

Guatemala

Ex-Post Evaluation of Japanese Grant Aid Project

“The Project for the Water Supply for the Urban Area of Quetzaltenango City”

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0 . Summary

The Project aimed to achieve a stable supply of clean water through the improvement and construction of facilities for water resources, reservoirs, and transmission and distribution pipelines. This is consistent with the development plan and development needs of the Republic of Guatemala, and also with Japan’s ODA (Official Development Assistance) policy; therefore, the relevance of the Project is high. Efficiency is also high because the cost and the period of the Project were within the planned budget and schedule.

The Project Purpose was to ensure that 100% of families in the target area could access “a 24-hour continuous water supply” and “a water supply without water pressure problems”. Even though this purpose was not achieved, more than 90% of families can use water continuously 24 hours a day, and are free from the problem of low water pressure. We can observe the effects of the Project. Moreover, we can observe the following effects: the unaccounted-for water rate has decreased from 40% (in 2000, before the Project implementation) to 20% (in 2010); the leakage rate has also decreased from 44.59% (in 2007, the year of the completion of the Project) to 19.92% (in 2010); the rate of collection of water service charges has increased; users have expressed their satisfaction that they can consume water stably at any time with good pressure. These effects are also attributed to complementary technical assistance for the improvement of the management of public water corporations, as well as the construction of facilities and the provision of equipment. (Regarding the reduction of the leakage rate, the replacement of old asbestos pipes by EMAX also partially contributed). On the other hand, we can also observe the wastage of water and the increase of sewage water as the supply of water has increased. Even with these concerns, we can evaluate that the effectiveness of the Project is relatively high.

EMAX, the implementing agency, does not have sufficient staff, but the terms of reference in each position are clearly defined and qualified staff are recruited and assigned to the respective positions. They have enough capacity to operate and maintain the facilities and equipment, to respond to the leakage of water, and to manage the public water supply. The financial status is also improving with a surplus of balance. Current concern regarding the sustainability of the Project relates to the technical enhancement of the detection of underground water leakages and the expansion of the application of a new service charge system.

In light of the above, this Project is evaluated to be highly satisfactory.

1 . Project Description



Project Site in Guatemala



Barehole at Zoologico

1.1 Background

The government of Guatemala made it a high priority to improve facilities related to clean and sewage water, hygiene and sanitation. The improvement of health and daily life conditions was considered important and the decrease of water-related diseases can be attained through a stable supply of good quality clean water. The city of Quetzaltenango, the target area of this Project, is the second largest city in Guatemala, and the regional economic and industrial center. Indigenous people make up 50% of residents. The water supply system in Quetzaltenango had been expanded with no long-term plan. Therefore, even though the rate of supply of clean water in urban areas was high at 94.3 % (in 2000), ongoing problems continued, such as the suspension of water supply, the instability of water supply, the lack of total volume of water for supply, low water pressure and so on. Reliable service delivery of clean water had not been achieved.

Under such circumstances, Quetzaltenango City developed the “Master Plan for Drinking Water Supply (hereinafter referred to as “Master Plan”) up until 2018, supported by the Government of Austria. In line with this Master Plan, Empresa Municipal Aguas de Xelaju, Municipalidad de Quetzaltenango (Municipal Water Authority of Xelaju, Quetzaltenango City, hereinafter referred to as “EMAX”) was established in 2000. EMAX promoted the construction of new facilities and the improvement of existing facilities for water resources, water reservoirs, and the transmission and distribution pipelines. However, due to budget constraints, the realization of the Master Plan had been suspended. As a consequence, in July 2002, the government of Guatemala requested a Grant Aid Project for the construction and improvement of facilities for the supply of clean water from the Japanese Government.

1.2 Project Outline

The objective of this Project is to provide a stable drinking water supply to residents in the center of Quetzaltenango City by constructing and improving the water supply facilities, such

as water resources, reservoirs, and transmission and distribution pipe-lines.

Grant Limit/Actual Grant Amount	17.59 million JPY/17.54 million JPY
Exchange of Notes Date	August, 2004 (First phase)/June, 2005(Second phase)
Implementing Agency	Municipal Water Authority of Xelaju, Quetzaltenango City (EMAX)
Project Completion Date	March, 2007
Main Contractor	Hazama Corporation
Main Consultant	Kyowa Engineering Consultants Co., Ltd. Nihon Suido Consultants CO., Ltd. (Joint venture)
Basic Design	Basic design report of “The Project for the Water Supply for the Urban Area of Quetzaltenango City” October 15, 2003~March 26, 2004
Detailed Design	N.A.
Related Project (if any)	<p>< Technical cooperation ></p> <ul style="list-style-type: none"> • Strengthening Water Associations and community Development (2009-2013) <p>< Grant Aid Project ></p> <ul style="list-style-type: none"> • “Rehabilitation of Plants for Drinking water Treatment” (1994~1997) • ”Plan of Groundwater Development in the Central Highland Area” (1997~1998) • ”Rehabilitation Plan of Rural Purification Plant”(1998~2001) • “Rehabilitation of Plants for Drinking water Treatment, Second Phase” (2001~2004) <p>< Yen Loan ></p> <ul style="list-style-type: none"> • ”Groundwater Development Plan of Guatemala City” (1990) <p>< Others ></p> <ul style="list-style-type: none"> • Cooperation from Austria “Master Plan of Drinking Water Supply” (1999)

2. Outline of the Evaluation Study

2.1 External Evaluator

Keiko Asato, Foundation for Advanced Studies on International Development

2.2 Duration of Evaluation Study

Duration of the Study : November 2010 - October 2011

Duration of the Field Study : February 2 - 12, 2010, May 11 - 14, 2011

2.3 Constraints during the Evaluation Study

It was difficult to obtain numerical data to see the transition of achievement of indicators to evaluate the effectiveness. Therefore, the situation before the Project was compared with the situation after the Project to evaluate the Project effects.

3. Results of the Evaluation (Overall rating: A¹)

3.1 Relevance (Rating : ③²)

3.1.1 Relevance with the Development Plan of Guatemala

At the time of the ex-ante evaluation, there was a Master Plan for the supply of water to urban areas up until 2018 as a water supply related development policy, with which this project is aligned. In the Poverty Reduction Strategy Paper (hereinafter referred to as “PRSP”) 2001, the construction and improvement of infrastructure were considered as important development issues, and the improvement of water supply facilities was also listed as one of these issues. The Social Policy Matrix 2000-2004, which was developed by the Administration of Portillo, also put the stable supply of drinking water as a high priority.

At the time of the ex-post evaluation, the “National Plan for the Health of all Guatemalans” (Plan Nacional, Para la Salud de Todas y Todos los Guatemalteco) set “the improvement of the drinking water and sanitation environment for the progress of daily life of people” as a prioritized policy for 2008-2012. In this policy paper, the construction and improvement of drinking water facilities was also set as a prioritized development issue.

3.1.2 Relevance with the Development Needs of Guatemala

At the time of the ex-ante evaluation, the coverage of drinking water supply in urban areas of Quetzaltenango city was 94.3% (2000), which is relatively high. However, this water supply system had been expanded without a long-term plan as the city developed. As a result, many chronological problems had occurred, such as the inappropriate location of the reservoirs and distribution areas, the suspension of water supply, instability in the supply of water, the lack of total volume of water and water pressure. At the same time, problems in the operation, maintenance and management of the water supply system were not few, and included an ineffective water service charge system, the inappropriate collection of service charges based on the consumption of water use, many illegal users, many problems with water meters and substantial leakage of water. As a result, the accounted-for water rate was low at

¹ A : Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory

² ③ : High, ② Fair, ① Low

65%.

At the time of the ex-post evaluation, full utilization of existing water resources was an important issue as well as the development of new water resources and the collection of service charges for its consumption. In particular, because the suburban area of Quetzaltenango had developed, the incoming population for work and study during the day-time is growing. Hence the gap of water consumption between night and day is getting bigger. To handle this complicated balance of demand and supply, the appropriate planning and operation of water management is considered as an important issue.

3.1.3 Relevance with Japan's ODA Policy

According to the "ODA data book" in 2004 at the time of the ex-ante evaluation, one of the important development issues for Japanese ODA was: "Rural development with consideration to the indigenous people". It was agreed with the Administration of Berger that agriculture, education, health and sanitation are the prioritized areas in supporting indigenous people. 50% of the population in Quetzaltenango city is made up of indigenous people. From this perspective, cooperation for the stable supply of drinking water to this city is consistent with Japan's ODA policy.

In light of the above, this project has been highly relevant to the country's development plan, development needs, as well as Japan's ODA policy. Therefore, its relevance is high.

3.2 Efficiency (rating : ③)

3.2.1 Project Outputs

As Outputs on the Japanese side, there are three components: construction, procurement and technical transfer related to the detection of leakages and the improvement of the management of EMAX. These components were planned during the Basic Design Study (hereinafter referred to as "BD"). The construction component includes the following items: the expansion of the San Isidro reservoir, the construction of the Zone Media reservoir, the construction of a pump station at the San Isidro reservoir, the installation of transmission and distribution pipelines in the Media and Baja Area, the renewal of electro-mechanical equipment at seven existing boreholes, and the renewal of pumps at two existing boreholes. The procurement component includes a correlative type leakage detector, a portable ultrasonic meter for water flow, an acoustic bar, a small excavator, a compressor, a water CAD, and a meter. The complementary technical assistance component was conducted in relation to the detection of leakages utilizing the equipment procured by this Project, as well as in the improvement of the operation and management of EMAX, targeting issues such as the conversion of illegal users to registered users, the revision of the water service charge system, customer surveys, the revision of user categories, the installation of water meters and so on.

The construction and procurement components were changed partially due to technical reasons; however, this did not impact on the effect of the Project. The changes were mainly

related to the exact location of the construction of facilities and installation of equipment based on the actual measurements of the related sites. These changes were accompanied by the modification of specifications, such as the quantity and the length of the equipment, which would not change the effect of the Project.

The Outputs planned by the Guatemalan side are as follows: to obtain and level the site of construction for a distribution reservoir and pump station; to transfer the existing facilities; to clean up the construction site; to install the electric line, access road and transformer to the site; to get approval from the municipality; and so on. In addition to these outputs for construction, as for the procurement component, the following outputs were planned: to secure a place to stock the water meters and the equipment for leakage detection; to install the distribution pipelines; and, to formulate the working team for the detection of underground water leakages. These outputs were conducted without problems.

3.2.2 Input

3.2.2.1 Project Cost³

Comparing the original planned cost of 1,759 million JPY on the Japanese side, the actual cost was 1,754 million JPY (99.7% of the original plan).

Table 1: Planned and actual project cost on the Japanese side

(Unit : thousand yen)

	First phase	Second phase	Total
Plan	711,000	1,048,000	1,759,000
Actual	710,000	1,044,000	1,754,000

(Source) Project Completion Report

Regarding the project cost on the Guatemalan side, a total of 880,000 GTQ (equivalent to 11,977,000 JPY⁴) was planned, which was composed of: 1) lead of electricity (370,000 GTQ); 2) the pavement of access roads (Q 350,000 GTQ); 3) the arrangement of fences and so on (140,000 GTQ); and, 4) the separation of the distribution areas (20,000 GTQ). Among these costs, components 1, 3 and 4 cost 403,000 GTQ in total⁵, even though 530,000 GTQ had been planned (76% of plan). In addition to these expenses originally calculated in the BD, 2.5 million GTQ for the acquisition of land for the distribution reservoir and the receiving reservoir and 2.745 million GTQ for tax related to the Grant Aid project was also borne by EMAX.

Even though the total cost and expensed items borne by the Guatemalan side exceeded the

³ Some information related to the input from the Guatemalan side could not be obtained. Therefore, the rating was done based on only the information from the Japanese side.

⁴ 1 GTQ =13.61 JPY is applied for the calculation of the exchange rate, which is the rate at the time of the Exchange of Notes (August 2004).

⁵ The information of costs for component 2, arrangement of access roads, could be attained.

original plan, this was necessary for the Project. Regarding the planned expense items, the cost of component 2 was not calculated. But in general, it is expected that the cost was roughly within the original plan.

3.2.2.2 Project Period

The project period was planned to be 32 months (August 2004 – March 2007) at the ex-ante evaluation, including the detailed design period. The actual period was 30.5 months (August 31, 2004 – March 15, 2007), which was lower than planned. (95% of plan).

In light of the above, the project cost was mostly as planned, and the project period was within the plan; therefore, efficiency of the project is high.

3.3 Effectiveness ⁶(Rating : ③)

3.3.1 Quantitative Effect

3.3.1.1 The Number of Families with “24-hour Continuous Water Supply” and “No Problems with Water Pressure”

As indicators to measure the effect of this Project, “24-hour continuous water supply” and “No problem with water pressure” were set. The level of achievement of these indicators is as follows:

Table 2: % of families with 24-hour continuous water supply and without water pressure problems

(Unit : %)

Indicator	2004 (Actual)	After 2008 (Target)	2011 Ex-post evaluation
Families with 24-hour continuous water supply	55	100	91
Family without water pressure problems	60	100	91

(Source) Data offered by EMAX

According to the data offered by EMAX, the rates of families with 24-hour continuous water supply and without water pressure problems were both 91% at the time of the ex-post evaluation (2011). Some areas in Zone 8 are restricted from receiving 24-hour running water, which impedes the achievement of the target. According to EMAX, the reason which impedes the 100% water supply is attributed to the restriction of water supply at Zone 8 due to insufficient water production. Even with that circumstance, 20-hour continuous water supply a day, by average, is achieved in the Zone 8. In addition, the beneficiary survey at the time of the ex-post evaluation reveals that 85% of families can enjoy a 24-hour running water supply.

⁶ The rating for the effectiveness was evaluated considering the achievement of impact.

In this survey, it was found that even families that cannot receive water continuously 24-hours-a-day have water in the morning and afternoon when they need it. On the other hand, regarding the water pressure, 94% of the families responded that they had no problems based on the result of the beneficiary survey.

The target year to attain the level of indicators was 2008. However, the transition data showing the achievement of the indicators since 2008 could not be obtained. Even given that situation, the production volume of water resources remains at the same level from 2008 to the time of ex-post evaluation, as stated in the next section (3.3.1.2.). We can anticipate that the achievement level in 2008 was not so different from that in 2011.

In summarizing, 85 – 90% of families can enjoy a 24-hour continuous water supply, and more than 90% of them also have no problems with water pressure. This represents substantial progress in the supply of water.

3.3.1.2 Production Volume from Water Sources

At the time of the ex-ante evaluation, the production volume of water was 87% of the maximum water demand. In this Project, the enhancement of production capacity at boreholes was directed at the renovation of pumps, the control panel, tubes and accessories around the boreholes and not by developing a new water source (such as a spring or borehole).⁷ The production volume at each water source, and the distribution volume from each reservoir to the distribution area before and after the Project, is as stated in Table 3. All boreholes, except for the one at San Isidro, have increased their production capacity. In particular, the boreholes at Zoologico and Pacaja, which had pumps renovated, have remarkably increased their production volume by 170% and 191% respectively, compared to the time of the ex-ante evaluation. On the other hand, the borehole at San Isidro is decrepit, but in 2010, it could still produce 89% of the volume of 2004.

Table 3: Production volume at each water source

(Unit : m³/day)

Boreholes	2004 年	2007 年	2008 年	2009 年	2010 年	Volatility rate (%)
Production at each borehole under the San Isidro Reservoir						
Spring	13,727	13,727	13,727	13,727	13,727	100
San Isidro	1,104	0	982	982	982	89
Democracia	2,127	2,491	2,491	2,491	2,491	117
(Sub-total)	16,958	16,218	17,200	17,200	17,200	101
Distribution volume from San Isidro Reservoir (To Baja Area)						

⁷ The pump renovation was done at the Zoologico and Pacaja boreholes. The renovations of the control panel, tubes and accessories around the boreholes were done at all seven boreholes, including Zoologico and Pacaja.

	14,831	(***)---	16,958	16,958	16,958	
Production at each borehole under the Zone Media Reservoir						
Ciprezada	0	0	2,453	2,453	2,453	---
Zoologico	1,666	2,837	2,837	2,837	2,837	170
El Paraiso	1,302	2,177	2,177	2,177	2,177	167
Pacaja	1,384	2,650	2,650	2,650	2,650	191
Las Americas	1,744	1,744	1,744	1,741	1,741	106
Zona 8	(*) 0	(*) 0	2,177	2,177	2,177	---
(Sub-total)	8,549	9,408	14,038	14,035	14,035	164
Distribution volume from the Zona Media Reservoir						
	(**) 0	(***)---	11,750	11,750	13,927	
Total production/Distribution volume						
Production	25,507	25,626	31,238	31,235	31,235	122
Distribution	23,380	(***)---	28,708	28,708	30,885	132

(Resource) Data offered by EMAX

(*) : The Zona 8 borehole was developed by the EMAX project after the ex-ante evaluation.

(**) : The reservoir at Zone Media was constructed by this project. (It did not exist before 2004)

(***) : The distribution volume in 2007 could not be obtained.

3.3.1.3 Complaints Sent to EMAX

EMAX records the complaints they receive. The transition of the number of complaints is as follows:

Table 4: Number of complaints to EMAX

(Unit : number of complaints)

Year	2001	2002	2003	2007	2008	2009	2010
Number	2,086	2,043	2,512	4,243	3,650	2,140	3,254

(Source) Response by EMAX to the questionnaire

According to the number of complaints that EMAX recorded, the most frequent complaints are related to “leakage of water-pipes” before and after the Project, which began to decrease gradually after the completion of the Project. EMAX also explains that the number of complaints sent to the radio program in which the Mayor is open to listening to the opinions of citizens, has also reduced.

It has been noted that the number of complaints increased in 2007 compared with in 2003, before the Project. This increase of complaints could be attributed to the bursting of old asbestos pipes in Zone Media.⁸ In 2007, after the completion of the Project, the asbestos pipes in Zone Media burst due to high water pressure and the number of complaints related to this problem increased. EMAX replaced these old asbestos pipes with new pipes to reinforce the distribution pipe network, as well as adjusting the water pressure by shifting the distribution reservoir from Media reservoir to San Isidro reservoir to lessen the water

⁸ This information is based on the interview with EMAX.

pressure⁹. The San Isidro reservoir is located at a lower altitude than the other. With these measures, the complaints from citizens have been alleviated. Other than this problem, the change in the complaints record system might be one of the reasons. Previously, the Department of Public Services exclusively received complaints from users. However, in addition to the Department of Public Services, the Department of Operations and Maintenance now also responds to and records complaints. The complaint record process has not been adjusted accordingly, and complaints are recorded in duplication. This might be the cause of the increase in complaints since 2003. Also EMAX explained that residents outside of the target area of this Project registered complaints comparing the service they received with the service provided in the target area.

The increase of complaints from 2009 to 2010 is attributed to the unusual climate with much rain in 2010. The heavy rain caused the leakage of distribution line, and unstable electricity supply to function the machines at boreholes. With these temporary problems, the complaints from the residents increased in 2010.

3.3.2 Qualitative Effect

In this Project, indicators to measure the qualitative effect were not set. In the ex-post evaluation, the following qualitative effects were observed.

3.3.2.1 Centralized Control of Supply and Demand of Water by Reservoir

Before this Project, 70% of water was provided directly from boreholes, which was out of the centralized control of EMAX of its comprehensive supply and demand of water. Under these circumstances, even though the total production volume exceeded the total demand, water shortages occurred due to the inefficient distribution of water. In the Master Plan, it was recommended that distribution reservoirs be constructed to deliver water to the respective distribution area. Following this plan, the Zona Media reservoir was constructed for the Media distribution area, and the San Isidro reservoir was set for the Baja distribution area. EMAX was to be responsible for the total management of water supply and demand. Through this process, the total volume of water came to be distributed effectively, and the rate of 24-hour continuous supply has increased.¹⁰

In light of the above, even though the original target of 100% families with a 24-hour continuous water supply and without water pressure problems could not be attained, more than 90% of them could enjoy the expected target situation. This project has largely achieved

⁹ The San Isidro reservoir is located in Zone Media (altitude 2350m–2390m), and the Zona Media reservoir is in Zone Alta (altitude 2390m-2430m). It was planned that the San Isidro reservoir was to deliver its water to the Baja distribution zone, and the Zona Media reservoir was to deliver to the Media distribution zone. However, the water pressure from Zona Media reservoir was too high for the Media distribution zone, and led to the bursting of pipes. So until the completion of the change of pipes, the San Isidro reservoir, which is located at a lower altitude, delivered its water to the Media distribution zone.

¹⁰ The water from springs and boreholes at San Isidro and Democracia is sent to the San Isidro reservoir. The water from boreholes at Cirezada, Zoologico, El Paraiso, Pacaja Las Americas and Zona 8 is sent to the Zona Media reservoir. The water from the latter six boreholes is sent to the old San Isidro reservoir, and transmitted to the Zona Media reservoir.

its objective; therefore its effectiveness is high.

3.4 Impact

3.4.1 Intended Impact

At the time of the ex-ante evaluation, the following three indicators were set to measure the effect of the Project indirectly: 1) the number of registered families, 2) the amount of collected water service charges, and 3) the opinion of users.

3.4.1.1 The Number of Registered Families

The population around Quetzaltenango has drastically increased¹¹. Hence the number of newly registered beneficiaries is also growing. The effort to convert illegal connectors to registered beneficiaries also went successfully, and the number of newly contracted families has grown. The transition to registered beneficiaries is as stated in Table 5.

Table 5: The number of registered beneficiaries

Year	2004	2007	2008	2009	2010
Newly registered beneficiaries (number of families)	730	1051	893	690	653
Total registered beneficiaries (number of families)	22,641	24,988	25,881	26,571	27,224
Water supply population	113,205	124,940	128,405	132,85	135,620
Illegal connectors (number of families)	---	1,264	1,195	1,139	1,095
Rate of water supply (%)	83.7	84.36	84.74	84.37	83.53

(Source) Documents offered by EMAX

The Department of Public Services fines illegal connectors, in cooperation with the Municipality of Quetzaltenango. If illegal connectors do not pay the fine within the specified period, water supply will be suspended¹². By this measure, the conversion from illegal to legal connectors has been promoted.

On the other hand, the rate of water supply remains stable because the total population is growing in parallel with the increase in newly registered beneficiaries. The actual total of registered beneficiaries has increased from 22,641 families/113,205 persons in 2004 to 27,124 families/135,620 persons in 2010, which represents a 20% increase.

3.4.1.2 Collection of Water Service Charges

Based on the complementary technical assistance for improving of the management of the

¹¹ The rate of population growth in 2004 was 3.11%.

¹² Once the illegal connectors are detected, 1,200 GTQ is fined. If they do not pay the fine before the deadline, the Municipality fines them 2,500 GTQ. If payment is still not paid, the water supply is suspended. It takes about a month from the first fine request till the final suspension of water supply.

water supply, a committee to enforce financial regulations (composed of four members, headed by a vice president, directors of the Departments of Planning and Project,, and Finance and Administration and others) was established. This committee has discussed measures to increase the collection of water service charges. Up to the time of the ex-post evaluation, four measures, such as: 1) the enforcement of detection of illegal connectors and the collection of their fines, 2) the conversion of illegal connectors to registered users, 3) capacity enhancement of inspectors for correct reading of meters, and 4) the revision of the water service charge system, were discussed and put into practice. In regards to measures 1 and 2, EMAX has been detecting illegal connectors and trying to convert them to registered users, in cooperation with the Municipality, as stated in 3.4.1.1. As for measure 3, training for the inspectors has been undertaken. For measure 4, it is expected that the simplification of the charge system and the introduction of a pay-as-you-go system starting with a lower fixed price will enable EMAX to increase its revenue.

With these measures, the portion of water service charges in EMAX's total revenue has been growing as stated in Table 6.

Table 6: Portion of collected service charges in the revenue of EMAX

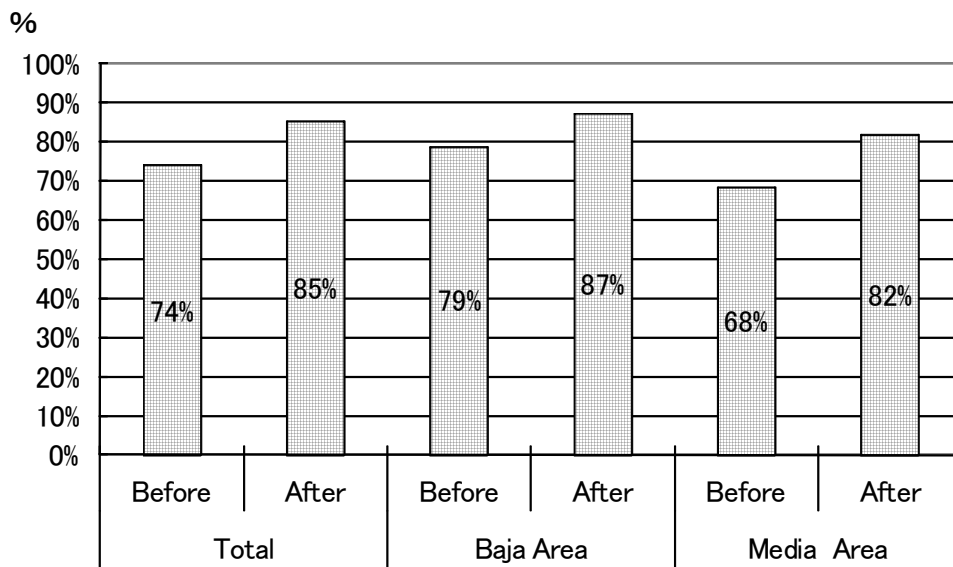
Year	Total revenue (GTQ)	Collected service charge (GTQ)	Portion of service charges in total revenue (%)
2007	5,829,397	4,378,377	75.10
2008	6,350,625	4,807,094	75.69
2009	6,802,228	4,926,280	72.42
2010	6,900,186	5,652,010	81.91

(Source) Documents offered by EMAX

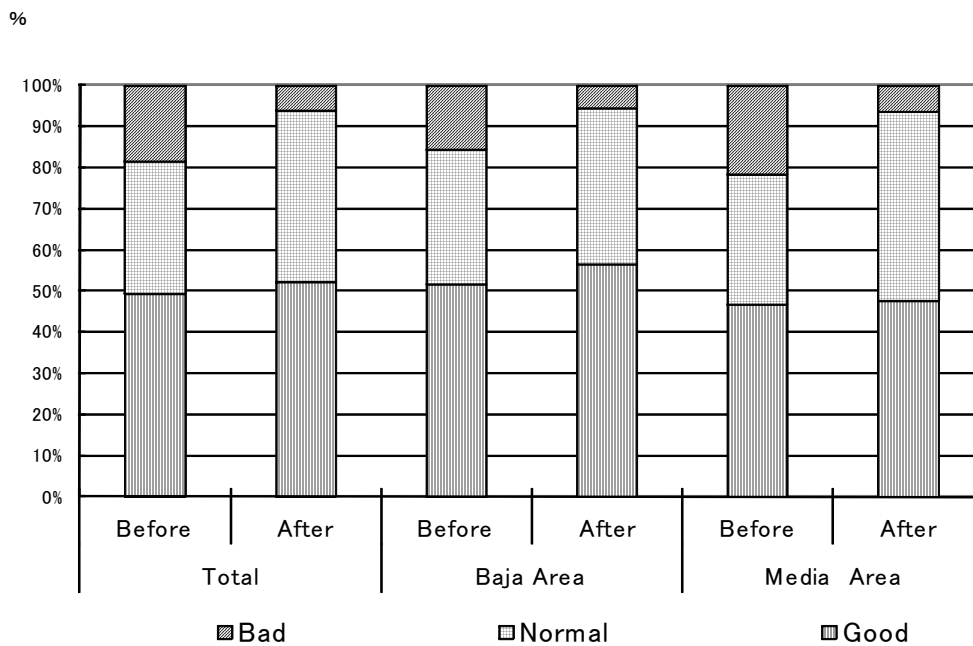
3.4.1.3 Opinion of Users

The results of the beneficiary survey at the time of the ex-post evaluation are as follows.¹³ Regarding the 24-hour continuous water supply, 85% of families can use water at any time of the day. In the Media distribution area, we can observe a greater improvement than that of the Baja area. As for the water pressure, families experiencing problems total 6%. As in the 24-hours continuous water supply case, we can observe a better improvement in the Media distribution area.

¹³ The beneficiary survey was conducted from February to March 2011 to assess the impact of this Project. The target sample was 132 households. The number of sample households in the target administrative area was decided at a rate proportional to the population in each area, and EMAX extracted the sample household at random from their users list. When the external evaluator visited the site in February 2011, she conducted a sample survey with a local consultant to finalize the questionnaire. After these processes, the local consultant visited each household and held face-to-face interviews.



Graph 1: % of families accessing 24-hour continuous water supply
 (Source: Beneficiary survey in the ex-post evaluation survey)



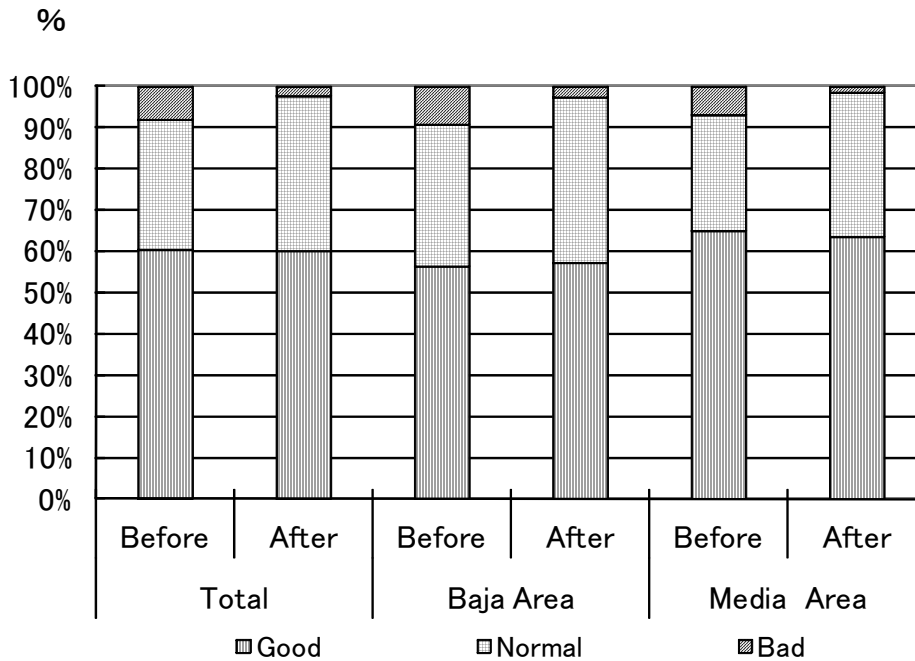
Graph 2: Status of water pressure

(Source: Beneficiary survey in the ex-post evaluation survey)

Not many residents felt that the quality of water was bad even before the Project; at the time of the ex-post evaluation, a smaller number of people found its quality to be bad. Still, only less than 10% people have access to tap water to drink. Most people purchase drinking water

or boil tap water. Even though not many residents find the quality of water to be bad, quite a few residents pointed out the smell of chlorine after the Project. Due to the installation of an automatic chlorine injecting machine, 44% of respondents in the beneficiary survey noted the smell of chlorine.

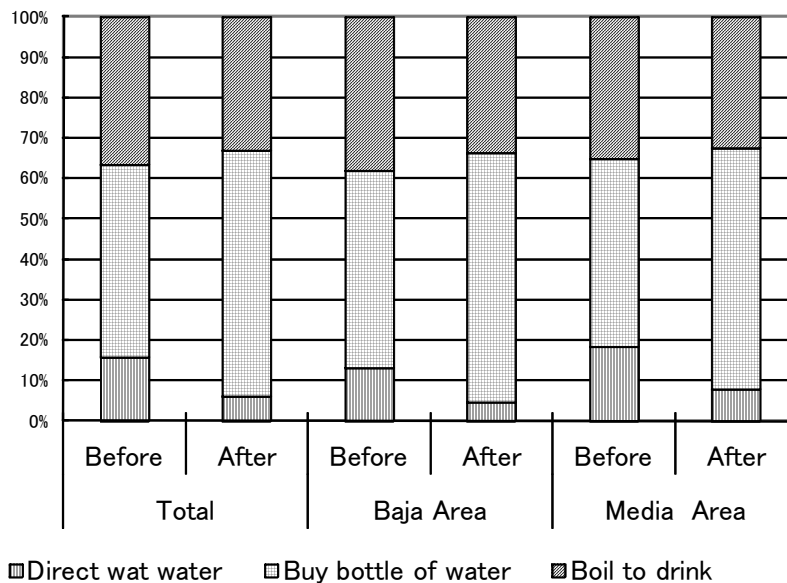
On the other hand, the injection of chlorine is a necessary procedure to secure safe water. With this procedure, microbes which cause water-related diseases such as diarrhea are sterilized and safe water is provided.¹⁴



Graph 3: Opinion of water quality

(Source: Beneficiary survey in the ex-post evaluation survey)

¹⁴ According to the consultant of this Project, it is a common case even in Japan that a person who is not accustomed to chlorine-sterilized water may feel uneasy from its smell. The website of the Department of Clean and Sewage Water in Kaitzuka City indicates, “The smell of chlorine of tap water is not abnormal, and rather, is the evidence of safe water. The smell is recognized depending on the distribution area, the weather and physical condition. Without the sterilization of chlorine, the germs in the tap water might grow. To prevent the germs from growing, a certain amount of chlorine is injected.”



Graph 4: The method of obtaining drinking water

(Source: Beneficiary survey in the ex-post evaluation survey)

In addition to the above, the beneficiaries expressed the following opinions about the utilization of water at the time of the ex-post evaluation.

- They can spend daily life free from any problems related to water.
- There is no need to carry water.
- The pressure of water is higher than before.
- They can take longer showers.
- Every day, they can take a shower at a different time of the day.
- They can use water when they need it with enough volume.
- There is no suspension of water supply.
- There is no turbidity in water, and they can get clean water.
- They can wash their clothes any time at their home.
- It takes less time to repair leakages.
- The water smells of chlorine.

3.4.2 Other Impacts

3.4.2.1 Leakage Rate and Unaccounted-for Water Rate

(Unit: %)

年	2000	2004	2007	2008	2009	2010
Leakage rate	---	---	44.59	18.40	20.82	19.92
Unaccounted-for water rate	40	---	---	35	30	20

(Source) Response to the questionnaire by EMAX

The leakage rate, which was 44.59% at the completion of the Project, decreased to 19.92% in 2010, utilizing the equipment provided by the Project. Since the completion of the Project,

it takes less time to respond to superficial leakages. While it took 2-3 days to undertake repairs before the Project, repair within a day was possible at the time of the ex-post evaluation. The replacement of old pipes by the EMAX project is also contributing to the reduction of the leakage rate. In this Project, equipment used to detect underground leakages was procured, and technical assistance on how to use the equipment was conducted. However, the detection of underground leakages is not conducted effectively. According to the Implementing Agency, detection at night-time, which is common practice in other countries, is difficult to undertake in Guatemala due to budget and security constraints. Moreover, the understanding of equipment use was not enough to utilize equipment practically and accurately on specific occasions and to interpret the data correctly. For these reasons, the equipment is not being fully utilized.

The reduction of the unaccounted-for water rate is attributed to the various measures introduced in order to increase the collection rate of service charges as stated in 3.4.1.2. It was 40% in 2000, before the Project, and had been reduced to 20% in 2010.

3.4.2.2 Increase in the Consumption of Water beyond its Increase of Production

As the supply of water increases, the consumption of water per person has also grown. The increased rate of the latter exceeds that of the former. The consumption volume per person per day is as below in Table 8.

Table 8: Consumption volume of water per person per day (on average)

Year	2000	2004	2007	2008	2009	2010
Consumption (Ltr)	150	187	N.A.	235.80	N.A.	240.40
Increase rate (%)	---	1	---	26%	---	29%
Production volume (m ³)	---	25,507	25,626	31,238	31,235	31,235
Increase rate (%)	---	1	0%	22%	22%	22%

(Source) Response to the questionnaire by EMAX

As stated in 3.3.1.2, while the production volume at the water source has increased by 22% compared with in 2004, the consumption volume per person per day has increased by 29%. EMAX is concerned about the balance of supply and demand in the future. They have been promoting a campaign program to conserve water use. They call on citizens to save water through announcements on TV or the radio, and also promote various programs to teachers and students, in collaboration with schools¹⁵.

The consumption volume stated above is per household. However, there is some suspicion that commercial/industrial users might register as households to be charged a lower fee. The figure stated above infers a bigger volume than the actual consumed volume.

¹⁵ EMAX gives lectures to teachers on saving water, conducts tours to observe the water supply facilities, and organizes water saving contests for children. In addition to these measures, plans have been made to develop another program collaborating with the private sector from now on.

3.4.2.3 Environmental and Social Impact

A negative environmental impact by the Project has not been observed. However, an increase in water supply causes an increase in sewage water. In Guatemala, a regulation regarding the residual and re-use of discharge water and the disposal of sludge was established in May 2006. In this regulation, the quality of water in discharging sewage water was defined. However, the disposal facilities have not been set up yet, and sewage water has been directly discharged into the river without disposal. The critics of this inappropriate treatment of sewage water and contamination of water are growing.

The land for the construction of the Zona Media reservoir was the property of a religious school of U.S. origin. EMAX purchased this land at its own expense. There was no case of transferring residents caused by the reservoir construction.

3.4.2.4 Smell of Chlorine in Tap Water

The users criticize the smell of chlorine in tap water. As described in 3.4.1.2, 44% of users expressed their concern about this issue according to the beneficiary survey. In response to these concerns, it has been explained on the municipal radio program that even though the water smells of chlorine, the injection volume is under the limit set by the regulation. As a result of this announcement, the critics have calmed down. In the Project, the chlorine injection machines were installed at the old and new San Isidro water reservoirs. The chlorine is injected automatically, observing the volume regulated by the national guidelines. In addition to the automatic injection, the operator at the Zone Media reservoir checks its concentration. The EMAX laboratory also inspects the water quality twice a year, and confirms that the density of chlorine is within the regulation. The result of the inspection is as below in Table 9.

Table 9: The result of the water quality inspection by EMAX laboratory for the San Isidro reservoir and the Zona Media reservoir

Year	2007	2008	2009	2010	LMA*	LMP**
San Isidro reservoir						
Turbidity	0.25	0.1	0.2	0.15	5UNT	15UNT
Chlorine	0.42	0.4	0.45	0.45	0.5mg/L	1.0mg/L
pH	7.22	7.135	7.15	6.89	7.0-7.5	6.5-8.5
Smell	Normal	Normal	Normal	Normal	Normal	Normal
Colon bacillus	0	0	0	0	0	0
Zone Media reservoir						
Turbidity	0.2	0.14	0.15	0.1	5UNT	15UNT
Chlorine	0.4	0.39	0.38	0.36	0.5mg/L	1.0mg/L
pH	7.55	7.15	7.2	7.1	7.0-7.5	6.5-8.5
Smell	Normal	Normal	Normal	Normal	Normal	Normal
Colon bacillus	0	0	0	0	0	0

(Source) Documents offered by EMAX

In principle, water from springs and boreholes is underground water of good quality. But colon bacillus was found in the spring water, which requires sterilization by chlorine for use. Even in Japan, there are some cases that citizens who are not accustomed to using water sterilized by chlorine complain about the smell of chlorine.

The volume of chlorine in this Project is under the limitation of national guidelines, and this is not a big problem.

3.5 Sustainability (Rating : ③)

3.5.1 Structural Aspects of Operation and Maintenance

Before 1999, the operation of the water supply was handled by four persons in charge in the Municipality of Quetzaltenango. At the establishment of EMAX in 2000, four departments were set up: 1) the Department of Finance and Administration, 2) the Department of Public Services, 3) the Department of Operations and Maintenance, and 4) the Department of Planning and Projects. The Department of Finance and Administration takes care of finance, accounts and procurement. The Department of Public Services handles the registration of users, installation of meters, and then collection of water service charges. The Department of Operations and Maintenance manages the facilities of springs, boreholes, water reservoirs and so on, and operates the network of distribution pipes, repairs leakages, and the installation of pipes. The Department of Planning and Projects is responsible for projections of the supply and demand of water, the expansion of pipes and the management of surveys and construction contracts. The number of staff in EMAX at the time of the ex-ante evaluation was 96, and was 106 at the time of the ex-post evaluation. While the total number of staff has increased, some departments decreased their staff. The allocation of staff at each Department is as follows in Table 10.

Table 10: Number of staff in each department

(Unit : person)

年 / Department	2004	2010	Volatility
Management	3	8	+5
Finance and Administration	11	5	△6
Public Services	24	19	△5
Operations and Maintenance	35	51	+16
Planning and Projects	28	23	△5
Total	98	106	+8

(Source) Response to the questionnaire by EMAX

To respond to the decrease in the number of staff, the Department of Finance and Administration has taken measures to introduce a new accounting system, Siscon (Sistema Integrado de Contabilidad), and adjust the workload among its staff. On the other hand, the

Department of Public Services and Planning and Projects confronts the challenges of the increased workload of each staff member, and the suspension of work (centralized record system of complaints from users) due to the decrease in the number staff. The Department of Operations and Maintenance has increased its staff. However, their work is growing as the facilities (such as pipes and water reservoirs) are expanding. The Department still needs more staff.

EMAX recruit their staff in line with the guidelines set out in the “Organizational Regulation of EMAX” (Codificación de Unidades Organizativas de EMAX). Based on this policy, competent staff have been recruited who meet the qualification requirements of the position and department. require.

EMAX provides with the stable supply of water through the allocation of competent staff, and sufficient staff at the Department of Operations and Maintenance. However, in order to carry out the tasks efficiently in the future, the appropriate allocation of staff in the Department of Public Services and the Department of Planning and Project will be required.

As stated in 3.4.2.3, the volume of sewage water is increasing as the consumption of clean water grows. The direct discharge of sewage water has been criticized. To respond to this issue, EMAX integrated the sewage water section, which was part of the Municipal organization since before 2009. At the time of the ex-post evaluation, they were still dormant without a clear job description. However, EMAX recognizes the seriousness of this issue, and has started to restructure their organization to handle the comprehensive treatment of clean and sewage water.

3.5.2 Technical Aspects of Operations and Maintenance

The staff at EMAX have opportunities to brush-up their skills through OJT (on-the-job training) or off-JT (off-the-job training).

The Department of Finance and Administration trains their staff so that they can use Siscon (accounting system), and conduct their job efficiently. The Department of Public Services has its inspectors attend training on the correct reading and functioning of meters. The staff of the Department of Planning and Projects have attended training courses on water resources management, to develop their capacity to plan balanced water supply and demand. However, specialized software to calculate the water flow is not utilized because they cannot use it correctly. At the time of the ex-post evaluation, they were using other software. The technical staff of the Department of Operations and Maintenance joined the training at ESMAT, which is the public water supply organization in Torino, Italy. The operators at the facilities are trained on mechanical issues and occupational safety.

In addition to staff at EMAX having opportunities to strengthen their capacity, the staff that participated in the complementary technical assistance remain working at EMAX. The “detection of underground water leakage” and “the improvement of the management of water supply organizations” were topics taught in the complementary technical assistance sessions. Eleven out of fourteen staff members are still working at EMAX. What they learned

is shared and transferred to the other staff members, and technical manuals are also in use. Regarding the detection of underground water leakages, even though participants could learn basic techniques during the complementary technical assistance, it was found that they could not reach an adequate level for practical use of the equipment at the time of the ex-post evaluation.

The operation of springs, boreholes and water reservoirs is taken care of by operators, and there have not been any major problems. The water from the reservoirs has been discharged to the respective distribution areas. The operators at each borehole and reservoir operate the facilities based on the operation manuals. The senior staff are assigned accordingly to operate the distribution water reservoirs.

Superficial water leakages are acted upon more quickly than before using the equipment provided by the Project. On the other hand, underground water leakages are not responded to sufficiently. The staff at EMAX understand the basic use of the equipment used to detect underground water. However, they cannot utilize the equipment adequately in different specific situations. Nor they can interpret or analyze the data that the equipment shows. They take time to detect the area of leakage of underground water. EMAX cannot assign staff that are exclusively engaged in this task. Detection at night, which is common practice in Japan, is difficult to conduct in Guatemala due to security and budget issues. These difficult situations do not encourage EMAX to detect underground water leakages. EMAX responds to underground water leakages not by using the equipment, but by adjusting the volume of water delivered from the reservoir by decreasing its pressure at night.

The staff that joined the technical assistance for the improvement of the management of public water supply organizations take various measures towards the improvement of the operation and management of EMAX, such as negotiating with users in regards to the installation and calibration of meters, the modification of the water service charge system, the detection of illegal connectors and so on.

3.5.3 Financial Aspects of Operations and Maintenance

(1) Financial Status

EMAX has been working to reduce the unaccounted-for water rate, as well as to engage itself in the detection of water leakages and the modification of the water service charge system, which were points to be improved at the time of the ex-ante evaluation. Taking measures towards these points, the ratio of revenue from water supply of the entire EMAX revenue is gradually increasing. The record of EMAX' s financial balance is described in Table 11.

Table 11: Balance of EMAX

(Unit: thousand Quetzal)

	2007	2008	2009	2010
Entire revenue	5,829	6,350	6,802	6,900

(Revenue from water supply)	(4,378)	(4,807)	(4,926)	(5,652)
(Ratio of revenue from water supply against the entire revenue)	75.10	75.69	72.42	81.91
Expenditure	8,459	6,105	5,578	5,643.
Balance	△2, 630	245	1,224	1,257
Subsidy from the Municipality for the new project	2,172	943	1,449	1,558

(Source) Responses to the questionnaire by EMAX

Since 2008, the annual financial balance is increasing its surplus. The revenue of EMAX is mainly expended for the cost of operations and maintenance of existing facilities. The budget for the new investments has been subsidized by the Municipality. This budget system will continue from now on.

In the year 2008, the water service charge system was modified to simplify the system and to increase the revenue from the water supply. For example, the service charge was set according to the category of customers, whether they are residents, commercial sector or industrial sector. A pay-as-you-go system was introduced, so that the more water people consume, the more they pay. EMAX now has a system to increase their revenue. The complementary technical assistance for this Project for the improvement of the management of public corporations has contributed to the modification. However, the application of the new charge system is limited only to newly registered users, which comprises 2-3% of total users. For its expanded application, approval by the Municipality is required. At the time of the ex-post evaluation, it was difficult to get approval because the new system enforced an economic burden on citizens. Moreover, the citizens who have not received the improved service will not accept the increase in charges. Under these circumstances, most of users remain under the old charge system.

Since 2011, EMAX can expense all the revenue of their service charges due to changes in the budgetary system. The conventional budget system required that the water service charges be paid to the account of the Municipality, together with other public service fees. Once it was paid to the Municipality, not all of which have charges were necessarily transferred to the account of EMAX. Now with the new budgetary system, it is expected that the direct payment of water service charges will enable EMAX to increase its revenue. In addition to this, the new system motivates EMAX to reduce their costs because the reduction of costs brings surplus to their account balance. Such motivation could not be expected before because the Municipality compensated its deficit whenever it occurred. In this manner, the financial status of EMAX can be expected to improve. On the other hand, EMAX still needs the additional budget for new investments. To push through the Master Plan, the strengthening of the financial status is desirable by expanding the application of the new service charge system and so on.

3.5.4 Current Status of Operations and Maintenance

(1) Status of Equipment and Facilities

The equipment is kept in a locker with a key, and the excavator and truck is utilized and maintained well within the same premises. The boreholes and water reservoirs are operated by operators, who take care of the cleaning of the facilities and the equipment. Even though the boreholes are located in the middle of the city, they are surrounded by fences so that the general public cannot get in.

(2) Status of Maintenance of Equipment and Facilities

The operators operate and inspect the facilities for 24 hours at the water reservoirs and boreholes, every second day. They operate the facilities in accordance with the manuals. The volume of water production, transmission and distribution is recorded in a standardized form. The borehole operators take care of multiple boreholes and springs are taken care of by two operators on rotation. At the water reservoirs, the operators adjust the number of operating transmission pumps and the volume of incoming water. This task, the management of the volume of incoming and outgoing water, requires skillful techniques. Hence the operators with more experience are assigned to work at the water reservoirs. In addition to the adjustment of the water volume, they handle the injection of chlorine, the management of operation records and other tasks. The operators can manage the level of water volume with no problems.

The maintenance of equipment is done properly. The band of excavator will be replaced at the agency in the Guatemala.

The distribution pipes made of old asbestos burst in the first year after the completion of the Project. This happened due to the elevated water pressure as a result of the Project. After this incident, EMAX replaced the faulty pipes with new ones, which had been completed at the time of the ex-post evaluation. Superficial leakages are acted upon by EMAX by regular inspection and also in response to complaints from citizens. Regarding underground leakages, EMAX staff have tried to respond using the equipment provided by this Project. However, they cannot hit the leakages accurately, and their work continues on inefficiently.

In light of the above, no major problems have been observed in the operations and maintenance system in terms of organizational, technical and financial aspects; therefore, the sustainability of the Project effects is high.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

The Project aimed to achieve a stable supply of clean water through the improvement and construction of facilities for water resources, reservoirs, and transmission and distribution pipelines. This is consistent with the development plan and development needs of the Republic of Guatemala, and also with Japan's ODA (Official Development Assistance) policy; therefore, the relevance of the Project is high. Efficiency is also high because the cost and the

period of the Project were within the planned budget and schedule.

The Project Purpose was to ensure that 100% of families in the target area could access “a 24-hour continuous water supply” and “a water supply without water pressure problems”. Even though this purpose was not achieved, more than 90% of families can use water continuously 24 hours a day, and are free from the problem of low water pressure. We can observe the effects of the Project. Moreover, we can observe the following effects: the unaccounted-for water rate has decreased from 40% (in 2000, before the Project implementation) to 20% (in 2010); the leakage rate has also decreased from 44.59% (in 2007, the year of the completion of the Project) to 19.92% (in 2010); the rate of collection of water service charges has increased; users have expressed their satisfaction that they can consume water stably at any time with good pressure. These effects are also attributed to complementary technical assistance for the improvement of the management of public water corporations, as well as the construction of facilities and the provision of equipment. (Regarding the reduction of the leakage rate, the replacement of old asbestos pipes by EMAX also partially contributed). On the other hand, we can also observe the wastage of water and the increase of sewage water as the supply of water has increased. Even with these concerns, we can evaluate that the effectiveness of the Project is relatively high.

EMAX, the implementing agency, does not have sufficient staff, but the terms of reference in each position are clearly defined and qualified staff are recruited and assigned to the respective positions. They have enough capacity to operate and maintain the facilities and equipment, to respond to the leakage of water, and to manage the public water supply. The financial status is also improving with a surplus of balance. Current concern regarding the sustainability of the Project relates to the technical enhancement of the detection of underground water leakages and the expansion of the application of a new service charge system.

In light of the above, this Project is evaluated to be highly satisfactory.

4.2 Recommendations

4.2.1 Recommendations to the Implementing Agency

- The information collected by the different departments is not managed in a unified way, and is not utilized effectively for the improvement of service delivery. (The Department of Public Services and the Department of Operations and Maintenance treat the complaints in duplication, and information and responses are not shared with each other). A centralized system for the management of complaints, the efficient recording of complaints,¹⁶ the establishment of a system of information sharing which strengthens the improvement of service delivery, are desirable.
- Discussion with the Municipality of Quetzaltenango is recommended to expand the

¹⁶ The complaints can be classified based on the contents. Encoding of complaints might facilitate the simplification of records.

application of the modified water service charge system and the reinforcement of the financial status of EMAX.

- The achievement of practical use of equipment for the detection of underground water leakages is recommended. The response to underground leakages, as well as action in response to superficial leakages, should be strengthened.
- The negative impact of increasing sewage water discharged directly into rivers along with the increase of clean water consumption has been criticized by environmental organizations. Define the job description of the department of sewage water incorporated by EMAX, and take action to alleviate the damage caused by water contamination.

4.2.2 Recommendations to the Municipality of Quetzaltenango

- The approval of the application of the new water service charge system is recommendable, not only to newly registered users but also to conventional users. In this way, the Municipality can support the reinforcement of the financial status of EMAX, which enables it to provide a stable supply of clean water, responding to the expanding demand for water.
- The treatment of sewage water is not done properly. Budgetary assistance to EMAX is necessary so that the incorporated sewage department can take appropriate action.

4.2.3 Recommendations to JICA

- Follow-up training for the practical use of equipment to respond to underground leakages is recommended. This equipment is not utilized effectively because EMAX staff do not understand how to use it in practice. JICA should provide the opportunity to train staff on how to use this equipment on a practical basis.

4.3 Lessons Learned

At the time of the defect inspection one year after the completion of the Project, follow-up technical assistance regarding the practical use of equipment. The Project aimed to achieve a stable supply of clean water through the improvement and construction of facilities for water resources, reservoirs, and transmission and distribution pipelines. This is consistent with the development plan and development needs of the Republic of Guatemala, and also with Japan's ODA (Official Development Assistance) policy; therefore, the relevance of the Project is high. Efficiency is also high because the cost and the period of the Project were within the planned budget and schedule.

The Project Purpose was to ensure that 100% of families in the target area could access "a 24-hour continuous water supply" and "a water supply without water pressure problems". Even though this purpose was not achieved, more than 90% of families can use water continuously 24 hours a day, and are free from the problem of low water pressure. We can observe the effects of the Project. Moreover, we can observe the following effects: the unaccounted-for water rate has decreased from 40% (in 2000, before the Project

implementation) to 20% (in 2010); the leakage rate has also decreased from 44.59% (in 2007, the year of the completion of the Project) to 19.92% (in 2010); the rate of collection of water service charges has increased; users have expressed their satisfaction that they can consume water stably at any time with good pressure. These effects are also attributed to complementary technical assistance for the improvement of the management of public water corporations, as well as the construction of facilities and the provision of equipment. (Regarding the reduction of the leakage rate, the replacement of old asbestos pipes by EMAX also partially contributed). On the other hand, we can also observe the wastage of water and the increase of sewage water as the supply of water has increased. Even with these concerns, we can evaluate that the effectiveness of the Project is relatively high.

EMAX, the implementing agency, does not have sufficient staff, but the terms of reference in each position are clearly defined and qualified staff are recruited and assigned to the respective positions. They have enough capacity to operate and maintain the facilities and equipment, to respond to the leakage of water, and to manage the public water supply. The financial status is also improving with a surplus of balance. Current concern regarding the sustainability of the Project relates to the technical enhancement of the detection of underground water leakages and the expansion of the application of a new service charge system.

In light of the above, this Project is evaluated to be highly satisfactory.

- Should be undertaken as well as an inspection of the operation of equipment. After the utilization of the equipment by themselves, the implementing agency will have practical and concrete concerns to be clarified, and its understanding on how to use the equipment practically will be deepened and promoted. Hence, a question-and-answer style follow-up is recommended to be included in the process of defect inspection. On this occasion, the target project should be defined only to the one which raises the concrete questions through their actual utilization, not to all the projects so that the follow-up training will be practical and substantive.
- The increase in the consumption of clean water results in the increase of sewage water. It is recommended that the partner government be encouraged to implement sewage water disposal appropriately during the formulation of clean water projects.