Republic of Ecuador

Ex-Post Evaluation of Japanese Grant Aid Project

"Water System Improvement Project for Ibarra"

External Evaluator: Takeshi Yoshida

Global Group 21 Japan, Inc.

0. Summary

This project was implemented to establish stable and safe water supply by improving and providing water supply facilities and maintenance equipment in Ibarra, Ecuador. This objective has been highly relevant with the country's development plan, development needs in the time of both planning and ex-post evaluation, and consistent with Japan's ODA policy; therefore, the relevance of the project is high. Also, project output was delivered as planned, and both project cost and project period were within the plan; therefore, efficiency of the project is high. As one of the effects of the project, the rate of non-revenue water in urban areas decreased from 43% to 36% after the completion of the project. Also, the construction of reservoirs contributed to the stable amount of water supply, and 24-hour water supply was realized in all urban areas. In rural areas, the improvement of purifying plants in Aloburo and Zuleta achieved the improvement of water quality and the securing of sufficient amount of water. As a result, the project greatly contributed to the improvement of standard of living for local residents. This project has largely achieved its objectives; therefore, its effectiveness and impact are high. While there is no considerable problem in the maintenance of facilities and equipment, organizational structure is expected to be strengthened for non-revenue water prevention; therefore, sustainability of the project effect is fair.

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

1. Project Description

Project Location

Purifying plant in Aloburo

1.1 Background

The city of Ibarra is the capital of Imbabura province, located at 2,200m above the sea level and about 120km north of Quito, the national capital of the Republic of Ecuador. Ibarra is the

transportation hub and commercial center of five provinces near the border with the Republic of Colombia. The main industries are agriculture and pasturage, manufacturing industry, and service industry.

At the time of 2005, water supply system of Ibarra had some problems. In urban areas, the water leakage rate was over 43% due to aging deterioration of water supply system build in the 1970s. Also, the use of water was regulated in many areas within the city because the construction of water supply system was not catching up on the increasing population and the extending urban areas. In rural areas, since water-purifying facilities were not sufficiently equipped, people had to use water of bad quality (high turbidity) during the rainy season.

Municipal Enterprise for Water Supply and Sewerage System of the City of Ibarra (Empresa Municipal de Agua Potable y Alcantarillado del Canton Ibarra; hereinafter referred to as "EMAPA-I") developed a "Water Supply System Improvement Plan for Ibarra" in 2003. For facility improvement and equipment procurement with high urgency and priority in the plan, EMAPA-I requested a grant aid project from JICA. This project was implemented for two terms.

1.2 Project Outline

The objective of this project is to establish stable and safe water supply by improving water supply facilities and providing maintenance equipment in Ibarra, Ecuador.

Grant Limit / Actual Grant Amount	(Term 1) 681million yen / 679million yen (Term 2) 372million yen / 366million yen
Exchange of Notes Date	(Term 1) August, 2005 (Term 2) June, 2006
Implementing Agency	Municipal Enterprise for Water Supply and Sewerage System of the City of Ibarra (EMAPA-I : Empresa Municipal de Agua Potable y Alcantarillado del Canton Ibarra)
Project Completion Date	(Term 1) March, 2007 (Term 2) February, 2008
Main Contractor(s)	Hazama Corporation
Main Consultant(s)	Kyowa Engineering Consultants Co., Ltd. Nihon Suido Consultants Co., Ltd. (JV)
Basic Design	November, 2004 – June 2005
Related Projects (if any)	N/A

2. Outline of the Evaluation Study

2.1 External Evaluator

Takeshi Yoshida, Global Group 21, Inc.

2.2 Duration of Evaluation Study

The ex-post evaluation study for the Project was conducted over the following period.

Duration of the Study	:	September, 2011 – September, 2012
Duration of the Field Study:		January 22, 2012 – February 2, 2012
		May 20, 2012 – May 28, 2012

2.3 Constraints during the Evaluation Study

N/A

3. Results of the Evaluation (Overall Rating: A[1])

3.1 Relevance (Rating: ③[2])

3.1.1 Relevance with the Development Plan of Ecuador

Ecuador's "National Development Plan (2011 - 2005)" stated that the improvement and spread of water supply and sewerage system was one of the most important issues of the country, and they were making efforts toward such improvement. However, when this project was planned, the rate of safe water supply was only 65 % in urban areas and 43% in rural areas, lower than neighboring countries. At the provincial level, they had "Strategic Development Plan" which prioritized the improvement of water supply facilities, based on the above national development plan. Following the national and provincial plans, EMAPA-I had prepared "Water System Improvement Plan for Ibarra" in 2003, and implemented the improvement of water supply facilities.

According to "National Plan for Good Life (2009 - 2013)", a national development plan as at the time of this ex-post evaluation, the widespread access of safe water is a human right determined by the constitution, and one of the national strategies to guarantee people's better life.

Thus, the stable supply of safe water has consistently been an important political issue of Ecuador.

3.1.2 Relevance with the Development Needs of Ecuador

As stated in the background section, Ibarra is the capital of Imbabura province and the commercial center of five provinces near the border with Colombia. However, at the time of 2005, the water leakage rate reached nearly 50% in urban areas due to aging deterioration of water supply system, and the use of water was regulated in many areas within the city[3]. Also, water pipes made of

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

[2] ③: High, ② Fair, ① Low

[3] Continuity of water supply differed depending on areas. Only the central area had 24 hour water supply. In some areas in the southeast, water supply was limited to only 6 hours a day.

asbestos cement had serious aging deterioration, and damaged parts were causing not only water leakage but also water contamination. Therefore, renewal of the deteriorated facilities was required, as well as the procurement of equipment for early detection of underground leakage, repair of water pipes, control of water delivery, and chlorine disinfection. At the same time, it was also required to improve the leakage prevention skills. In rural areas, deteriorating water quality during the rainy season was a problem.

In EMAPA-I's strategic plan for 2009 – 2014, the followings are the improvement objectives for overall management of water supply.

- Improvement of the potable water coverage from 93.51% to 96.52 %
- 100% compliance with EMAPA-I's water quality standard
- Improvement of non- revenue water from 44.13% to 39%

In 2011, non-revenue water of the city as a whole was 37.9%, reaching the objective; however, that of rural areas was high at 43.1%, and the improvement of non-revenue water is still a serious issue. Thus, since the planning of this project until today, it has been important issues to provide stable supply of potable water, secure water quality, and improve non-revenue water. Therefore, the relevance of this project with the development needs of the country is high.

3.1.3 Relevance with Japan's ODA Policy

In an aid policy dialogue with Ecuadorian government in February, 1999, it was confirmed that the focus of Japanese assistance to Ecuador would be in "poverty reduction", "infrastructure development", "environment protection", and "disaster management". This project was considered as "infrastructure development", corresponding to Japan's ODA policy at the time[4].

In summary, this project has been highly relevant with the country's development plan, development needs, as well as Japan's ODA policy, therefore its relevance is high.

3.2 Effectiveness[5] (Rating: ③)

3.2.1 Quantitative Effects (Operation and Effect Indicators)

(1) Urban Areas

For stable water supply in urban areas of Ibarra, this project included (i) replacement of deteriorated conveyance pipes, transmission pipes, and distribution pipes to reduce water leakage, (ii) construction of reservoirs to improve water supply adjustment ability, and (iii) provision of equipment and training for inspecting and repairing water leakage points.

[4] The basic design of this project was studied in 2004. Later in July, 2005, a policy dialogue for economic cooperation was held between the local ODA task force (centering the Embassy of Japan in Ecuador) and Ecuadorian government. As a result, a new assistance policy was created, which consisted of three focusing areas, "poverty reduction", "environment protection", and "disaster management", with other specific development issues determined under them.

[5] Sub-rating for Effectiveness is to be put with consideration of Impact

As shown in Table 1, non-revenue water in urban areas decreased after the completion of this project in 2008, and has been improving due to the continuous effort of the city of Ibarra for improving facilities and reducing leakage[6]. As a result, the amount of revenue water per population increased while the amount of water supply per population decreased, indicating more effective use of limited water resources[7]. Moreover, due to the reduction in water leakage and the improvement of water supply adjustment ability, water supply regulation, which had used to affect approximately half of the population before the project, had become unnecessary in 2010.

Equipment for reducing leakage was provided to non-revenue water prevention office, a new office established as a division of engineering department. Such equipment was utilized for inspecting and repairing underground leakage points that had used to be difficult to detect. Together with the improvement of the skills of EMAPA-I's technical staff through technical assistance, the equipment contributed to the reduction in water leakage rate[8].

Thus, in urban areas, this project has largely achieved its intended effectiveness[9].

Table 1: Improvement of Water Supply System in Urban Areas

Item	2006	2008	2010
Non-revenue water rate (%)	43.1	41.9	36.0
Population with water supply (%)	99.8	100.0	100.0
Total annual water supply (1,000 m^3)	14,165	14,871	13,963
Water supply per person (liter/day)	327	319	292
Population with 24-hour water supply (%)	52	-	100
Total annual revenue water (1,000 m^3)	8,060	8,640	8,936
Revenue water per person (liter/day)	175	172	184

Source: EMAPA-I

(2) Rural Areas

During the rainy season, the quality of raw water gets worse, deteriorating the quality of supply water in rural areas. In order to solve this problem, two water purifying plants were repaired in the project to strengthen the water purifying capacity. As a result, settling reservoir and slow filter were added, enabling the treatment of high-turbid raw water during the rainy season. According to EMAPA-I data, the highest turbidity of supply water in target areas improved from 16.0NTU before the project (2006) to 3.7 NTU at the best after the project (2010) at Zuleta purifying plant[10]. However,

[6] Some of the request from Ecuadorian government was not included in this project (1 section of water pipes in urban areas, 1 reservoir, and 5 water purification facilities in rural areas). However, all of these facilities were constructed by the city of Ibarra by themselves. Also, EMAPA-I invested US$ 1.69 mil in 2008 and US$ 2.12 mil in 2010 for facility improvement.

[7] Total annual water supply and water supply per person decreased in 2010 because of the decrease in water leakage.

[8] At the time of this ex-post evaluation, non-revenue water prevention office had been merged into water supply division, and activities for non-revenue water prevention had been slowed (See 3.5 Sustainability).

[9] At the time of appraisal, the increase of population with 24-hour water supply and the reduction of non-revenue water (leakage) rate were set as indicators, but numerical targets of those were not set.

[10] NTU (Nephelometric Turbidity Units) is the units of turbidity from a nephelometer. It indicates the

at Aloburo purifying plant, during the rainy season, earth and sand mixed in raw water when raining could not be completely treated, and such water were distributed. Because the average turbidity was 5.6 NTU in 2010, being worse than the target of 5.0 NTU, rapid filtration was installed upstream by EMAPA-I's budget in 2011. Since then, supply water has not been overly deteriorated (the highest turbidity in 2012 is 4.3 NTU).

3.2.2 Qualitative Effects

Workshops with local residents were held in rural areas (Aloburo and El Tejar) and urban areas (Bella Vista) to hear opinions about this project from beneficiaries. As a result, it was confirmed that, both in urban and rural areas, this project had shown some effects such as stable water supply (longer supply hours and improvement of water pressure) and better water quality. (See 3.3 Impact for detail.)

3.3 Impact

3.3.1 Intended Impacts

This project was intended to contribute to the improvement of living environment in urban and rural areas of Ibarra. In order to study how residents' everyday life had changed due to the improvement of water supply, workshops were held with local residents in representative villages which were selected through discussion with EMAPA-I. Beneficiaries' opinions in the workshops revealed that the stability of water supply and the quality of water improved, contributing to their everyday life in following ways.

Water intake at Guaraczapas

Conveyance pipe at Esperanza

density of insoluble particles in a liquid measured by Nephelometric Turbidity Units. The higher the turbidity, the lower the clarity of the sample is. According to WHO guideline, the turbidity of potable water should be 5 NTU or lower.

Purifying plant at Zuleta

Rapid Filtration installed at Aloburo Purifying plant

Workshop with the local residents

A beneficiary washing plates

(1) Impact in urban areas

In Bella Vista area, a workshop was held with 27 local residents, and it became clear that there were some changes before and after the project in this area, as shown in Table 2. Before the project, water supply was regulated, and water outage often happened; therefore, they could not get enough water and sometimes had to go to rivers. After the completion of the project, however, some people said they became able to use the spare time for other jobs and earn some income. This area belongs to a water distributing area of Bella Vista de Caranqui reservoir which was extended through this project; therefore, the project contributed to these impacts to a certain degree.

Table 2: Change in Urban Areas before and after the Project (Bella Vista)

	Before the Project	After the Project
Cooking	- Water supply hours were regulated - Water outage sometimes happened - Time was taken for fetching water	- Water is available at any time - No water outage
Laundry	- When water supply was regulated during the dry season, laundry was done at streams - Laundry was possible only every 2 or 3 days	- Laundry is possible at any time - Clothes don't get dirt from laundry
Health	- Water sometimes got unclear - Diseases and parasites	- Better water quality - Less parasites
Others		- They became able to do other labor for the spare time that were used to be used for water drawing and laundry - They become able to earn additional income by raising animals and sawing and stitching

Table 3: Change in Rural Areas before and after the Project (Aloburo)

	Before the Project	After the Project
Cooking	- They used to go to rivers to draw water and carry in containers - They sometimes had to boil water	- Enough water is supplied for all necessities
Potable Water	- Water was unclear and colored - They sometimes used coal and sand filters to purify water - They sometimes had to purchase bottled water	- Water is clear - They do not need to buy bottled water - Water quality improved and is good for health
Bath	- Water supply was not enough - Water pressure was low at high place - They used rain water	- Enough water pressure even at high place
Laundry	- Water was dirty or sandy, so laundry clothes did not get clean - Water outage sometimes happened	- Some people use washing machine
Health	- Infectious diseases and parasites sometimes happened	- Infectious diseases and parasites disappeared

(2) Impact in rural areas

In Aloburo area (population: 4,000), a workshop was held with 19 local residents to hear residents' opinion for the change before and after the project (See Table 3). Before the project, both water supply hours and amount were not sufficient, and going to rivers for drawing water was a part of their daily life. Also, they sometimes had to use high- turbid water. After the project, the quality of water got better, and some said diseases such as parasites decreased. The improvement of Aloburo

purifying plant through this project seems to contribute to the improvement of water quality and the elimination of water shortage which used to be caused by the increased turbidity during the rainy season.

El Tejar, another village in the distribution area of Zuleta purifying plant, is located at hilly area. A participatory workshop was conducted with 24 local residents to hear their opinions. Before the implementation of this project, they did not have enough water because of the water supply regulation and had to draw water from rivers for cooking and laundry. However, after the project, they became able to use such time for other work. Also, before the project, children did not wash their hands at home even though they were told to do so at school because they did not have enough access to good-quality water. However, they started to acquire the habit of washing hands now. Therefore, this project would have contributed to the improvement of sanitation.

Table 4: Change in Rural Areas before and after the Project (Zuleta purifying plant, El Tejar)

	Before the Project	After the Project
Water Supply Hours	- Only 2 hours	- Available at any time
Water Quality	- Water was sandy, unclear, and colored	- Water quality got better, and few people boil water before drinking
Cooking	- Women had to fetch water	- No need for fetching water
Laundry	- Laundry was done at rivers	- No need to go to rivers for laundry, and the spare time can be used for resting, other work, and family care
Water Storage	- They had to store water in big tanks	- No need for water storage
Washing Hands	- Children did not have habit of washing hands	- Children acquired the habit of washing hands

3.3.2 Other Impacts

No negative impacts on the local area and residents and the natural environment have been reported.

No big issue was reported on land acquisition and resettlement, as there was no resettlement and underground installation was made where the pipes are constructed on private land. According to EMAPA-I, there were opposing opinions against the construction of water pipes under one road in a village, so they changed the route to cut across a farm land, but no land purchase was necessary due to this change.

Based on the above, this project has largely achieved its objectives, therefore its effectiveness is high.

3.4 Efficiency (Rating: ③)

3.4.1 Project Outputs

As shown in Table 5, the output of this project is implemented as planned. In urban areas, 3 sections (14.2 km) of conveyance and transmission pipes were renewed, and reservoirs were constructed in 5 areas. Also, distribution tanks were constructed in Caranqui purifying plant, and flowmeters and equipment for leakage reduction were procured. In rural areas, purifying plants were improved in 2 areas. Also, as soft components, technology transfer to EMAPA-I was conducted for inspecting and reducing water leakage.

Table 5: Comparison of Planned and Actual Output

Planned Output	Actual Output
① Renewal of conveyance pipes and transmission pipes in urban areas (3 sections, about 14.2 km) Guaraczapas purifying plant - Caranqui purifying plant (11.8 km) Yuyucocha intake - Caranqui purifying plant (1.0 km) Guaraczapas intake - Guaraczapas purifying plant (1.4 km)	① Renewal of conveyance pipes and transmission pipes in urban areas: implemented as planned
② Construction of reservoirs in urban areas (5 areas) Azaya (2,500m3×1), Chuchupungo (100 m3×2) Bella Vista de Caranqui (100 m3×2) Santa Rosa (100m3×2), TRP#6 (100m3×2)	② Construction of reservoirs in urban areas: implemented as planned
③ Improvement of purifying plants in rural areas (Aloburo Priorato area, Zuleta area): extension of regular settling reservoir and slow filter	③ Improvement of purifying plants in rural areas: implemented as planned
④ Distribution tanks in Caranqui purifying plant	④ Distribution tanks in Caranqui purifying plant: implemented as planned
⑤ Procurement of flowmeters (36 points), equipment for leakage reduction, and others (1 set)	⑤ Procurement of flowmeters, etc.: implemented as planned
⑥ Technical assistance to counterparts for inspecting and reducing leakage (soft component)	⑥ Soft components: implemented as planned
⑦ Construction work financed by Ecuadorian government: fences for reservoirs, etc.	⑦ Construction work financed by Ecuadorian government: implemented as planned

3.4.2 Project Inputs

3.4.2.1 Project Cost

As shown in Table 6, the actual project cost (1,055 million yen) was lower than the planned project cost (1,070 million yen, 99% of the planned cost).

Table 6: Comparison of Planned and Actual Project Cost

Planned Cost	Actual Cost
1,070 million yen (Japan's contribution: 1,057 million yen, Ecuador's contribution: 13 million yen)	1,055 million yen (Japan's contribution: 1,046 million yen, Ecuador's contribution: 9 million yen, using average exchange rate of 2007-2009, US$1 = ¥104.99)

3.4.2.2 Project Period

The actual project period (32 months) was shorter than the planned project period (35 months, 91% of the planned period).

Both project cost and project period were within the plan, therefore efficiency of the project is high.

3.5 Sustainability (Rating: ②)

3.5.1 Structural Aspects of Operation and Maintenance

EMAPA-I, established in 1969, is in charge of the operation and maintenance of the facilities and equipment constructed and improved by the project. In 2005, EMAPA-I had total of 246 officials, including 145 in technical department, 45 in administration department, and 46 in financial department. In 2004, non-revenue water prevention office was established in engineering department with 7 officials mainly for the repair of water leakage on the ground.

As of 2012, EMAPA-I has increased its officials to 314, including 173 in technical department. After the completion of the project, non-revenue water prevention office in technical department utilized the equipment procured through the project to reduce water leakage. However, this office has merged into water supply division in engineering department. This was due to the central government's instruction for unifying the organization structure of public corporations. However, as mentioned in the section of effectiveness, after the organizational change, it was observed that activities for non-revenue water prevention decreased and equipment is not fully utilized[11]. In addition, the loss of an organizational unit which has a name reflecting the important objective of reducing non-revenue water would result in unclear sense of purpose and lower motivation of personnel in charge. It would also make it difficult to transfer specialized skills to other engineers because skilled

[11] The officials in non-revenue water prevention office received technical assistance for leakage inspection as a soft component part of the project, but after the organizational change, they are assigned to new projects, and activities for non-revenue water prevention has slowed. Among the equipment procured through the project, leakage detectors are not used at the time of this evaluation.

engineers and technicians are scattered in the organization.

During the field visit for this evaluation, his structural issue was addressed in the meeting with the director-general and the manager of engineering department, and the director-general expressed his opinion that it would be better to have non-revenue water prevention office independent as it was for their operation. Thus, it was stated that the operation would return to non-revenue prevention office.

Personnel increase was suggested at two purifying plants in rural areas during defect inspection, and it has been corresponded as suggested.

3.5.2 Technical Aspects of Operation and Maintenance

EMAPA-I experienced a severe sanitary accident in 2002, allowing the inflow of sewerage water to supplying water due to the breakage of water pipes. Since then, they have been making effort to improve their technical skills in order to prevent such accident. EMAPA-I has an alliance with the municipal enterprise for water supply and sewerage system of Quito. EMAPA-I also provides regular trainings for engineers, and their technical skills are considered as at high level. Moreover, it has quality assurance division and organizational development division, which aims at obtaining ISO certification; one of the reasons is the prevention of such accidents as above. For ISO 9001 (quality management), they have already obtained in urban areas, and the target year for rural areas is 2014. For ISO14001 (environmental management), they are in the application process and planning to obtain it in 2013.

As a part of the project, they provided equipment and technical assistance for leakage prevention. Those engineers and technicians who received such assistance are in the operation of leakage prevention. It shows the continuity of the technical aspect provided through the project.

It seems that they are quickly responding to troubles after the completion of the project. For example, when water pipes across a river in La Esperanza got damaged because of a flood in 2011, they recovered the damage in one week. Therefore, there is no big issue for technical capacity for operation and maintenance.

3.5.3 Financial Aspects of Operation and Maintenance

As shown in Table 7, the financial situation of EMAPA-I has been progressing favorably. The periodical increase in unit price and the improvement of fee collection rate greatly contributed to the increase in income from water supply fee[12]. The balance is surplus every year, and they use it for investment such as facility renewal. Considering operation and maintenance, EMAPA-I has no financial issues in short term.

[12] For example, water supply fee increased by 12 % on average in 2011.

Table 7: Financial Situation in EMAPA-I (Unit: US$ 1,000)

	2004	2008	2010
Income	3,712	6,111	7,297
Water supply fee	2,214	3,428	4,087
Expenditure	3,478	4,974	6,078
Personnel cost	1,603	2,822	3,441
Other expenditure	1,875	2,152	2,638
Balance	234	1,137	1,218

Source: EMAPA-I

3.5.4 Current Status of Operation and Maintenance

As a result of the field survey, operation and maintenance of the facilities constructed by the project are fairly managed with no considerable issue. The covers of Azaya reservoir, which were reported as stolen in the defect inspection, were replaced by new ones. Fences for reservoirs, whose necessity was pointed in the inspection, were also set by EMAPA-I's finance. In Aloburo purifying plant, when it rained, earth and sand mixed in raw water could not be completely filtered and distributed as water supply. Thus, EMAPA-I installed rapid filtration equipment upstream by its own budget (about US$ 8,000) in 2011. Since then, distributing water has not been deteriorated. Among the procured equipment, leakage detectors are not utilized because non-revenue water reduction activities have been slowed. A compactor, a roadroller, drain pumps, a dump truck, and a backhoe are properly managed and utilized for various maintenance activities because they can be used for multiple purposes.

Equipment provided by the project (small power shovel)

Works for water leakage prevention

In summary, some problems have been observed in terms of structural aspects of operation and maintenance, therefore sustainability of the project effect is fair.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

This project was implemented to establish stable and safe water supply by improving and providing water supply facilities and maintenance equipment in Ibarra, Ecuador. This objective has been highly relevant with the country's development plan, development needs in the time of both planning and ex-post evaluation, and consistent with Japan's ODA policy; therefore, the relevance of the project is high. Also, project output was delivered as planned, and both project cost and project period were within the plan; therefore, efficiency of the project is high. As one of the effects of the project, the rate of non-revenue water in urban areas decreased from 43% to 36% after the completion of the project. Also, the construction of reservoirs contributed to the stable amount of water supply, and 24-hour water supply was realized in all urban areas. In rural areas, the improvement of purifying plants in Aloburo and Zuleta achieved the improvement of water quality and the securing of sufficient amount of water. As a result, the project greatly contributed to the improvement of standard of living for local residents. This project has largely achieved its objectives; therefore, its effectiveness and impact are high. While there is no considerable problem in the maintenance of facilities and equipment, organizational structure is expected to be strengthened for non-revenue water prevention; therefore, sustainability of the project effect is fair. In light of the above, this project is evaluated to be highly satisfactory.

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

The improvement of facilities through the project contributed to the reduction of water leakage, which is an effective way to respond to the increase in water supply in short term. However, non-revenue water prevention office was merged into another division as a part of EMAPA-I's organizational restructuring. Officials are in charge of other operations in addition to non-revenue water prevention, and it would lead to unclear sense of purpose and degree of achievement. It would also make skilled engineers and technicians scattered in the organization. In reverse, maintaining an organization with specialized skills may contribute to effective operation and easier technology transfer. Currently, EMAPA-I is considering to make non-revenue water prevention office independent again, which is recommended to be realized as soon as possible for fully utilizing and maintaining the ability of preventing non-revenue water obtained through the project.

4.2.2 Recommendations to JICA

None.

4.3 Lessons Learned

<u>The importance of technical consideration in the basic design:</u>

Aloburo purifying plant was planned with slow filtration method. However, after the

completion of the project, it became apparent that the plant could not sufficiently treat the raw water when it rained much during the rainy season. Therefore, EMAPA-I had to install rapid filtration by their own budget. Slow filtration method was selected assumably because operation was easier and operational cost was relatively lower without chemicals. It would be also because sample raw water for planning was not taken during the season of most severe rain. Therefore, in basic design study, they should have considered the fluctuation in the quality of raw water and had repeated discussion for technical aspects with EMAPA-I.