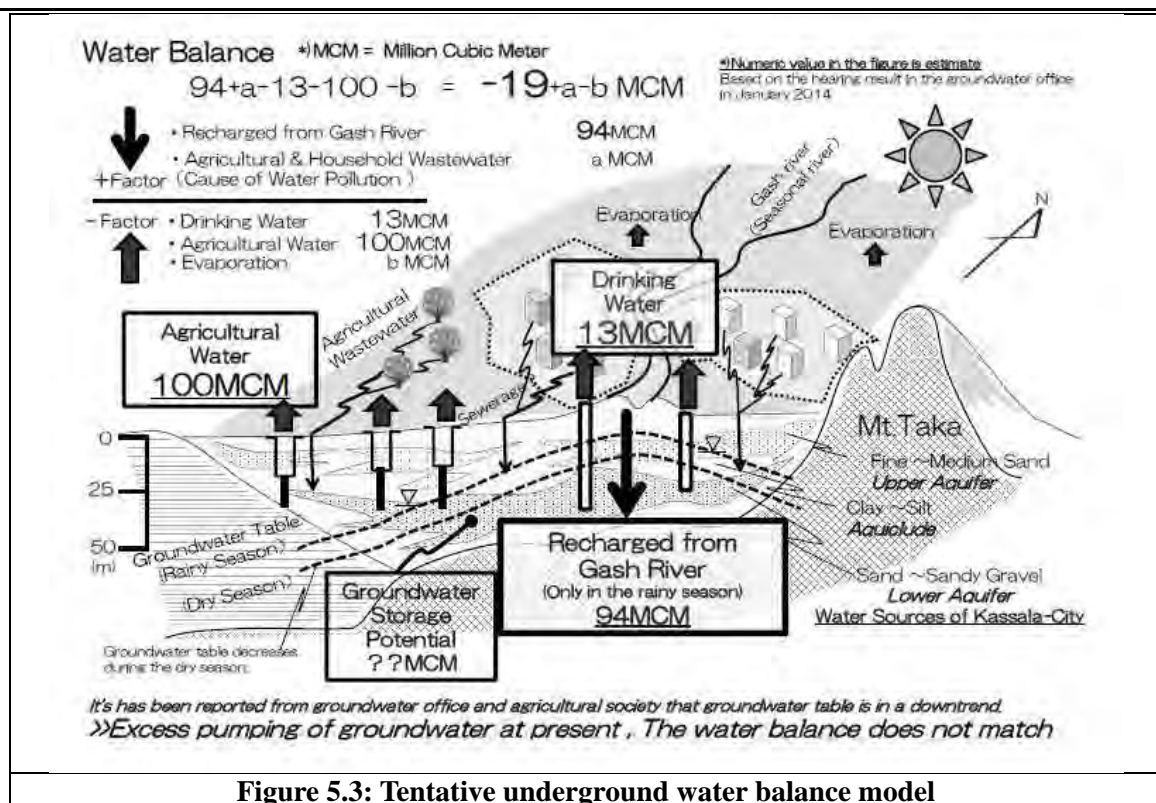
<p>( . Financial Management )</p> <ul style="list-style-type: none"> <li>● Old Customer Database with MS-DOS (Microsoft Disk Operation System).</li> <li>● Low collection rate</li> <li>● Unclear cash flow in SWC</li> <li>● Financial difficulties of the SWC due to much non-revenue-water</li> </ul>	<ul style="list-style-type: none"> <li>● Formulate a new Customer Database with Visual Basic</li> <li>● Respond to non-revenue-water problem by making non-payment customers visible through building a customer database that monitors actual water use volume of each customer, and charge payments</li> <li>● Study and propose a new water charge system</li> </ul>	<p>III -1. Formulate management plans/ annual reports based on the SWC's mission and goal.</p> <p>III -2. Apply a water balance management with the Management Information System (MIS) to improve the SWC's operation.</p> <p>III -3. Install water meters in a part of large water volume consumers at a selected district to keep records of their consumption, aiming at application of a consumption volume based tariff in the future.</p> <p>III-4. Strengthen the current water consumption monitoring system to increase an awareness of water conservation.</p>
<p>(IV. Training )</p> <ul style="list-style-type: none"> <li>● Low attendance of Kassala SWC to PWCT programs and below average scores of their performance, thereby having a poor reputation</li> </ul>	<ul style="list-style-type: none"> <li>● Assist the SWC to establish a training unit in cooperation with PWCT (Public Water Corporation Training Centre in Khartoum)</li> </ul>	<p>IV-1. Strengthen training capacity in cooperation with Gedaref/ Red Sea SWCs, DWST and ONEP in Morocco.</p>

Recommendations would be:

### 1) Water resource management of Kassala town

The drinking water in Kassala depends on underground water of the Gash river basin. It is thus necessary for the SWC to build a monitoring system of the basin water resource quantity and quality to continuously supply safe water to Kassala residents. SWC shall establish a groundwater balance model with the monitoring data to estimate the amount of usable water resources, thereby recommending appropriate pumping volume. The following graph shows an outline of the underground water balance model.

In addition, the SWC shall make a survey of daily waste water treatment methods which might cause pollution, thereby proposing a sewerage disposal and reuse method, as well as increasing an awareness of water conservation for Kassala residents and farmers. The SWC will disseminate the underground water resource management method to other SWCs having underground water resources.



**Figure 5.3: Tentative underground water balance model**

**2) Establishment of a rural water supply system, in cooperation with local water committees, residents, locality offices and donors**

It is necessary for the SWC to conduct following activities: 1) a baseline survey of rural water facilities, 2) prioritization, long list formulation, 3) development plan formulation, 4) fund raising for construction and rehabilitation, 5) support for operation/ maintenance and 6) SWC monitoring system establishment.

SWC will reinforce and disseminate the above rural water supply models established in the K-TOP project in cooperation with the stakeholders.

It is thus necessary to increase the staff number of SWC “Rural Water Supply Department” to proceed with those works. The SWC will implement a mapping by Unmanned Aerial Vehicle (UAV) and build database with GIS. In addition, it will be efficient to conduct a monitoring in remote areas by smartphones. The SWC and DPD will jointly conduct a monitoring and evaluation of those activities.

**3) Clarification of SWC’s mission/ goal and application of Management Information System (MIS) to improve the SWC’s operation.**

It is necessary for SWC to formulate management plans with clear organizational mission statement and goal. SWC shall monitor the progress of the plans to record monitoring results in annual reports. SWC shall apply a water balance management with Management Information System (MIS) to improve the SWC’s operation. In addition, SWC shall install water meters to selected large consumer to keep records of their consumption, aiming at application of a consumption volume based tariff in the future.

**4) Strengthening of training capacity in cooperation with Gedaref/ Red Sea SWCs, DWST and ONEE in Morocco**

SWC shall strengthen training capacity in cooperation with Gedaref/ Red Sea SWCs, DWST and ONEE in Morocco. It is necessary for the SWC to conduct capacity development of its staff, by



learning from Morocco in reference to management vision, goal, water resource control, local water supply system and others.

**添付資料**

**Appendix**

## 1-2: Project Design Matrix (PDM ver. 4.0) - Water Cluster

Name of the Project: Capacity Development Project for Provision of the Services for Basic Human Needs in Kassala, Sudan (K-TOP Project)

Duration: May 2011 – April 2014 (3 years)

Date: 20 Dec. 2012

Target Area: Kassala State

Target Group : Kassala State Water Corporation

PDM Version 4.0

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATIONS	IMPORTANT ASSUMPTIONS
<p><b>OVERALL GOAL</b></p> <p>Basic Human Needs of the people in Kassala State are ensured by enabling them to access quality public services by the State.</p>	<p>1. Percentage of households who have access to safe water in Kassala State (from 48% in 2010 to 60% in 2017)</p>	<p>1. Kassala Water Sanitation and Hygiene Sector Strategic Plan for 2011-2016, March 2011 2. Sudan Household and Health Survey (SHHS)</p>	<p>Kassala State Government is committed in expanding the achievements of K-TOP Project to non-pilot areas.</p>
<p><b>PROJECT PURPOSE</b></p> <p>Kassala State Water Corporation (SWC)'s capacity to provide service for Water Supply is strengthened.</p>	<p>1. Percentage of SWC works to respond to customer complaint records for Kassala city urban water supply. (from 60% in March 2012 to 80%) 2. Kassala resident satisfaction degrees for urban water supply (very good 5, good 4, normal 3, bad 2, very bad, the actual average score 3.3 in November 2011 to target 4.0) 3. Ratio of functioning of the rural water supply facilities in Wad El Helew and Girba localities (from 36% to 64% as of March 2012, more to 80% in Wad El Helew, from 57% in April 2012 to 80% in Girba)</p>	<p>1. Complaint record in SWC 2. Customer satisfaction survey 3. Inventory survey by SWC</p>	<p>1) The C/Ps who have been trained will not quit the SWC. 2) The Kassala city has enough underground water resources.</p>
<p><b>OUTPUTS</b></p> <p>1 O &amp; M and financial capacity of SWC for urban water supply is strengthened.</p>	<p>Base line survey in May,2011 1) No. of water distribution network map revision (from 0 to 1/month) 2) No. of rehabilitation works conducted based on the technical manual on operation and maintenance of water distribution network (from 0 to 40/month) 3) Water fee collection rate of the SWC East and West Offices (64% to 80%) 4) No. of Kaizen meetings implemented (from 0 to 2/ month) 5) Recommendation letter on tariff revision to the Kassala State Government (from 0 to 1)</p>	<p>1) Progress Reports (map revision record) 2) Progress Reports (work implementation record) 3) Progress Reports (fee collection record) 4) Progress Reports (Kaizen record) 5) Progress Reports (recommendation record)</p>	<p>Sudanese counterparts are not changed frequently.</p>

2 A financial management and O & M model for rural water supply facilities in the pilot areas is established.	1) No. of new or rehabilitation works of rural water yards (from 0 to 12) 2) Records of incomes/ expenses and cash reserve (from 0 to 1/month) 3) No. of training implemented by the SWC for rural well operators (from 0 to 1/month) 4) Recommendation letter on a financial management and O & M model for rural water supply facilities to the Kassala State Government (from 0 to 1)	1) Progress Reports (work implementation record) 2) Progress Reports (book keeping record) 3) Progress Reports (training record) 4) Progress Reports (recommendation record)	
3 SWC's Capacity of water resources development for rural water supply is strengthened.	1) No. of water resource surveys implemented by the SWC (from 0 to five)		
ACTIVITIES	INPUTS		PRECONDITIONS
<p>1 O &amp; M and financial capacity of SWC for urban water supply is strengthened.</p> <p>1.1 The SWC manages the water distribution network in Kassala Town on GIS system.</p> <p>1.2 The SWC formulates a GIS updating manual.</p> <p>1.3 The SWC formulates a operation and maintenance manual of water distribution network.</p> <p>1.4 The SWC formulates an equipment management manual.</p> <p>1.5 The SWC establishes a training unit and a training system.</p> <p>1.6 The SWC implements training of technology.</p> <p>1.7 The SWC perfectly runs the new customer database.</p> <p>1.8 The SWC implements training of the new customer database.</p> <p>1.9 The SWC implements training of financial management.</p> <p>1.10 The SWC implements training of computer skill.</p> <p>1.11 The SWC implements planning and monitoring the O &amp; M and maintenance of urban water supply system (Water distribution and service) : 1 person</p>	<p>A. Inputs from Japanese side</p> <p>A-1 Assignment of experts Pipe network Management/Construction Management</p> <p>Financial Management:</p> <p>Rural Water Supply Program:</p> <p>Geophysical Survey:</p> <p>A-2 Counterpart training in Japan and other countries</p> <p>1) Appropriate Management of Land and Water Resources for Effective Utilization: 1 person</p> <p>2) African Region Urban Waterworks Engineering : 1 person</p> <p>3) Administration and organization management of water works in Japan : 5 persons</p> <p>4) O &amp; M and Maintenance of urban water supply system (Water distribution and service) : 1 person</p>		<p>SWC is serious to improve their service for Water Supply to the local population.</p>

1.12 The SWC implements rehabilitation works using the operation and maintenance manual of water distribution network.	A-3 Provision of equipment		
1.13 The SWC recommends water tariff revision to the Kassala State Government.	Crane Truck (8t, 10t), backhoe Loader x2, Work shop tools, List of HDPE		
2 A financial management and O & M model for rural water supply facilities in the pilot areas is established.	Welding Machine x2, Air compressor, Generator x5, Water quality instruments, Air lifting tools, Pumping test tools (3 submersible pumps), Borehole camera, Resistivity Image Profiling system, Water meter 130units, Leakage detector, PC (Laptop x 15, Desk top		
2.1 The SWC conducts a inventory survey of rural water supply facilities.	A-4 Operational expenditure		
2.2 The SWC implements rehabilitation works of rural water supply facilities.	B Inputs from Sudanese side		
2.3 The SWC implements training of rural water supply operation and maintenance.	B-1 Assignment of Sudanese counterparts		
2.4 The SWC, locality and village and water committees establish a water tariff setting and collection system at the pilot sites (Wad El Helew and Barnard).	Mr.Hashim, Mr.Isam, Mr.Yusef, Mr.Ali, Mr.Abdelgadir, Mr.Mataz, Ms. Amal, Mr.Sofyan, Mr. Alamin, Mr. Abdla asalam, Mr. Shalah Kanali, Mr. Abdla, Ms Umsal		
2.5 The SWC recommends a financial management and O & M model for rural water supply facilities to the Kassala State Government.	B-2 Local Component budget		
3 SWC's Capacity of water resources development for rural water supply is strengthened.	B-3 Facilities		
3.1 The SWC conducts training of geophysical survey for ground water resources.	JICA Expert Office, Workshop in East Office, Training center		
3.2 The SWC implements the geophysical survey for ground water resources.			

