The Islamic Republic of Pakistan

FY2017 Ex-Post Evaluation of Japanese Grant Aid Project

"Project for the Improvement of Water Supply System in Abbottabad"

External Evaluator: Hideyuki Takagi, Ernst & Young ShinNihon LLC

0. Summary

This project was implemented to provide safe and stable water supply services in Abbottabad city and 4 neighboring areas, a medium-scale urban area located in Abbottabad district of Khyber Pakhtunkhwa province in the northern part of Pakistan, by newly developing a gravity-flow surface water supply system (hereinafter referred to as "surface water supply system") and the renewal and enhancement of the groundwater system. The Project thereby contributed to increasing the water supply coverage ratio and access to safe water for the residents in the project area, where water supply capacity was insufficient despite an expected population increase due to expansion of the urban area.

This project was highly relevant as it was consistent with the development plan and development needs of Pakistan, as well as Japan's ODA policy. The efficiency of the Project is fair as the project period exceeded the plan, although project outputs were almost as planned and the project cost was within the plan. As an effect of the Project, the amount of water distributed from the supply side is almost as planned; however, the quantity and quality of water received by the local residents from tap water in their house has been far below the target, which seems due to leakage from the water distribution network. Therefore, improvement of access to safe water for the residents has not been fully achieved yet. The effectiveness and impacts of the Project are concluded as fair considering that the surface water supply system, the main part of the Project, supports the local water supply. The sustainability of the effects of the Project is fair as there are some minor problems to be improved in the technical and financial aspect of the newly established wide water supply area utility. In light of the above, this project is evaluated to be partially satisfactory.

1. Project Description

Source: Website of the district government of Abbottabad[1]

Project Location
(Map of the Abbottabad District)

Photo 1. Newly constructed water treatment plant of the surface water supply system (a distant view as of July 2015)

1.1 Background

Although Abbottabad city and the surrounding area in Khyber Pakhtunkhwa province had relied on groundwater for its water supply for many years, an urgent need to increase the water supply capacity arose in order to deal with the expansion of urban area and population increase, and the reduction of the pumping capacity of existing tube wells. Although the development policy of the Pakistan government at the time of planning of this project aimed to improve access to safe water from 65% in 2005 to 76% in 2010, and 93% in 2015, in the "Mid-term Development Framework 2005-2010," the water service coverage ratio in that area was below the national average of 57% as of 2009 and the water supply was unstable in many places as the duration of water supply per day was less than 1 hour. In terms of water supply operation, the operation cost was high as it pumped groundwater into a high water reservoir, which financially pressed the water supply operation. In addition, as maintenance and management of tube well pumps etc. was not carried out properly, among some tube wells there was conspicuous underground water shortage and significant aging of the pumps due to excessive pumping, and these tube wells could not be used in the long term.

In light of this situation, the government of Abbottabad district formulated a plan for water supply by gravity flow from the valley in the eastern part of Abbottabad City in 1990. Thereafter, the feasibility study (F/S) was conducted by the Asian Development Bank (ADB) in 1994, and in December 2000 a request was made for grant aid to the Government of Japan. In response to this request, the Japan International Cooperation Agency (JICA) conducted a preliminary survey in 2002 and a basic design study in 2004. After a four-year interruption

[1] Website: http://dga.com.pk/district-profile/ Access: June 6, 2018

due to the North Earthquake which occurred in October 2005 and the settlement of a water rights issue with downstream municipalities, JICA conducted a preparatory survey in 2009. Based on the survey, this project was planned with the goal of improving the access to safe water for local residents, including the increase of the water supply coverage ratio, by newly developing a gravity-flow surface water supply system and updating/strengthening the existing groundwater supply system in Abbottabad City and the surrounding 4 areas in Abbottabad district.

1.2 Project Outline

The objective of this project is to provide safe and stable water supply services in Abbottabad City (including Nawanshehr area) and the surrounding 4 areas in Abbottabad district by constructing a gravity-flow surface water supply system, improving the groundwater system and providing technical assistance for maintenance and management of water supply facilities to the engineers of the executing agency, thereby contributing to an increase in the water supply coverage ratio and improvement of the living environment of the residents in the project area[2].

Grant Limit / Actual Grant Amount	Detail design: 53 million yen / 53 million yen Construction: 3,644 million yen / 3,559 million yen Total: 3,697 million yen / 3,612 million yen
Exchange of Notes Date / Grant Agreement Date	Detail design: February 17, 2010 / February 17, 2010 Construction: July 27, 2010 / September 14, 2010
Executing Agency	The Government of Abbottabad District
Project Completion	July 2014
Main Contractors	Tobishima Corporation / Dai Nippon Construction (JV)
Main Consultants	Nihon Suido Consultants Co., Ltd. / Japan Techno Co., Ltd. (JV)
Basic Design / Preparatory Survey	July 2003 – July 2004 / April – September 2009
Related Projects	German Government-owned Development Bank (KfW): Ÿ Drinking Water Supply and Sanitation Measures in the Northern Uplands/Chitral District (1996) ADB: Ÿ NWFP Urban Development Sector Project (2001 – 2008)

[2] The following additions are made to the “purpose of the project” described in the ex-ante evaluation summary report of this project: geographic information and quantitative / qualitative impact (referred to the "objective of the project" in the summary of the preliminary study report)

	Ÿ Khyber Pakhtunkhwa Intermediate Cities Improvement Investment Project (in progress)

2. Outline of the Evaluation Study

2.1 External Evaluator

Hideyuki Takagi, Ernst & Young ShinNihon LLC

2.2 Duration of Evaluation Study

This ex-post evaluation study was conducted according to the following schedule.

Duration of the study: November 2017 – November 2018

Third-country meeting: February 18 – 21 and May 6 – 9, 2018

Duration of the Field Study: March 4 – 23 and June 6 – 9, 2018 (The field study was carried out by a local consultant.)

2.3 Constraints during the Evaluation Study

The evaluator did not enter Pakistan for security reasons and a local consultant carried out the entire process of the field survey under the direction of the evaluator. The evaluator performed a desktop evaluation based on the results of information gathering, interviews, site examinations, etc. by the local consultant. The evaluator and the local consultant had a preliminary meeting in the third country (Thailand) before the field study to give the local consultant an explanation about the method and subject of field survey, how to share the results of field survey result and the analysis result, and how to explain the provisional evaluation result to the water utilities (Public Health Engineering Department Abbottabad (hereinafter referred to as "PHED") and Water and Sanitation Services Company Abbottabad (hereinafter referred to as "WSSCA[3]"), etc.

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

3.1 Relevance (Rating: ③[5])

3.1.1 Consistency with the Development Plan of Pakistan

(1) Consistency with the national development plan

Although the national development policy of Pakistan differs between the *medium-term development framework* at the time of the planning of the Project and the 5-year plan and the *medium- to long-term growth strategy* at the time of ex-post evaluation, the policy goal

[3] Established in 2015 as a public enterprise integrating and managing water supply, sanitation and solid waste management services in the Abbottabad urban area, it began providing services in April 2017 (for details, refer to "Organizational aspect of operation and maintenance").

[4] A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory

[5] ③: High, ②: Fair, ①: Low

to ensure drinking water for people has consistently been maintained.

The *Medium Term Development Framework 2005-2010* at the time of planning aimed to increase the rate of public access to safe water from 65% in 2005 (85% in urban areas, 55% in rural areas) to 76% by 2010 (95% in urban areas, 65% in rural areas) and up to 93% in urban areas by 2015. The national development policy at the time of ex-post evaluation, *11th Five Year Plan 2013-2018*, deals with water shortages as a serious problem in "energy, water and food safety," one of the seven pillars of policy, and it has promoted comprehensive measures including construction of dams for securing agriculture, industrial and household water. In addition, the future medium- to long-term growth strategy *Vision 2025* approved by the government in May 2014 aims to secure clean drinking water for all people in the country as a goal of the "energy, water and food safety" policy pillar.

(2) Consistency with the sector development plan

With the amendment of the Constitution in 2012, the Federal Government has transferred the authority of water administration to the provincial government. For this reason, consistency between the Project and the sector development policy on drinking water at the time of ex-post evaluation was confirmed with the *National Drinking Water Policy 2009* as well as the development policy of the Khyber Pakhtunkhwa province. Although there are differences between the sector development policy before and after the project implementation, the main policy of providing safe drinking water has consistently been maintained.

From the time of planning, the *National Drinking Water Policy* aimed to reduce water-borne diseases and mortality and improve the quality of life by supplying safe and sustainable drinking water to all citizens by 2025. At the time of ex-post evaluation, the water supply policy of Khyber Pakhtunkhwa province[6] is placed as one of the major policies *of the Integrated Development Strategy 2014 – 2018*. The water supply policy states that safe drinking water and hygiene are the most effective means for improving people's health and are social services to be provided as basic rights of citizens.

3.1.2 Consistency with the Development Needs of Pakistan

The urban area of Abbottabad district is a mid-sized city with a population of 200,000, and it was expected at the time of planning of the Project that the population would increase due to the expansion of the urban area. On the other hand, there was an urgent need to increase the water supply capacity, as there had been progressive reduction in the pumping

[6] As the formulation of water policies was transferred from the federal government to the provincial government by the revision of the Constitution in 2012, the consistency between the sector development policy and this project was confirmed with the development policy of Khyber Pakhtunkhwa province.

capacity of tube wells and aging of facilities.

The population in the project area was estimated to increase about 17% from the time of planning through the target year (2015, two years after project completion) to about 235,000 people with 32,500 households. The actual population increase by the time of the ex-post evaluation (2017) was 25% with 40% increase in households, which is almost the same as the increase as expected at the time of planning[7]. Therefore, the Project is consistent with the development needs to enhance water supply capacity to cope with population increase.

Table 1. Status of population increase in the project area

(Unit: People, Households)

Water supply area*1	Baseline (2009) (estimation)		Actual at the time of ex-post evaluation (2017)			
	Population	Households	Population (% increase)		Households (% increase)	
Abbottabad city	67,450	8,875	70,100	4%	11,229	27%
Nawanshehr area	27,338	3,645	50,486	85%	7,736	112%
Sheikhuk Bandi	19,033	2,799	26,158	37%	4,171	49%
Salhad	23,392	3,440	36,018	54%	6,068	76%
Mirpur	13,287	1,954	46,206	248%	6,668	241%
Jhangi	49,749	7,316	20,764	-58%	3,230	-56%
Total	200,249	28,029	249,732	25%	39,102	40%

Source: Baseline was the estimate at planning based on the census in 1981 and 1998 and population growth rate (materials provided by JICA) / Actual at the time of ex-post evaluation refers to the census in 2017 (materials provided by the executing agency).

*1 The administrative divisions of the water supply area were changed between 1998 Census, the base year of the estimated population and the number of households, and 2017 Census. For this reason, whereas the total of the entire water supply areas compares the population at the time of planning and ex-post evaluation, its breakdown is treated as reference information because of the change in area of administrative divisions.

3.1.3 Consistency with Japan's ODA Policy

This project was consistent with Japan's aid policy as follows during planning of the Project.

(1) Country assistance program

The Project was positioned as a "program to secure water and sanitation" in the "Securing human security and human development" aid priority area of the *Country Assistance Program (February 2005)* to Pakistan.

(2) JICA's aid policy

In the *Country Assistance Implementation Policy (June 2009)* to the Islamic Republic of

[7] There were overcrowded conditions in Abbottabad district urban area at the time of ex-post evaluation, influenced by refugees of the 2005 major earthquake and 2009 Waziristan conflict.

Pakistan, the water supply and sewerage sector was positioned as an important development field contributing to poverty reduction. Regarding municipal water supply, the main support policy was to secure access to safe drinking water, to promote safe living conditions with improved public hygiene in the urban environment by the improvement of water supply and sewerage, to strengthen autonomy and improve operation efficiency and effectiveness of operating agency, and to promote participation of beneficiaries and consideration for the poor etc. for improving water services.

This project has been sufficiently consistent with the development plan and development needs of Pakistan, as well as Japan's ODA policy. Therefore its relevance is high.

3.2 Efficiency (Rating: ②)

3.2.1 Project Outputs

The outputs of the Project were the construction of a surface water supply system and the improvement of groundwater supply system (renewal and new construction) and consulting services related to design and construction as hard component works, and technical assistance on maintenance and management to the engineers of the executing agency as technical assistance.

1) Construction Works

(1) Gravity-flow surface water supply system

This is a major part of the Project, which doubles the amount of water supply in the city of Abbottabad by constructing a new surface water supply system. Changes from the facility outline and the plan are as follows. Although there were minor changes from the plan with regard to land acquisition, etc., it was constructed almost as planned.

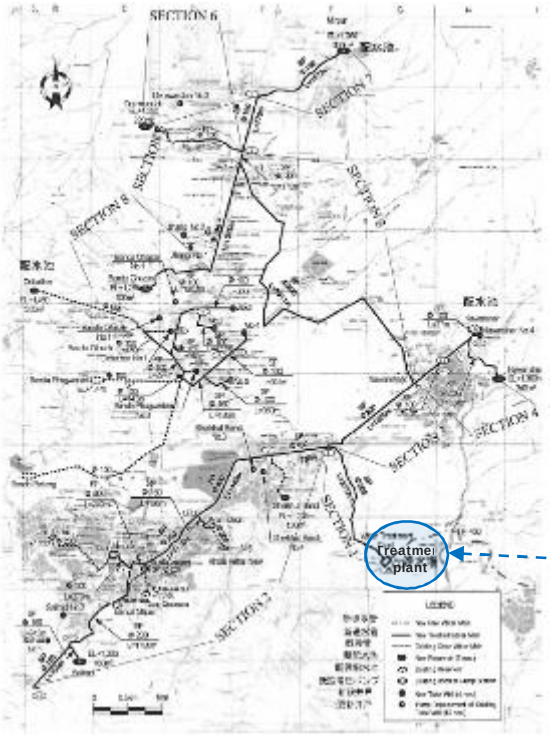
Table 2. Outline of the facility and changes from plan (Surface water supply system)

Facility	Scale	Changes from the plan
Water intake facility	4 locations (Bagh river, Gaya river, Namly Mira river and Bandi river) Intake amount: 17,280m^3/day (200 liters/sec)	Location and structure of Namly Mira intake facility (effect of flooding in 2010) Construction site and structure of Bandi intake facility (moved to upstream 200m due to overlap with road construction site)
Raw water transmission mains	Total length: 20.9km Diameter: 100 - 500mm	Route and extension of raw water transmission mains due to the change of the construction site of the Bandi intake facility and water treatment plant
Water treatment plant	Water treatment process: Sedimentation pond →Roughing filtration pond → Slow filtration pond → Chlorination →Purified	Layout of the facility as a result of changing the construction site to an adjacent place (as a result of negotiations with landowners)

	water reservoir Treatment capacity: 17,280m^3/day (200 liters/sec)	
Treated water transmission mains	Total length: 25.8km Diameter: 100 - 500mm	Route and extension of treated water transmission mains due to changes in the construction site of the water treatment plant
Distribution reservoir	6 locations (Nawanshehr, Sheikhuk Bandi, Salhad, Mirpur, Derawandah and Banda Ghazan) Total capacity: 1,320m^3	No particular change

Source: Materials provided by JICA

The surface water supply system distributes water from a water source located in a valley in the southeastern part of Abbottabad city, with the gravity-flow facility from water intake facilities to water treatment plant through transmission mains and distribution reservoirs. As it does not rely on electric power nor use a pump, it solves the problems of instability and cost burden of electric power. Water is distributed to the Abbottabad urban area through the newly constructed reservoirs, along with the groundwater supply system of which tube well as source of water.



Source: Materials provided by JICA

Figure 1. Location and arrangement of the facilities in the water distribution area

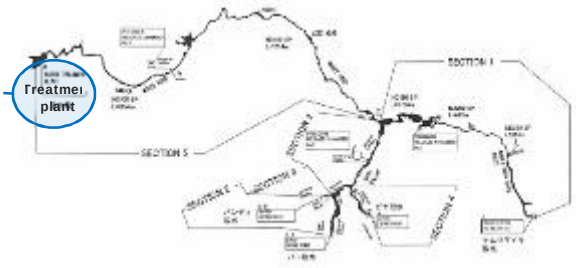


Figure 2. Surface water system (intake facilities - water treatment plant)

(2) Groundwater supply system

Changes from the facility outline and the plan of groundwater supply system are as follows. It was almost as planned; however, the change related to the implementation of replacement work at 8 tube well pumps affected the project period as well.

Table 3. Outline of the facility and changes from plan (groundwater supply system)

Facility	Scale	Changes from the plan
Water intake facilities	New tube wells: 4 locations (at Dobathar) Intake amount: 1,814m^3/day (21 liters/sec)	Construction site of well No.4
	Renewal of existing tube wells: 12 locations (at Nawanshehr, Sheikhuk Bandi (2), Salhad (2), Derawandah, Jhangi (2), Banda Ghazan, Banda Dilazak, Banda Phugwarian and Dobathar) Intake amount: 3,197m^3/day (37 liters/sec)	Replacement work of 8 tube well pumps to be conducted by Pakistan side (because of diminished water supply from surface water due to more severe drought conditions than usual during the scheduled period of pump replacement, pumping of these tube wells could not be stopped for replacement. In addition, delay in the installation of the stabilizing device to address the large voltage fluctuation was also a factor behind replacement work being delayed.)
Transmission mains	Total length: 4.5km Diameter: 100 - 150mm	Extension of water supply pipe due to change of construction site of well No.4
Distribution reservoir	1 location (at Dobathar) Total capacity: 300m^3	No particular change

Source: Materials provided by JICA

2) Consulting services and technical assistance

Consulting services and technical assistance were implemented almost as planned. In the technical assistance, technology transfer was made towards the following outputs.

Table 4. Implementation result of technical assistance

Item	Contents and achievements
Output 1	"Capacity development of well management and operation and maintenance of pumps" Ÿ Acquisition of basic knowledge on well management and pump operation maintenance management as well as strengthening of the capacity of operators were carried out through seminars, training and OJT. Ÿ "System Operation Manual for Tube Well" was prepared.
Output 2	"Development and strengthening of the organizational structure for the operation and maintenance of surface water supply system" Ÿ A draft policy on surface water supply committee and unit was prepared. Ÿ An agreement was reached on the volume of water supply and water tariff supplied to the wide water supply area by the surface water supply system. Ÿ The organizational structure for operating and maintaining the surface water supply system was developed.
Output 3	"Strengthening of the administrative and technical divisions of surface water supply system" Ÿ Seminar and OJT were implemented for the technical division of the surface water supply system to acquire the operation and maintenance technology of the slow filtration system.

	Ÿ "Manual for System Operation & Maintenance and Chlorination for Gravity-Flow Water Supply System" and "Final Report for Management Guidance of Gravity-Flow Water Supply System (Operation and Maintenance of Slow Sand Filtration System)" were prepared. Ÿ Lectures were given to the management department. Ÿ "Text for Water Supply Management and Accounting" was prepared.
Output 4	"Improvement of the environment for establishment of metered tariff system" Ÿ Public information activities and questionnaire survey for residents, and training for meter readers were conducted. Ÿ "General Description of New Water Supply System" was prepared as a support activity for consensus building between three water utilities and residents for establishing a metered rate water tariff system. In addition, "Typical Questions and Answers regarding New Water Supply System" was prepared by each water utility and distributed to the residents. As a result, the environment for shifting to tariff collection under a metered rate water tariff has been enhanced.

Source: Materials provided by JICA

3) Pakistan side implementation part

Land acquisitions, renewal and extension of water distribution pipes, procurement and installation of water meters, etc. were carried out by the Pakistan side. A breakdown of the works is as shown in Table 5 "Comparison of the planned and actual project cost."

3.2.2 Project Inputs

3.2.2.1 Project Cost

Out of the inputs of the Project, the total project cost fell within the plan as it was 95% of the planned amount (the project cost was 98% of the planned amount by the Japanese side, and 82% of the planned amount by the Pakistan side).

Table 5. Comparison of the planned and actual of the project cost

(Unit: Million yen)

Breakdown	Plan	Actual	% of the plan
Japanese side:			
Detail design	53	53	100
Main construction work	3,644	3,559	98
Subtotal	**3,697**	**3,612**	**98**
Pakistan side:			
Land acquisition	84	12	14
Construction of access roads to the project sites	53	86	162
Power and telephone lines to the water treatment plant and power to the tube wells	45	10	22
Connection between the existing and new distribution reservoirs	33	50	152

Renewal and extension of water distribution pipes	162	158	98
Procurement and installation of water meters	82	69	84
Others	145	108	74
Subtotal	**606**	**496**	**82**
Total project cost	**4,303**	**4,108**	**95**

Source: Materials were provided by JICA for the plan and actual of Japanese side costs and by the executing agency for the actual of Pakistan side costs (answer to the questionnaire).

3.2.2.2 Project Period

The actual project period exceeded the plan as it was 144% of the planned project period. The main reason for exceeding the planned period was that there were delays of about 8 months before completion of the surface water system in October 2013 due to the changes in the location and structure of the project facilities[8], and about 7 months to wait for the conditions necessary for the renewal of the existing tube well pumps which were delayed due to lack of water supply from the surface water system as an effect of seasonal fluctuations of rainfall and a more severe drought than usual. The renewal of existing tube well pumps was handed over to Pakistan side, and it was decided that the main construction was completed with preparation for the replacement of the tube well pumps in July 2014. Then an agreement was reached with the Pakistan side to complete the replacement of the tube well pumps by September 2015[9].

Table 6. Comparison of the planned and actual of the project period

	Plan	Actual	Difference
Process	Start of detail planning[10] – completion of technical assistance	Start of detail planning – completion of the main construction work	The end point of the actual project period was changed to completion of main construction work as it was completed after the completion of the technical assistance.
Period	February 2010 – February 2013 (36 months)	April 2010 – July 2014 (52 months)	144% of the planned period

Source: Materials were provided by JICA

Although the project cost was within the plan, the project period exceeded the plan. Therefore, efficiency of the Project is fair.

[8] Partial completion certificates were issued in December 2013 as to components other than replacement of existing tube well pumps (surface water supply system and construction of new tube well facilities).
[9] Of the eight works on the Pakistan side, four were completed at the time of agreement and the rest were completed after the agreement.
[10] Since the starting point of the project period is not specified in the ex-ante evaluation summary report of the Project, the starting point of detail design was adopted for both planned and actual results, which is the starting point of the implementation process chart of the preparatory study.

3.3 Effectiveness and Impacts[11] (Rating: ②)

3.3.1 Effectiveness

3.3.1.1 Quantitative Effects (Operation and Effect Indicators)

1) Operation indicators

Water distribution volume (daily maximum and daily average), average hours of water supply, and rate of the utilization of water treatment plant[12] were set as operation indicators of the water supply facilities developed by the Project. Comparison of the target and actual results is as follows.

Table 7. Comparison of the target and actual of the operation indicators

	Baseline	Target	Actual		
	2009	2015	2014	2016	2017
	At planning	2 years after completion	Year of completion	2 years after completion	As of ex-post evaluation
Indicator 1-1. Maximum water distribution per day (m^3/day):					
Surface water supply system	—	16,894	16,891	17,387	17,230
Groundwater supply system	No data	13,958	No data	No data	15,660
Total	No data	30,852	No data	No data	32,890
Indicator 1-2. Average water distribution per day (m^3/day):					
Surface water supply system	—	14,690	No data	12,802	8,592
Groundwater supply system	12,195	12,137	No data	No data	11,880
Total	12,195	26,826	No data	No data	20,472
Indicator 2. Average hours of water supply (hour/day)*1	1 time/week–10 days,< 1 hour/day	24 hours/day	No data	No data	2-3 times/week, < 1 hour/day
Indicator 3. Rate of utilization of the water treatment plant (average %)	—	N/A	No data	No data	No data

Source: Materials were provided by JICA for the baseline and target, and by the executing agency for the actual at the time of ex-post evaluation (answer to the questionnaire and interview).

*1 Planned and actual of average hours of water supply are based on interviews with residents in the qualitative survey.

(1) Volume of water distribution to the project area[13] (Maximum and average per day)

Comparison of the target and actual of the volume of water distribution in each water supply area of the Project is as follows.

[11] Sub-rating for Effectiveness is to be performed with consideration to Impacts.

[12] Rate of utilization of the water treatment plant was added in the ex-post evaluation. However, data for this indicator was not obtained from the executing agency.

[13] Although there are flow meters of the water pipe in the Abbottabad water supply, the water supply amount on the demand side cannot be calculated as the installation of the house water meter is not proceeding and the installed meters are hardly in operation at present. For this reason, analysis was made on the water production amount based on the supply side data, and the effectiveness indicator "water supply volume" set at the time of planning was changed to "water distribution amount".

Table 8. Volume of water distribution in each water supply area of the Project

(Unit: m^3/day)

Water supply area*1	Baseline (2009)	Target (2015)*2		Actual at the time of ex-post evaluation (2017)					
	Ave./day	Max./day	Ave./day	Max./day			Ave./day		
	Ground water	Surface + Groundwater		Surface water	Ground water	Total	Surface water	Ground water	Total
Abbottabad city	6,247	11,469	9,973	9,994	1,350	11,344	5,517	1,080	6,597
Nawanshehr area	3,240	4,540	3,948	2,068	2,700	4,768	900	1,620	2,520
Sheikhuk Bandi	357	2,659	2,312	1,292	2,160	3,452	900	1,620	2,520
Salhad	530	3,174	2,760	1,292	1,080	2,372	200	1,080	1,280
Mirpur	272	1,945	1,691	1,292	1,890	3,182	726	1,890	2,616
Jhangi	1,549	7,065	6,142	1,292	6,480	7,772	349	4,590	4,939
Total	**12,195**	**30,852**	**26,826**	**17,230**	**15,660**	**32,890**	**8,592**	**11,880**	**20,472**

Source: Materials were provided by JICA for the baseline and target, and by the executing agency for the actual at the time of ex-post evaluation (answer to the questionnaire and interview).

*1 As stated in the note to table 1, there was a change in the administrative divisions in the water supply area. Therefore, whereas the total of the entire water supply areas compares the volume of water distribution at the time of planning and ex-post evaluation, its breakdown is treated as reference information because of the change in area of administrative divisions.

*2 The target value is the volume of water demand in 2015 (two years after 2013, which was the original target year of project completion) assumed at the time of project planning.

Surface water supply system

As shown in Table 7, the actual result of maximum daily water distribution in the target year (2016) was 17,387m^3 (103% of the plan) and the actual result at the time of ex-post evaluation (2017) was 17,230m^3 (102% of the plan), which were higher compared to the planned target of 16,894m^3. The target for average daily water distribution was 14,690m^3, whereas the actual result in the target year was 12,802m^3 (87% of the plan) and the actual result at the time of ex-post evaluation was 8,592m^3 (58% of the plan), which has decreased from the previous year.

With respect to daily average water distribution, in which the actual amount at the time of ex-post evaluation was lower than the target year, an average value across the year was also analyzed based on the understanding that the surface water is greatly influenced by the precipitation amount, which varies from year to year. As a result, the average for the two years from the target year to the ex-post evaluation was 10,697m^3 (73% of the plan). Since the amount of water intake facilities during this period was 158 liters/second (79% of the facility design value of 200 liters/second), the fact that the intake amount was less than planned is considered to be the main factor causing less daily average water distribution than the plan.

In addition, Bandi water intake facility has suspended its operation since around 2014, right after its completion due to concern about pollution of water sources by domestic

wastewater by the migrants of about 50 households to the upstream after the earthquake in 2005. The inhabitants also take water from the river for their daily life. As an effect, the volume of water flow nearby the water intake facility has been very low (approximately 4 to 5 liters/second at the time of site inspection). (Refer to the lessons learned on "Water source preservation").

The three water intake facilities in operation may also be lower than the design value; however, because the amount of water at Namly Mira is large, the overall surface water supply is complemented to just under 80% (average[14]) of the plan.

Photo 2. Abundant water flow at Namly Mira water intake facility (taken during interview at site inspection)

Table 9. Volume of water flow at site inspection (for reference)

(Unit: liters/second)

Water intake facilities	Designed capacity	Actual at site inspection	Difference from designed capacity	
			Difference	%
Namly Mira	52	65	13	25%
Gaya	49	35	-14	-29%
Bagh	54	45	-9	-17%
Bandi	45	0*1	-45	-100%
Total	200	145	-55	-28%

Source: Executing agency (interview at site inspection)

*1 The volume of water flow is shown as 0 as its operation has been suspended.

Groundwater supply system

The planned maximum daily water distribution was 13,958m^3, whereas the actual result at the time of ex-post evaluation was 15,660m^3 (112% of the plan). The planned daily average water distribution volume was 12,137m^3, whereas the actual result at the time of the ex-post evaluation was 11,880m^3 (98% of the plan); therefore, both of the actual results have almost achieved the target.

On the other hand, there are some differences in the operation status of water intake facilities of the groundwater system (well/spring) in the target area from the assumption at planning. Specifically, 8 of the 27 facilities which were in operation or scheduled to continue

[14] The average water intake amount from September 2015 to May 2018 that data could be obtained in the ex-post evaluation survey.

operating by renewing pumps (one of the 27 facilities is spring water) have been in a disposal or inoperable state[15]. Also, 1 out of the 4 tube wells newly established by the Project has not been in operation as it was damaged about one year ago but has not yet been repaired. Meanwhile, the executing agency has restored the old tube wells that had not been operated according to budget available for the restoration; therefore, 16 restored water intake facilities (including 1 spring) have been in operation. As a result, a total of 38 groundwater intake facilities are in operation at the time of ex-post evaluation, which secures the same level of water distribution as the target of the Project.

The entire water supply system

The planned maximum daily water distribution was 30,852m^3, whereas the actual result at the time of ex-post evaluation was 32,890m^3 (107% of the plan). The planned average daily water distribution was 26,826m^3, whereas the actual result at the time of ex-post evaluation was 20,472m^3 (76% of the plan). On the other hand, the actual result of average daily water distribution at the time of ex-post evaluation is calculated as 22,577m^3 (surface water 10,697m^3 + groundwater 11,880m^3), which becomes 84% in comparison with the target based on the average of actual water volume over the last two years considering the annual fluctuations of rainfall.

Based on the above analysis, the target for this indicator is considered to have been almost achieved.

(2) Average hours of water supply in the project area

The actual water supply situation in the target area as a whole has been about 2 to 3 times per week of water supply with just under 1 hour per time at the time of ex-post evaluation, although about 24 hours/day of water supply was targeted by the Project. Based on the above, it is concluded that the achievement of the target for this indicator was low. However, according to the interview with the local residents conducted in the qualitative survey[16], the frequency of water supply for each house before the Project was once a week to 10 days for about 1 hour per time. Therefore, the water supply frequency has been improved by about 2-3 times of that compared to before the Project. Although the degree is not significant in comparison with the target, improvement to some extent has been observed in the hours of water supply by the Project.

(3) Rate of utilization of the water treatment plant (average %)

Although the data of actual water treatment volume was not obtained by the by the

[15] Two of these tube wells were subject to the renewal of pumps by the Project.
[16] Refer to “Outline of the qualitative survey” in 3.3.1.2 Qualitative Effects (Pg. 18).

executing agency, the water treatment plant has been operated properly since the commencement of its operation according to its explanation. As described in "Stability of water supply" in the qualitative effects below, there are seasonal fluctuations in the water distribution volume of the surface water system. However, the average water distribution volume is about 70% of the target value and the volume of water intake has been about 80% of the designed capacity. Therefore, it is assumed that the facility utilization rate of the water treatment plant has been maintained at about 70 to 80%. Based on the above analysis, the target for this indicator is considered to have been almost achieved.

2) Effect indicator

Water supply per capita was set as an effect indicator of the water supply facilities developed by the Project. The comparison between the target and actual is as follows.

Table 10. Comparison of the target and actual of the effect indicator

	Baseline	Target*1	Actual*2		
	2009	2015	2014	2016	2017
	At planning	2 years after completion	Year of completion	2 years after completion	As of ex-post evaluation
Indicator 1. Water supply per capita (liters/person/day)					
Abbottabad city	44	103	No data	No data	47～60
Nawanshehr area	48	103	No data	No data	
Surrounding 4 areas	No data	95	No data	No data	

Source: Materials were provided by JICA for the baseline and target and by the executing agency for the actual at the time of ex-post evaluation (answer to the questionnaire and interview)

*1 The target includes the volume of water for commercial use.

*2 The actual value has a range which shows the difference by region.

(1) Water supply per capita in the project area (average unit volume of water supply)

The actual water supply at the time of ex-post evaluation was in a range of 47 to 60 liters/person/day, compared to the target of 95 to 103 liters/person/day. Although the increase rate was supposed to be 115% from the baseline of 46 to target of 99 liters/person/day, the actual of average water supply was 53.5 liters/person/day, a slight increase of 16% from the baseline. It cannot be concluded since these figures are not measured values of the water meter, but the achievement rate of the target value of this index is assumed to be low (the comparison was calculated using the median for both the target and actual).

3.3.1.2 Qualitative Effects (Other Effects)

Regarding qualitative effects, the status of improvement of the water supply service was

confirmed through interviews with local residents, who are the users of water service, about the assumed effects of the enhancement of water supply capacity by the Project.

(1) Stability of water supply

As mentioned in the average hours of water supply in the quantitative indicator above, there continues to be a restricted water supply to certain hours (intermittent water supply) at the time of ex-post evaluation as before the Project began, and the water supply volume is still below the target as with the water supply per capita of the effect indicator. The local residents have been receiving an unstable and small volume of water supply to their house connections, and it is not certain for the residents when and to which water supply area water is supplied. The duration of water disruption is usually about 2 days at most, it may be longer if there are technical causes or when water intake is suspended temporarily due to turbid water in the rainy season. There are also seasonal fluctuations of water supply due to a decrease in water intake during winter. However, the frequency of water supply, which was once a week to 10 days and around 1 hour per time before this project, has improved to about 3 times a week since implementation. Therefore, there is considered to have been improvement to some extent in the effectiveness with respect to this indicator.

(2) Improvement of water pressure

Given that there continues to be a restricted water supply to certain hours (intermittent water supply), it is assumed that the water pressure is still low. According to the interview with the local residents conducted in the qualitative survey, they are concerned that due to the low water pressure, the amount of water storage in the water storage tank at each household will be reduced if a suction pump is not operated at the time of water supply[17]. Based on the above, effectiveness with respect to this indicator is considered low[18].

(3) Improvement of water quality

It is assumed that elimination of the negative water pressure will suppress the inflow of pollutants into the water pipe as an effect mainly due to the increase in the amount and duration of water supply. However, the current situation is a restricted water supply to certain hours (intermittent water supply). For this reason, it seems that sewage may infiltrate the water pipe during negative pressure conditions, which may cause contamination of water inside the pipe. The executing agency is also receiving complaints from local residents on water quality. According to the local residents, there is a bad smell which seems to be the

[17] However, the use of the suction pump is not accepted from the legal and ethical point of view and it is said that it should be eradicated. The user can be fined 15,000 to 30,000 Pakistan Rupees (Cantonment Board Abbottabad website http://cba.gov.pk/water-supply-branch/ Access: November 20, 2017).

[18] The executing agency answered the questionnaire that the problem of low water pressure improved greatly after this project. However, it is concluded in this evaluation that improvement for beneficiaries is low based on the water supply volume, hours of water supply and interviews with local residents.

infiltration of sewage from the sewer pipe laid in parallel with the water pipe. In this regard, the executing agency conducts regular water quality management at a frequency of twice per month. In addition, when receiving residents' complaints about water quality, they inspect the area's water and address the issue with the addition of chlorine etc. based on the inspection result. From the above, there is still room for improvement in the quality of tap water; therefore, effectiveness with respect to this indicator is considered low.

Outline of the qualitative survey: The qualitative survey was conducted at each water supply area of Abbottabad City, Sheikhuk Bandi and Jhangi in the project area through group interviews (Focus Group Discussions: FGDs). About 5 male or female interviewees were invited to each FGD (about 30 people in total), to discuss mainly the safety and stability of water supply service and improvement of the living environment before and after the Project.

Photo 3. Qualitative survey
(FGD with women's group)

From the above, the water distribution volume on the supply side has largely achieved the target level due to the implementation of the Project. On the other hand, the amount of water and water quality received by the local residents from tap water in their house is assumed far below the target, and it is far from the 24-hour water supply while the population increase trend is almost as expected as at the time of planning. Therefore, the degree of achievement of the effect and qualitative indicators of the Project is low. Water leakage from the distribution pipe is the assumed reason for this situation, which is taken into consideration regarding the degree of effectiveness and impact at this evaluation.

3.3.2 Impacts

3.3.2.1 Intended Impacts

1) Quantitative impact indicators

Table 11. Comparison of the target and actual of the quantitative impact indicators

	Baseline	Target	Actual		
	2009	2015	2014	2016	2017
	At planning	2 years after completion	Year of completion	2 years after completion	As of ex-post evaluation
Indicator 1. The number of connections (households)	15,700	29,800	No data	No data	24,453

Indicator 2. Service population (people)	113,900	216,400	No data	No data	157,331
Indicator 3. Water service coverage ratio (%)	57	92	No data	No data	63

Source: Materials were provided by JICA for the baseline and target, and by the executing agency for the actual at the time of ex-post evaluation (answer to the questionnaire and interview)

(1) The number of connections in the project area

It was assumed that users of public faucets would wish to newly register for tap water, thereby increasing the number of water connections as an effect of the improvement of water service such as increase of water supply volume, stabilization of water supply, and improvement of water quality which was expected to be realized due to the enhancement of water supply facilities through the Project. The number of water connections in the project area at the time of the ex-post evaluation was 24,453 households[19], which is only a 56% increase compared to the targeted 90% increase from the baseline of 15,700 households to the target of 29,800 households (62% of the targeted rate of increase). Based on the above, there is considered to have been improvement to some extent in the effectiveness with respect to this indicator.

Table 12. The number of connections in the project area

(Unit: Households)

Water supply area*1	Baseline (2009)	Actual at the time of ex-post evaluation (2017)	Increase	
			No. of households	%
Abbottabad city	5,800	8,010	2,210	38%
Nawanshehr area	3,603	5,002	1,399	39%
Sheikhuk Bandi	1,129	2,380	1,251	111%
Salhad	1,052	1,707	655	62%
Mirpur	887	2,766	1,879	212%
Jhangi	3,229	4,588	1,359	42%
Total	15,700	24,453	8,753	56%

Source: Materials provided by the executing agency

*1 As stated in the note to table 1, there was a change in the administrative divisions in the water supply area. Therefore, whereas the total of the entire water supply areas compares the number of connections at the time of planning and ex-post evaluation, its breakdown is treated as reference information.

(2) Service population in the project area

The population in the project area in 2017 was 249,732 people (as described in the section

[19] As of the beginning of June 2018, it has increased to 26,010 households (from the interview at the time of feedback of provisional evaluation result to the executing agency).

on “Relevance”). Based on this population, the estimated water service population is 157,331, calculated by multiplying the following water supply coverage ratio of 63%. The increase rate from the baseline of 113,900 to the targeted 216,400 is 90%, while the actual increase was only 38% (42% of the target increase rate). Therefore, the achievement rate of this indicator was low.

(3) Water service coverage ratio

The water service coverage ratio is calculated as 63%, based on 39,102 households in the project area in 2017 (as described in the section on “Relevance”) and 24,453 of the households with connection indicated above. The increase rate from the baseline of 57% to the targeted 92% is 61%, while the actual increase was only 11% (18% of the target increase rate). Therefore, the achievement rate of this indicator was low.

2) Qualitative impact indicators

(1) Improvement of public health

According to the executing agency, there is no statistical data but overall health problems caused by lack of safety of drinking water are recognized to be decreasing. Regarding the improvement of public health, local residents do not recognize significant improvements in the quality of tap water. Drinking water is obtained mainly from the public faucets [20] installed adjacent to the tube well of the groundwater supply system, whereas tap water through the water distribution pipe is not drunk or drunk after boiled. The spread of the practice of boiling tap water for drinking since the implementation of the Project is considered a main factor in the decrease of health problems due to water use.

(2) Improvement of the quality of living

Reduction of the water-fetching from public faucets: It was assumed that local residents enjoying improved water service and improved water service coverage ratio would lead to the reduction of water-fetching from public faucets. However, the water supply coverage ratio is around 60%, which has not reached the targeted 90% level. According to the local residents, households with a connection use tap water for their living needs, but many households still obtain drinking water from public faucets. In addition, if the amount of supply of tap water is small and the necessary amount of water for their living needs cannot be obtained, people go to tube wells nearby or the public facilities such as state hospital headquarters, and carry water with jerry can bottles by car.

[20] The public faucets were installed in the water distribution tank before the project, but now these are installed adjacent to the tube wells with a filter for water purification.

Improvement in cooking and washing (convenience of in-house water use): It was assumed that improvement in both quantity and quality of water service would improve the convenience of people's water use for their living. However, according to the local residents, use of tap water is avoided not only for drinking but also for cooking because of water quality concerns. Also, since the amount of water supply is not sufficient, it has to be used carefully and stored in a water storage tank installed in the house; therefore, housework using water such as cooking and laundry has still been inconvenient.

Based on the above, improvement in the quality of living of the residents as an effect of the Project is limited.

3.3.2.2 Other Positive and Negative Impacts

(1) Impact on the natural environment

According to the executing agency, there has been no negative impact on the natural environment by the Project. However, an environmental monitoring report was not provided although it was requested to the executing agency.

(2) Resettlement and/or land acquisitions

The owners of the land were initially not receptive to providing their land during the land acquisition for the Project, and were not convinced regarding the method of compensation. The water right interest at the construction site of water intake facilities was also an issue. Therefore, the executing agency solved these issues through discussion with the community and the land acquisition was completed. According to the executing agency, there are 3 to 4 lawsuits by the residents who claim the compensation amount is insufficient, although compensation[21] was made in accordance with the local legislation[22]. The executing agency also stated that there was no resettlement of residents in the acquired land, and no negative effects on the livelihood of affected people have been recognized in particular, while the access road is used for daily living purposes by neighboring villagers.

(3) Other impacts

Other positive impacts

Economic effects: It was assumed that improvement of public health and quality of life as an effect of water service improvement would lead to revitalization of economic activities and improvement of value as a tourist site[23]. Although the degree of water service

[21] As a general procedure, it is calculated with the average market price over the past three years.

[22] Payments for the compensation were made in accordance with the decision of Deputy Commissioner of Abbottabad district. (Website of Abbottabad district government for information about Deputy Commissioner: http://dga.com.pk/district-administration/ / Access: July 20, 2018)

[23] Abbottabad urban area is located at altitude of 1,200 m and is known as a summer resort because of its comfortable summer climate.

improvement by the Project is not high, the access road to water intake facilities contributes to the increase of tourists to scenic sites as a side effect of the Project.

Other negative impacts
None in particular.

As described in the summary of the section on "3.3.1 Effectiveness," while the amount of water distributed from the supply side is at the targeted level set at the time of planning, the amount and quality of water to the demand side that the local residents receive from tap water has been far below the target. Leakage from the water distribution network is considered a major cause of this situation based on the following considerations:

- More than 800 leak points have been identified[24]. It seems that there is a possibility of considerable leakage including underground leakage, as there are more than 800 identifiable ground water leaks.
- There are many customer complaints about water quality of tap water thought to be caused by sewage infiltration from the sewer pipe and it can be seen from interviews with the residents that the situation is worsening than before.
- There are many illegal connections. About 400 illegal connections have been removed since January 2018, from the start of removing. The large number of illegal connections also affects the water supply to the subscribers.

Although water leakage rate cannot be calculated accurately as most of the water supply facilities are not equipped with water meters, it is assumed that leakage is a major cause of the supply-demand gap of the water supply volume. Therefore, renewal/repair of the distribution pipe network is considered the top priority for water supply improvement (see the recommendation on water leakage reduction in water distribution network). Based on this analysis, the sub-rating of the effectiveness/impact of the ex-post evaluation of the Project reflects the fact that the surface water supply system, the main part of the Project, has greatly increased the water distribution volume of the target area and thereby supports the local water supply, although the water leakage from the water distribution network is considered the main cause of not achieving the expected effect.

This project has achieved its objectives to some extent. Therefore effectiveness and impacts of the Project are fair.

[24] Source: WSSCA annual report (as of March 2018)

3.4 Sustainability (Rating: ②)

3.4.1 Organizational Aspect of Operation and Maintenance (O&M)

(1) Establishment of a wide range water supplier

At the time of the planning of the Project, there was no wide water supply area utility in the project area, and the water supply service was operated by the following independent three water supply utilities in the Abbottabad district.

Ÿ PHED

Ÿ Abbottabad municipal water service (water supply division)

Ÿ Nawanshehr area service unit of the Abbottabad municipal

At the time of ex-post evaluation, the water service in the urban area of Abbottabad district is managed by WSSCA, except for facility management of surface water supply system. WSSCA has jurisdiction over the area covered by the target area of the Project and Dhamtor and Kakuru water supply areas (the approximate population within the jurisdiction is 280,000 as of 2017).

(2) Organizational aspect of O&M of the surface water supply system

As mentioned earlier in the section on Output of Efficiency, the existing three waterworks entities stated above had no experience in operating the water purification plant. Therefore, a surface water supply unit under PHED was newly established by the soft component outcome 2 of the Project, which still operates and maintains the surface water supply system. Currently, the number of staff of the surface water supply unit is 28 (23 from PHED, 5 from Abbottabad city water supply. Although it was initially 30 people, two PHED engineers moved outside the WSSCA jurisdiction). Among them, 21 staff members centering around 8 operators operate and maintain the surface water supply system, and 3 engineers and 4 administrative staff perform water quality management and accounting work.

It has been decided that the operation and maintenance of the surface water supply system will be transferred to WSSCA in the future, and official notification was issued by the Khyber Pakhtunkhwa province government on September 6, 2017. At the time of the ex-post evaluation, there was ongoing discussion regarding the operation and maintenance budget of the facility and the change of staff (including budget for personnel expenses) between PHED, the financial department of the state government and WSSCA. After conclusion, the surface water supply system will be officially transferred to WSSCA in the near future. According to PHED, there are some staff who do not want to transfer as they will no longer be government officials. WSSCA will employ new staff in response to the shortage of personnel.

(3) Organizational aspect of O&M of the groundwater supply system

WSSCA is currently operating and maintaining the groundwater supply system. It was established in 2015 by the Khyber Pakhtunkhwa province and began providing services in April 2017 after the transfer of the staff of PHED and Abbottabad municipal water service and the handover of the facilities and operations of the groundwater supply system. The total number of WSSCA staff is currently 468 (full-time 413, part-time 55), of which the number of staff in the water supply department is 199 (full-time 197, part-time 2). According to WSSCA, although there is no problem in organizational structure, the number of staff of the water supply department is insufficient. From the viewpoint of the number of connections per employee, the number of staff members themselves is not considered particularly low as it is relatively low as calculated at 135 based on the number of water connections of about 27,000.

Based on the above, it was confirmed that there are no particular problems in the organizational aspect of O&M of both water supply systems.

3.4.2 Technical Aspect of Operation and Maintenance

(1) Technical aspect of O&M of the surface water supply system

In the surface water supply unit, a training system on the surface water supply system and operation manual, etc. were established through the soft components of the Project, and the transferred technology has been shared and utilized within the organization. However, PHED considers further training to be necessary especially for safe and reliable operation and maintenance of water treatment plant.

The water quality inspection of the water treatment plant had previously been conducted at the facility of Abbottabad municipal water service. Before the transfer of the surface water system to WSSCA, inspection equipment materials are being prepared in the water treatment plant.

(2) Technical aspect of O&M of the groundwater supply system

According to WSSCA, a large number of new employment and high turnover rate are the factors that affect the technical level of its staff. In addition, training system and operation and maintenance manuals etc. were not handed over from PHED. WSSCA recognizes the lack of technical skills of its staff regarding the operation and maintenance of the groundwater supply system as one important issue to be addressed. For this reason, WSSCA is going to improve training and programs for strengthening technical skills of its staff, which has not been realized so far due to insufficient funds. Given these circumstances, WSSCA will accept ADB's support mainly on technical cooperation, which is to be implemented in the near future.

WSSCA's water quality management is done at the laboratory of WSSCA twice a month. In addition, when complaints about water quality are received from the residents, water in the area is inspected and measures are taken based on the inspection results.

Status of response to the recommendations on problems related to technical aspects of groundwater supply system:

In the course of the technical assistance aimed at proper operation and maintenance of the groundwater system, it was pointed out that in order to grasp a breakdown of water pumps in advance, there were issues on recording operation, measurement and maintenance of the equipment and acquisition of data such as groundwater pumping data. Although flow meters are not installed yet in most tube wells, WSSCA is working on procurement of flow meters, well cameras for monitoring and spare parts for the purpose of improving well management by systematizing data acquisition in response to the recommendation.

Despite its effort, Dobathar No. 3, out of the newly constructed tube wells, has not been in operation for about a year since the breakdown of the water pump due to the drop in pumped water volume, and similar water pump failures occurred in many existing tube wells. Excessive pumping in existing tube wells was also pointed out during planning of the Project. Therefore, it is necessary that WSSCA acquires technical skills regarding appropriate operation and shares them within the organization for the purpose of avoiding failure in the water pumps. (Refer to recommendations for preventing damage in groundwater supply system).

Photo 4. Intake facility of new tube well not used due to breakdown (Dobathar No. 3)

Based on the above, there are considered to be some problems in the technical aspect of O&M of groundwater supply system.

3.4.3 Financial Aspect of Operation and Maintenance

(1) Financial aspect of O&M of the surface water supply system

According to PHED, as to the condition before transfer of the system to WSSCA, there is no financial problem with the budget for the daily operation and maintenance of the surface water supply system as it is allocated by the provincial government. However, budget for the replacement of facilities is not secured. Regarding the budget for operation and maintenance expenses after transfer of the system to WSSCA in the near future, discussion

with the provincial government is ongoing as described above.

(2) Financial aspect of O&M of the groundwater supply system

WSSCA recognizes the lack of operation and maintenance budget as an important issue. At the time of planning of the Project, budget from the local government had been allocated to the water service operation of PHED, for the amount of financial shortfall with water tariff collection. The financial situation has continued since the commencement of water supply service by WSSCA in 2017. The allocation of budget from the provincial government to WSSCA is only committed to for the next few years; therefore, financial improvement is necessary for subsequent water service operations. Meanwhile, cost recovery ratio for water tariff is only about 37%, and the tariff collection rate is also low[25]. Low fixed water tariff collection has not been improved from the situation that was reported at the completion of the Project, which is assumed as a factor that led to the shortage of the operation and maintenance budget. Although the Project supported shifting to a metered water tariff system through technical assistance based on awareness of this issue, there has been no progress so far. As such, WSSCA is required to improve its financial base as a provider of water service, which is a public service operated based on the users-pay principle (Refer to the recommendation on increasing the billings collection of water tariff).

Based on the above, there are considered to be some problems in the financial aspect of O&M of groundwater supply system.

3.4.4 Status of Operation and Maintenance

(1) Status of O&M of the surface water supply system

Currently, no particular problems are pointed out in the operation and maintenance by the surface water supply unit under PHED. Periodic removal of accumulated sediments from the water intake facilities, which is necessary maintenance for these facilities as instructed by experts in the technical assistance of the Project, has been carried out by PHED through outsourcing.

[25] For the year ended March 2018, the collection rate was 14%, the ratio of the number of invoices issued to the number of connections was as low as 65%, and the percentage of delinquent loans that can be withdrawn was as low as 19% (WSSCA 2017 annual report).

The protective cover of the transmission mains has been damaged at Namly Mira intake facility due to flooding during the rainy season. JICA has implemented a follow-up study since March 2018, and necessary response measures for emergency construction and repairmen after emergency measures etc. are under consideration. According to the executing agency, it is necessary to re-arrange the route of the transmission mains where the foundation is damaged.

Photo 5. Damage to protective cover of transmission mains at Namly Mira intake facility due to flooding

(2) Status of O&M of the groundwater supply system

Regarding the operation and maintenance of the tube well intake facilities, wells and other equipment that are inoperative due to aging are repaired and/or replaced according to secured budget. According to WSSCA, the main problem in the maintenance of facilities is not due to the facilities constructed and/or improved by the Project but water leakage from water pipes. WSSCA addresses this by responding to reports from the residents.

It was confirmed that while there are restrictions on the operation and maintenance of facilities in terms of technical and financial aspects of WSSCA, both water supply systems undergo necessary measures such repairs in case of problems.

Some minor problems have been observed in terms of the technical and financial aspects. Therefore sustainability of the effects of the Project is fair.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

This project was implemented to provide safe and stable water supply services in Abbottabad city and 4 neighboring areas, a medium-scale urban area located in Abbottabad district of Khyber Pakhtunkhwa province in the northern part of Pakistan, by newly developing a gravity-flow surface water supply system and the renewal and enhancement of the groundwater system. The Project thereby contributed to increasing the water supply coverage ratio and access to safe water of the residents in the project area, where water supply capacity was insufficient despite an expected population increase due to expansion of the urban area.

This project was highly relevant as it was consistent with the development plan and

development needs of Pakistan, as well as Japan's ODA policy. The efficiency of the Project is fair as the project period exceeded the plan, although project outputs were almost as planned and the project cost was within the plan. As an effect of the Project, the amount of water distributed from the supply side is almost as planned; however, the quantity and quality of water received by the local residents from tap water in their house has been far below the target, which seems likely due to leakage from the water distribution network. Therefore, improvement of access to safe water for the residents has not been fully achieved yet. The effectiveness and impacts of the Project are concluded as fair considering that the surface water supply system, the main part of the Project, supports the local water supply. The sustainability of the effects of the Project is fair as there are some minor problems to be improved in the technical and financial aspect of the newly established wide water supply area utility. In light of the above, this project is evaluated to be partially satisfactory.

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

Recommendations to WSSCA

- Reduction of water leakage from distribution pipes: Because the population increase trend is almost as expected at the time of planning, the amount of water supplied to the demand side has been far below the target whereas the amount of water distributed from the supply side (water supply utility) is at the targeted level which was set at the time of planning. Because leakage from the water distribution network is considered a major cause of the gap in volume of water between the supply side and demand side, it is recommended that WSSCA makes efforts on the renewal/repair of the distribution pipe network as one of its most important issues.

  In addition, reduction of water leakage is also necessary for improving the quality of tap water. In terms of finance, it is important not only to control the wasted power cost of tube well pumps but also a matter to consider as an alternative to new water source development from cost aspect. From an environmental point of view, it is important to conserve the groundwater source as there are concerns about decreasing water levels due to excessive pumping.

- Measures to prevent damages in groundwater supply system: It is assumed that excessive pumping has caused water pump failures that have occurred in many tube wells including Dobatar No. 3, one of the newly constructed tube wells, which has not been in operation for about 1 year due to breakdown of water pump due to a drop in pumped water volume. Regarding excessive pumping, technical suggestions concerning the appropriate amount pumped up were also made during the project implementation, and WSSCA is currently working on data acquisition. It is recommended that technical

considerations on appropriate operation of the groundwater system are shared within the organization and implemented by WSSCA.

- Increase of the billings collection of water tariff: The rate of billing and collection of water tariff has been very low even in consideration of the fact that there is much room for improvement in both quantity and quality of water supply service. The low tariff collection is a factor in the lack of budget for proper water business management, and the insufficient budget causes a vicious cycle of unimproved water service. Therefore, it is necessary to improve the tariff collection rate through the improvement of billing and collection such as creation of a route map, training of visitors, etc.

4.2.2 Recommendations to JICA

- Technical assistance for the measures to deal with leakage: It is recommended to JICA that it supports the renewal/repair of the distribution pipe network by WSSCA, which is recommended above as one of its most important issues. Possible support from JICA includes technical assistance on the planning of facility improvement and water service operation and management, based on an appropriate balance of water demand and supply calculation considering leakage from the distribution pipe network.
- Technical assistance on the measures to prevent damages in groundwater supply system: According to WSSCA, it needs a systematic method for data management and operation techniques, including the control of appropriate pumping volume by which breakdown of water pumps is prevented as stated in recommendation to WASSCA above. It is recommended to JICA that it supports the above response measures by WSSCA with technical assistance.

4.3 Lessons Learned

- <u>Importance of water source preservation</u>

  According to the executing agency, Bandi intake facility has suspended its operation since around 2014, right after its completion due to the effects of migrants in the upstream after the earthquake in 2005. Based on this situation, especially the importance of grasping residents' trend should be taken into consideration in future water supply projects mainly using mountain streams from the viewpoint of water source conservation. Specifically, response measures might include that the executing agency or JICA study team thoroughly study and grasp residents in the water source area from the earliest stage of the planning, then consider policies and technical aspects such as creating rules for conservation of water sources. As for the monitoring for water source conservation, technical assistance for periodic monitoring methods, etc. might be conducted by JICA study team.

Ÿ Importance of the participation of a river engineering expert during the planning of a project

A river engineer participated in the follow-up survey mentioned in "Status of O&M of the groundwater supply system" above. There is a possibility that more appropriate design and maintenance methods would be planned if a river engineer participated at the planning stage of a project, through a precise consideration on the effects of flooding in the rainy season to the water facilities installed in river channel when laying transmission mains along the mountain stream.