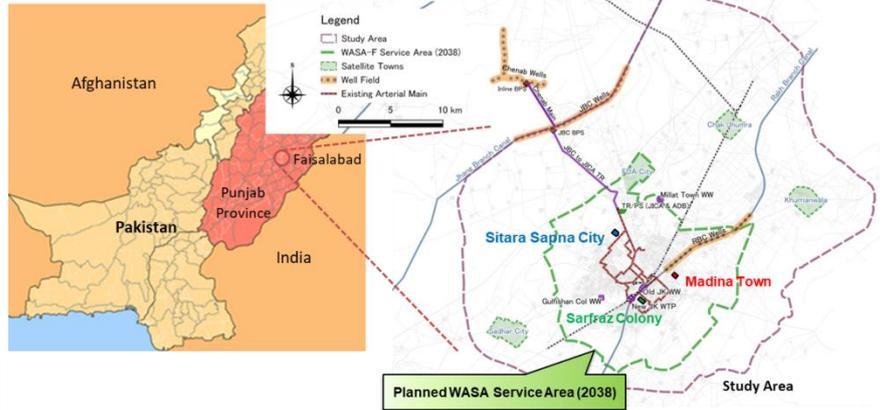


# THE PROJECT FOR WATER SUPPLY, SEWERAGE AND DRAINAGE MASTER PLAN OF FAISALABAD

- Improvement of Water Supply Service Resulting in Drastic Increase in Revenue -

May 2019



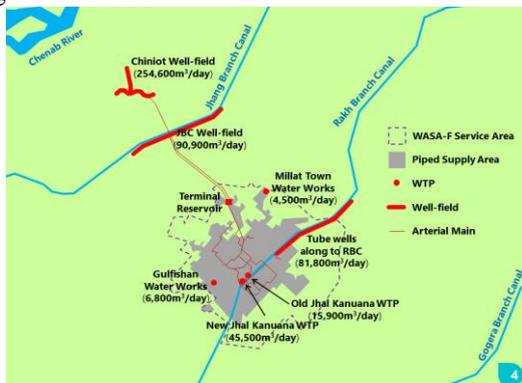
## 1 Background of the Project and Issues

### 1.1 Insufficient Water Supply

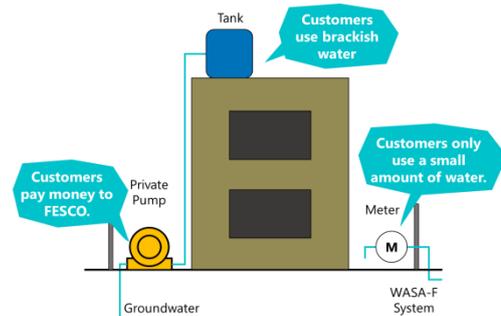
Faisalabad city, located in the Punjab Province of Pakistan is the country’s third largest city with a population of 2.7 million. Although Water and Sanitation Agency Faisalabad (WASA-F) has the infrastructure to supply 500,000 m<sup>3</sup> of water per day, only half of that amount is supplied due to the high cost of operating the transmission and distribution pumps. In addition, WASA-F has adopted a flat-rate tariff system where tariffs are based on the size of the property, not the amount of water used. Therefore, increasing supply to the current 113,000 customers may not lead to increased revenues. Therefore, WASA-F currently only supplies water 6 hours a day (2 hours x 3 times a day). Dissatisfaction with the intermittent water supply is growing among the residents.

Furthermore, the water distribution networks in the city are not divided into supply blocks. All pipelines are interconnected. This makes quantity and pressure difficult to control. While customers near water sources have access to large amounts of water, the other customers far from water sources cannot get enough water. WASA-F services result in unequal water supply.

For these reasons, many citizens have installed well pumps at their homes and use this groundwater for most of their domestic needs (as shown in “Groundwater dependent type”). However, the groundwater in the regions is highly saline and not appropriate for drinking. Salinity is increasing year by year and use for domestic purposes is also becoming difficult. In addition, the electricity cost for operating the well pump is much higher than the water tariff. In a real sense, citizens are paying high costs to FESCO, a power company, to meet their water needs.



Water Supply Facilities in WASA-F



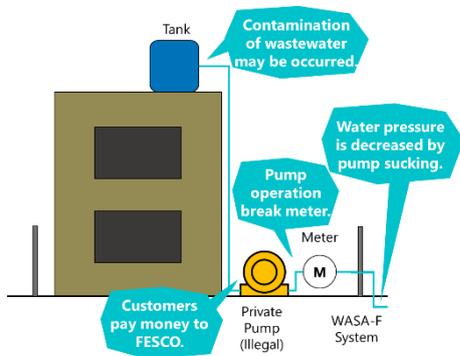
Groundwater dependent type (due to intermittent water supply)

## 1.2 Low Water Pressure

Faisalabad is totally flat, and in many areas away from the water source (especially the east area), the water pressure is as low as 1 to 3 meters. This is insufficient to supply water to a 2 or 3 story building. As a result, many customers connect their water pump directly to the service connection and pump water up to their roof-top tank for later use (as shown in "Pump Suction Type").

Since many customers suction water at once during the short water supply hours of the intermittent water supply, water pressure in the distribution networks dropped even further in some areas, often resulting in negative pressures inside the pipe.

These illegal suction pumps also lead to the failure of the water meters, which were newly installed to be shifted to metered-rate tariff system in future.



Pump suction type (due to low pressure)



Situation of illegal suction pump

In addition, WASA-F uses a flat-rate tariff system, so customers are not conscious of saving water, and the water suction pump operates during water supply time, resulting in a “first come, first served” situation. Fair and equal access to water becomes difficult in this situation.

## 1.3 Deteriorated Water Quality

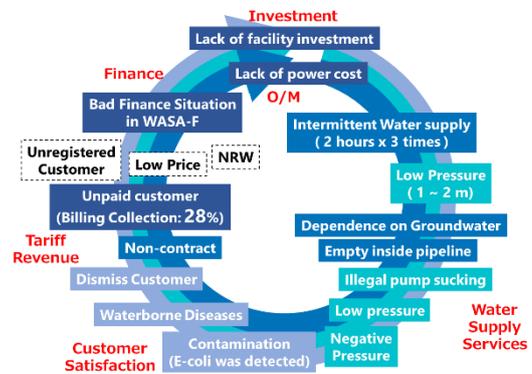
Negative pressure inside the distribution pipes due to intermittent water supply and illegal suction pumps can cause water to be drawn into the pipes through cracks and

other defects. Contamination by wastewater occurs chronically in the distribution pipes in various places, and much of the water in the city is not drinkable. As groundwater salinization is progressing, many citizens are forced to rely on bottled water to meet drinking needs.

## 1.4 Vicious Cycle in WASA-F

Thus, the water supply services of WASA-F have problems in terms of water quantity (water supply time), water pressure, and water quality.

As a result, there are issues such as distrust from customers of water supply services provided by WASA-F, non-payment customers who do not intend to pay water bills, and customers leaving due to deterioration of water quality. This leads to low revenues for WASA-F, and management deficits become more severe.



Vicious Spiral in WASA-F

## 2 Approach for Problem Solving

### 2.1 Master Plan Development

Under these circumstances, the Government of Punjab requested the Japanese Government to develop a long-term development plant (Master Plan) for Faisalabad water supply, sewerage and drainage. The Japan International Cooperation Agency (JICA) responded by implementing this project from 2016 as a Technical Cooperation for Development Planning Project.

This Master Plan was formulated to turn the vicious operation cycle of WASA-F into a virtuous one by the target year of 2038. The city was divided in to seven zones to facilitate project implementation and the zone to be tackled first was selected as the Priority Project.

### 2.2 Implementation of Pilot Activities

In parallel with the development of the master plan, pilot

activities related to improvement of water supply services by establishing distribution management system (improvement of water quantity, water pressure and water quality, reduction of water leakage) and increase of revenue (improvement of bill collection ratio and water meter installation, shifting to metering system) were conducted. Through these activities, the contents and feasibilities of the master plan were tested and verified.

In order to verify the proposed contents in the master plan and obtain persuasive materials for its expansion and development, three areas with different characteristics (Sarfraz Colony, Madina Town, Sitara Sapna City) were selected as pilot areas, and appropriate methods were considered for solving the problems of each area.



Location Map of 3 Pilot Areas

### 2.3 Goals of Pilot Activities

To improve water supply and sewerage services, and sound business operation, the goal of the pilot activities was set as "conversion from vicious spiral to virtuous spiral".

In order to shift from flat-rate to metered-rate (tariff system according to the water consumption), grasp water consumption volume, improve revenue, and reduce NRW in the pilot areas, four targets were set:

- (1) Establish a water distribution management system (hydraulic separation)
- (2) Achieve continuous water supply (at least for 12 hours/day)
- (3) Ensure appropriate water pressure (12 m or more)
- (4) Improve revenue and shift to metering system

Establishing a water distribution management system (Target 1) is necessary to extend water supply time (Target 2) and ensure appropriate water pressure (Target 3). By achieving (Target 2) and (Target 3), customer satisfaction will be improved. High customer satisfaction will lead to

non-contract households becoming new customers and promote payment from non-payment customers. This will improve revenue and support shifting to metering system (Target 4).

### 2.4 Methods of Pilot Activities

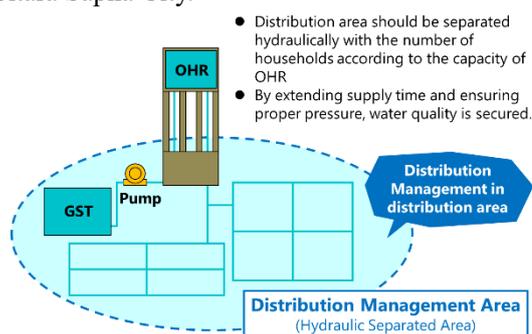
Initially, the water supply service level of WASA-F was extremely low. In order to improve the water supply services, pilot activities were started to establish an appropriate water distribution management system in the pilot areas.

Specifically, pilot activities aimed at continuous water supply at least for 12 hours, ensuring of water pressure of 12 m or more at a water tap (as stated in the design criteria of Government of Punjab), and elimination of wastewater contamination.

In Faisalabad city, since all water pipes are internally connected and the establishment of water distribution management system has been delayed, the water pressure generated at water treatment plants or terminal reservoirs quickly disappear to the vast distribution network.

Therefore, it is necessary to set an appropriate distribution management area according to the capacity of Ground Storage Tank (GST) and Over Head Reservoir (OHR) and achieve the hydraulic separation in each area. Only then can an appropriate water distribution management system be established in the area.

Based on this principle, pilot activities were started in Sarfraz Colony, and improved approaches based on those experiences were applied to pilot activities in Madina Town and Sitara Sapna City.



Hydraulically Separated Distribution Management Area

### 2.5 Meter Installation and Meter Reading

Before the start of the pilot activities, WASA-F had no experience with meter installation and meter reading. Although 20,000 water meters were procured in a previous donor project, these meters were not installed properly. In addition, 11,000 water meters had been already installed but

meter reading was never conducted.

The accuracy of the water meter is important because billing to the customer is based on the meter reading results. Therefore, a manual and SOP for water meter installation were developed. Specifically, it was decided that the water meters should be installed outside the premises to enable easy access for meter reading and repairs. Check valve installation for preventing backflow from the customers' roof-top tank and stop cock installation for preventing the overflowing from roof-top tank were also specified in the manual and SOP. For preventing theft, an iron cage was adopted. Moreover, a check sheet was prepared so staff in the field can confirm correct installation conditions, such as: making sure there are no branch pipes upstream of the meter and ensuring that the water meter was installed horizontally.



**Situation of meter installation**

Meter reading books and maps describing the meter reading route were also created. Furthermore, on the job training for meter readers was conducted, and meter reading system was established through the pilot activities.

## **2.6 Customer and Public Relations**

At the beginning of the pilot activities, the trust between WASA-F and customers was very weak.

Although there were many non-contract households and unregistered customers, WASA-F mainly dealt with customer complaints, and the organization to increase customers and improve revenue was not effective.

Once the water distribution management system was established through the pilot activities and the water supply services improved, WASA-F started to promote the new and improved WASA-F to customers.

Unregistered households were investigated throughout the city and registered as customers. Unregistered households were also detected during door-to-door surveys to check the water supply status in pilot areas. For shifting to metering system, WASA-F had to link the account

number to the address. Through these activities, unregistered customers were discovered and registered. Numerous careful field surveys were implemented in this project.

Many PR activities towards residents in the pilot areas were implemented through ceremonies, PR activities in mosques, distribution of flyers, banners on the street every time WASA-F achieved new services etc. (12 hours water supply, appropriate water pressure, no contamination inside the distribution pipeline).

In addition, members of taskforce team “SMART WASA” (described in Section 4.1) implemented door-to-door visits to confirm the water supply status in each house, and at the same time, announced new services and asked customers to pay their water bills.

## **2.7 Pilot Activities in Sarfraz Colony**

In Sarfraz Colony, it was planned to separate pilot area hydraulically by excavation of all points where pipeline crossing is expected at the boundary of the set water distribution management area.

However, the pipeline drawings of WASA-F were inaccurate, and multiple unknown pipelines were detected.

The excavation and pipe cutting work for hydraulic separation were massive undertakings because it is necessary to search for, discover, and identify all unknown pipelines. Due to the laborious and uncertain nature of this work, the staff became exhausted.

As a result, hydraulic separation was not achieved and the target water pressure of 12 m could not be secured.



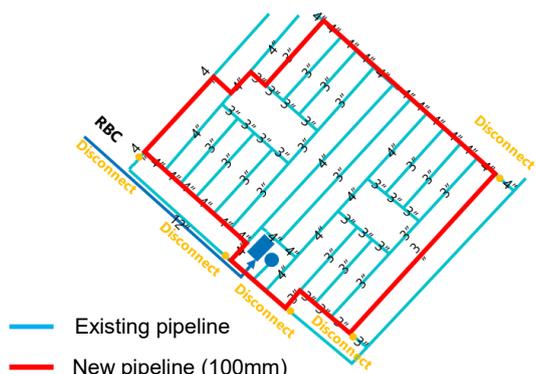
**Situation of duplicated pipeline**

## **2.8 Pilot Activities in Madina Town**

Based on the experience in Sarfraz Colony, the approach in Madina Town was changed and a new 100 mm distribution pipe was installed around the perimeter of the target area to ensure all connection pipes to the outside were cut. Acknowledging the importance of hydraulic separation,

about 15 million PKR (143 thousand USD) was spent for this construction work as the project cost of JICA.

All intersections were excavated. If multiple pipes were detected on the same line, one appropriate line was selected and all other lines were disconnected and plugged. All pipelines inside the pilot area were connected to the new perimeter pipe. It was also verified that there was no outflow from pilot area to outside areas. Complete hydraulic separation of the distribution management area was achieved in Madina Town. As a result, water pressure was improved and sufficient water quantity was secured.



**Hydraulic Separation Method in Madina Town**

## 2.9 Pilot Activities in Sitara Sapna City

Unlike the other areas, Sitara Sapna City has no GST or OHR. Water is supplied directly from Terminal Reservoirs by pump boosting via arterial main.

Although water reaches the area directly from Terminal Reservoir booster pumps 6 hours a day (2 hours x 3 times), water pressure is insufficient to reach the roof-top tank of some customers, even during the water supply times. On a positive note, in order to avoid main pipes becoming empty, water is supplied from the Chiniot water source by well pump, even during non-supply times. Therefore, water is always available in the pipelines near Sitara Sapna City, although the pressure is almost zero.

To take advantage of this situation, WASA-F is planning to install a booster pump at the inflow part of the distribution management area, aiming at extension of water supply time and securing of adequate water pressure.

In Faisalabad, a large number of small residential areas have been developed in recent years. In many cases, hydraulic separation has already been achieved, like Sitara Sapna City. In such areas, using a booster pump, new services of the extension of water supply time and ensuring appropriate water pressure may be effectively provided.

## 3 Results of Approaches

### 3.1 Sharing Master Plan to Other Donors

During the development of the master plan, discussion and information sharing with many other development partners were implemented, including two donor meetings.

Other donors were interested in the pilot activities and remarkable changes in the water supply situations (water quantity, water pressure and water quality), and many opinions were exchanged with them. Since this project directly links to revenue, its causality was also shared with them.

This master plan was provided to other donors like World Bank (WB), Asian Development Bank (ADB), French Development Agency (AFD), Danish International Development Agency (DANIDA), etc., and they have signed MoUs or agreements for supporting development related to water and sewerage with WASA-F.

### 3.2 Improvement of Water Supply Services

#### (1) Sarfraz Colony

Although complete hydraulic separation could not be achieved in Sarfraz Colony, disconnection of many pipelines connecting to the outside of pilot area significantly reduced the amount of outflow from the OHR and 12 hours water supply was achieved. Water pressure of 7-10m was also ensured, and all contaminations observed at the pipe end was eliminated.

With these achievements, WASA-F declared the start of new services in Sarfraz Colony on September 15, 2017. For these constructions, 5.37 million PKR was required and expended by WASA-F.



**New Services Ceremony in Sarfraz Pilot Area**

#### (2) Madina Town

In Madina Town, based on the experiences in Sarfraz Colony, complete hydraulic separation was achieved by the new method, and 12 hours water supply was achieved. In

calculation from the amount of outflow from the OHR, it is possible to realize 24 hours water supply. However, by extending the water supply time, overflows from sewerage manholes were observed. This is due to the lack of capacity of the sewerage side. 24 hours water supply is desirable for water safety, and by solving this issue, it is expected to be able to achieve 24 hours water supply in the future.

More than 18 m of water pressure has also ensured. Initially, water leakage caused by poor construction and poor-quality materials frequently occurred at joints of distribution pipes and service branches, and only 10 m of water pressure could be ensured. After leakage survey was instructed and leakage was repaired, more than 18 m of water pressure was finally ensured.

A ceremony was held on January 10, 2019, and the start of a new services in Madina Town was declared.



**New Services Ceremony in Madina Town**

Throughout the pilot activities, WASA-F faced challenges such as inaccurate pipeline information and unknown multiple piping. The effectiveness of the above-mentioned new hydraulic separation method was also demonstrated through such activities.

Although the outer perimeter construction cost was met by project funds of JICA, another 6.55 million PKP related to internal connection work and repair work of the existing facilities was expended by WASA-F.

### 3.3 Improvement of Billing Collection Ratio

Water supply services were improved in Sarfraz Colony and Madina Town through the establishment of a water distribution management system.

As concrete results, in Sarfraz Colony, continuous water supply was achieved for 12 hours, the water pressure was improved to 7-10m, and as a result, the bill collection ratio and the number of customers increased (As shown in "Before and after the pilot activities in Sarfraz Colony"). In Madina Town, hydraulic separation was achieved, and

continuous water supply for more than 18 hours was achieved. Water pressure was also dramatically improved.

#### [Sarfraz Colony]

	As of Nov. 2016	As of Mar. 2019
<b>Water Tariff System</b>	Flat-rate	<b>Metered-rate</b>
<b>Billed Amount</b>	Average: 200Rs Total: 97,304Rs	Average: <b>271Rs</b> Total: <b>160,522Rs</b> <span style="color: red;">+35.5%</span> <span style="color: red;">+65.0%, +63,218Rs</span>
<b>Water Supply Time</b>	3.5 hours	<b>12 hours</b>
<b>Water Pressure</b>	2-3m	<b>7-10m</b> <span style="color: red;">Water can reach 2nd Floor</span>
<b>Water Quality</b>	Contamination was observed	<b>Contamination was not reported</b>
<b>Bill Collection</b>	48.2%	<b>56.9%</b>
<b>Nos. of Conn.</b>	487 conn.	<b>592 conn.</b> <span style="color: red;">+21.6%, +105 conn.</span>

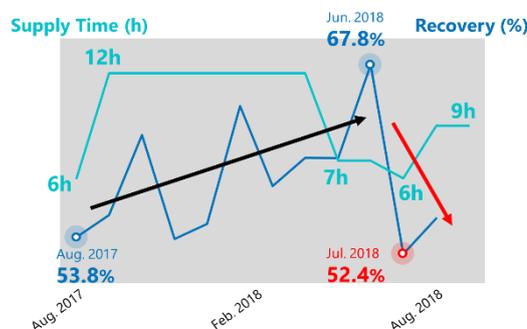
#### Before and after the pilot activities in Sarfraz Colony

#### [Madina Town X block]

	As of Nov. 2016	As of Mar. 2019
<b>Water Tariff System</b>	Flat-rate	<b>Metered-rate</b>
<b>Billed Amount</b>	Average: 144Rs Total: 46,599Rs	Average: <b>263Rs</b> Total: <b>91,788Rs</b> <span style="color: red;">+82.6%</span> <span style="color: red;">+97.0%, +45,189Rs</span>
<b>Water Supply Time</b>	6 hours	<b>18 hours</b>
<b>Water Pressure</b>	2-3m	<b>18m</b> <span style="color: red;">Water can reach 3rd Floor</span>
<b>Water Quality</b>	Contamination was observed	<b>Contamination was not reported</b>
<b>Bill Collection</b>	48.1%	<b>60.6%</b>
<b>Nos. of Conn.</b>	322 conn.	<b>350 conn.</b> <span style="color: red;">+9%, +28 conn.</span>

#### Before and after the pilot activities in Madina Town

The motivation of staff to acquire new customers and to improve bill collection ratio also increased, and it was possible to increase the billed amount by 165% in Sarfraz Colony and by 197% in Madina Town.



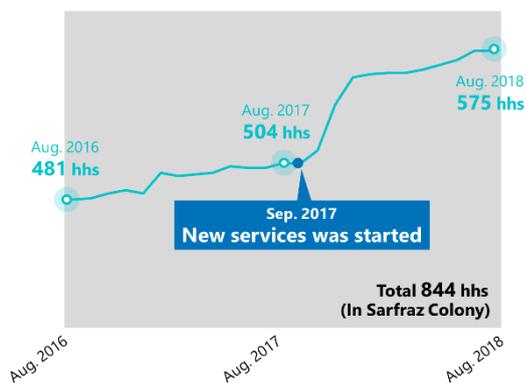
#### Transition of Recovery Ratio in Sarfraz Colony

In Sarfraz Colony, unfortunately, there were periods when 12 hours water supply was not maintained after the start of new services due to stoppage of water treatment plants, canal closures, power outages, and low vigilance among staff. The bill collection ratio that had been improving dropped significantly (as shown in "Transition of Recovery Ratio in Sarfraz Colony").

Staff of WASA-F were able to clearly see the importance of continuing the improved water supply services.

### 3.4 Meter Installation and Metering System

Along with the improvement of the water supply service, various campaigns were implemented such as distributing brochures, displaying banners, and promoting new services by door-to-door visits. These activities made it possible for customers to realize that it was different from the past water supply services of WASA-F, and customer satisfaction was improved. As evidence, many new customers have started to connect to the WASA-F system. Increasing in the number of customers led to increased revenue.



**Transition of number of customers in Sarfraz Colony**

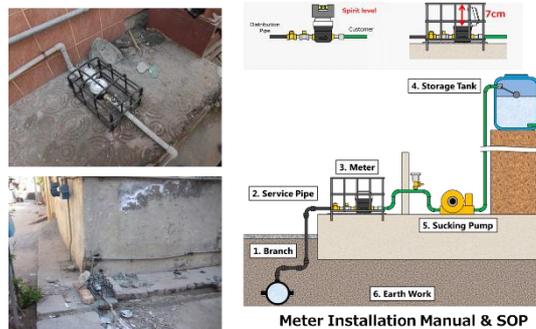
Based on this increase in the number of customers, a feasibility study on shifting to a metering system was conducted. With the improvement of the water supply services, customers understand the full potential of life sustaining water services provided by WASA-F and showed an understanding of shifting to metering system.

Therefore, in order to shift to metering system, water meters were installed to all customers. WASA-F has properly installed 577 water meters in Sarfraz Colony and 360 water meters in Madina Town according to the SOP created by the project and has started shifting to metered system.

Staff in Sarfraz Colony and Madina Town provided technical instruction to staff in Sitara Sapna City, and the experiences and know-how obtained in pilot activities were shared.

Before the start of the project, water meters were installed inside the customers' premises. There were no installation standards and installations were improper.

In this project, water meter installation manual and SOP were newly developed, and it was decided to install all water meters outside the customers' premises.



**Meter Installation according to SOP**

With the installation of water meters, meter reading books were prepared, meter readers were trained, and a new SOP was developed related to data management and billing method in metering system.

WASA-F itself needed time for shifting to metering system. It took about a year for preparation such as training of meter readers, simulation of billing cycle from meter reading to billing, analysis of customers' water consumption, etc.

In December 2018, two years after the project started in November 2016, first metering system was launched in Sarfraz Colony.

## 4 Strategies and Lessons in Pilot Activities

### 4.1 Taskforce Team “SMART WASA”

Most of the staff in WASA-F are a technical/engineering staff. However, for activities involving tariff shifting, the establishment of taskforce teams across organization was essential.

Thus, a taskforce team “SMART WASA (Supply Management and Revenue Team)” was established within WASA-F by request from JICA mission team. This team was designed as a cross-organizational and cross-hierarchical team. In order to practice from water distribution management to revenue recovery at once, it consists of members from each section of GIS, water distribution, revenue recovery, and also included employees from director to field staff.

JICA experts also belonged to this team and considered together what was necessary to achieve the project goals.



**Kick-off Meeting of SMART WASA (November 2016)**

Each of the four goals was prioritized. Budget and human resources were pooled as a single resource, and a method to solve each problem one by one was adopted.

By carrying out work that is not usually in their job descriptions, the staff understood the relationship between the work of their own department and the work of other departments. Through such development of relationships and exchange of various ideas, effective OJT was practiced.

### 4.2 From Vicious Spiral to Virtuous Spiral

In the pilot activities, various activities were promoted through SMART WASA in order to transform the management of the vicious circle business of WASA-F into a virtuous circle.

Improving water supply services led to customer satisfaction and new customers. Total customer base and bill collection ratio were improved. At the same time, shifting to metering system increased customer unit prices. Taken as a whole, the project activities led to increased revenues for WASA-F.

The effects were not limited to the pilot areas. By carrying out a customerization of unregistered customers and implementing a payment promotion campaign in all cities, revenue increase of 15 to 20 million PKP (143 to 191 thousand USD) per month was achieved for WASA-F.

	mil. Rs						
	FY2011	FY2012	FY2013	FY2014	FY2015	FY2016	FY2017
Jul.	27.00	25.58	46.09	47.03	54.61	49.10	68.31
Aug.	53.96	26.54	49.09	53.43	57.98	66.50	84.94
Sep.	25.45	45.89	60.11	55.15	49.19	48.96	71.17
Oct.	50.30	50.14	48.01	54.08	57.83	57.16	88.60
Nov.	24.66	51.26	53.60	49.00	51.19	62.59	73.82
Dec.	52.10	49.32	59.70	52.82	49.15	61.93	74.09
Jan.	31.40	49.99	59.40	58.15	66.11	66.05	87.60
Feb.	63.57	55.25	57.10	48.79	70.00	68.54	88.15
Mar.	22.65	53.45	60.30	54.28	64.29	67.58	83.77
Apr.	42.49	56.72	60.01	64.45	62.00	65.11	84.48
May	35.31	49.30	60.50	51.74	63.42	67.64	88.40
Jun.	55.42	57.83	59.37	60.74	54.74	64.47	78.31
Ave.	40.36	47.61	56.11	54.14	58.38	62.14	80.97

**Change of Tariff Revenue in WASA-F**

Water utilities must always make investments that lead

to increased revenues. In the pilot activity, all measures leading to increasing revenue such as, gaining new customers by improvement of water supply services, detection of unregistered customers, increasing payment customers, etc were discussed and implemented. The revenue increase can be said to be the result.

The pilot activities were able to demonstrate a virtuous spiral of establishing a water distribution management system, improving customer satisfaction, increasing tariff revenue, and improving financial conditions.

As a result, it is now possible for WASA-F to newly invest in further improvement of water supply services.



**Good spiral in WASA-F**

### 4.3 Data Management System

Proper data management is essential for all activities.

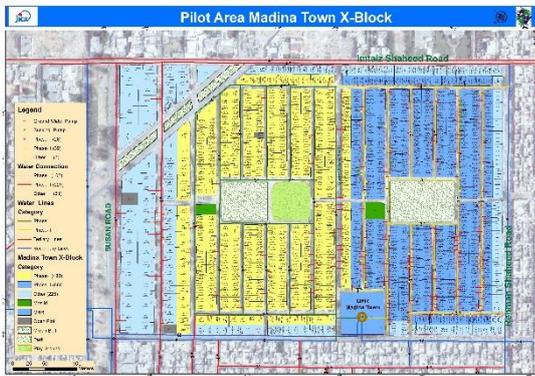
Although Faisalabad has many non-contracted residents and unregistered customers, WASA-F was not able to correctly identify them.

In addition, to implement the metering system, Account ID, Meter ID and House No. must be linked for billing and meter reading.

In many developing countries, GIS data are developed by GIS specialists employed for that purpose. However, the on-site information is often held by field staff themselves.

In this project, field staff of technical and revenue sections, and GIS staff were responsible for cooperating with each other to create accurate and useful GIS mapping.

Furthermore, customer surveys of all households in the pilot areas were conducted, and all information of pipelines, customers, water supply conditions, etc. were integrated into GIS and printed on a single sheet of paper. By printing map on a sheet of paper, field workers can easily use it for their day-to-day operation.



**Data Management using GIS**

It was identified that the contract ratio of each pilot area was 57% in Sarfraz area, and 35% in Madina Town. Many potential customers can still be expected. In addition, 45-50 unregistered customers were detected, and 38 households were legalized in Sarfraz Colony. Also, approximately 60 unregistered customers were detected, and all those households were legalized in Madina Town.

#### 4.4 Door-to-door Survey

It is the mission of any water utility to establish water supply services which provides access to use safe drinking water anytime with appropriate pressure. For this, it is necessary to grasp the situation at water taps and improve it.

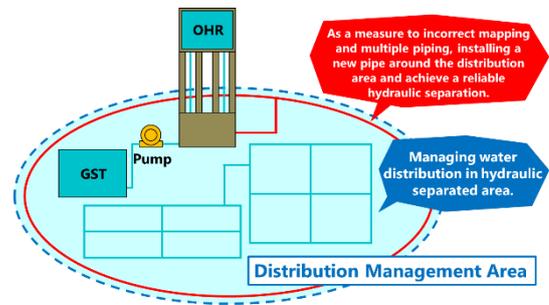
In this project, SMART WASA visited the customers one by one, checked the situations of water taps and improved the water supply services.

#### 4.5 New DMA Establishment

In Sarfraz Colony, WASA-F faced many challenges in trying to achieve hydraulic separation, such as inaccurate drawings and unknown multiple piping.

Under the same conditions, in Madina Town, a new distribution pipeline was installed around the perimeter of the distribution management area and all pipes connecting to the outside and unnecessary internal pipes were disconnected and plugged. Finally, the effectiveness of this method was demonstrated.

In many developing countries, undeveloped mapping and multiple piping have been reported. The same method may also be effective for these situations.



**Image of New Hydraulic Separation Method**

### 4.6 Japan-style Construction Management

In order to achieve complete hydraulic separation in Madina Town, the technology of companies with pipe installation experiences in Yokohama city was adopted. Japanese-style construction photograph management, construction record keeping methods and pipe joint check sheets were prepared for local use and utilized for construction management.

By keeping records of all construction processes, instances of water escaping the hydraulic separation area were eliminated, and hydraulic separation was achieved.



**Japanese-style Construction Management Sheets**



**Japanese-style Safety Management**

### 4.7 Water Meter Management System

In metering system, bill amount is determined by the water meter's measured value. 1% difference in the accuracy of the water meter will change the income by 1%.

Throughout this project, the importance of water meter accuracy have been discussed and appropriate meter selection and meter installation were promoted.

A simple meter inspection workshop was also built in this project to check the accuracy of meter itself.



**Construction of Simple Meter Workshop**

Water meters can be connected in series to a gravity flow pipe from an OHR. A plurality of water meters can be compared simultaneously by measuring the amount of passing water with a poly bucket or the like. As a result, WASA-F was able to establish a system to compare and study the accuracy of the meter.

Water meters do not work just by installing them. Only after meter reading and billing based on it, water meter becomes effective. In other words, water meters should be installed at a stage where a distribution management system is established.

#### **4.8 Manual and SOP for Meter Installation**

Many faulty meters have been reported through pilot activities.

In Faisalabad, fine particles are easily mixed in the pipes because WASA-F operates pipeline without cleaning after construction or there are few washouts and drain pipes in network of WASA-F. It is considered that those particles are clogging the water meters.

It was also observed that water meters were not installed properly. Not installing horizontally, installing after branched pipeline, sudden pump suction, air counting and reverse flow from roof-top tank were also observed and can lead to inaccurate readings for failures of water meters. Under such situations, it is not possible to make appropriate water bill in metering system.

In the pilot activity, the manuals and SOP for meter installation were developed and proper meter installation method was given. As a result, WASA-F is now able to install meter correctly.

#### **4.9 Introduction of Appropriate Water Meter**

Although the meter installation method has been improved, water meter itself still needs to be discussed.

The water meter adopted in WASA-F is a rotary piston type, and it is very high in accuracy. However, small dust or particles can become stuck and severely affect accuracy. Considering current WASA-F situation and water quality, propeller-type water meter is strongly recommended.

It is very significant that WASA-F was able to understand the importance of the type and specification of water meter and started to consider the introduction of appropriate water meter.

#### **4.10 Reduction of Non-Revenue Water**

In the pilot activities, two non-revenue water measures were implemented: activities to directly link to revenue increase by legalization of unregistered customers and activities to directly link to improvement of water supply services such as water leakage reduction.

##### **(1) Legalization of Unregistered Customers**

During the pilot activities, it was identified that there were many unregistered customers in pilot areas, and JICA experts recommended conducting a city-wide survey to accurately grasp the number of customers.

Results showed 16,332 unregistered water supply and 49,621 unregistered sewerage households. WASA-F had not billed these unregistered customers and had not recorded their water consumption.

However, the registration into legal of unregistered customers converted this non-revenue water into revenue water, which directly lead to increased revenue.

##### **(2) Water Leakage Reduction**

Water leakage accounts for a large percentage of non-revenue water. However, there are stages in leakage control, and under the current conditions of low water pressure in Faisalabad and inaccurate pipeline information, underground leakage investigation is extremely difficult.

In the pilot areas, creation of accurate drawings, establishment of water distribution management system, and improvement of water pressure allowed underground water leakage to be more easily detected and repaired. By repairing the water leakages, water pressure was improved day-by-day. Furthermore, it was possible to reduce the amount of outflow from OHR and this contributed to the extension of water supply time.

Non-revenue water reduction by DMA creation is not sustainable unless the water utility has the ability to create and manage accurate information, create hydraulic separation areas, and produce construction cost budgets based on this information.

The cost of the construction of the distribution management area compared with financial benefits of the pilot activities has not yet been discussed in detail. Therefore, a conclusive cost-benefit verdict is difficult to give.

However, it is clear that the pilot activities and the achievements therein were effective as a means of improving water supply services.

(Project Period: From July 2016 to June 2019)