No.

Ex-Post Evaluation Report of Japanese ODA Loan Projects 2008 (Sri Lanka, Pakistan)

November 2009

JAPAN INTERNATIONAL COOPERATION AGENCY

KAIHATSU MANAGEMENT CONSULTING INC.

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Preface

Ex-post evaluation of ODA projects has been in place since 1975 and since then the coverage of evaluation has expanded. Japan's ODA charter revised in 2003 shows Japan's commitment to ODA evaluation, clearly stating under the section "Enhancement of Evaluation" that in order to measure, analyze and objectively evaluate the outcome of ODA, external evaluations conducted by experts shall be enhanced.

This volume shows the results of the ex-post evaluation of Japanese ODA loan projects that were mainly completed in fiscal year 2007. The ex-post evaluation was entrusted to external evaluators to ensure objective analysis of the projects' effects and to draw lessons and recommendations to be utilized in similar projects.

The lessons and recommendations drawn from these evaluations will be shared with JICA's stakeholders in order to improve the quality of ODA projects.

Lastly, deep appreciation is given to those who have cooperated and supported the creation of this volume of evaluations.

November 2009
Atsuo KURODA
Vice President
Japan International Cooperation Agency (JICA)

Disclaimer

This volume of evaluations shows the result of objective ex-post evaluations made by external evaluators. The views and recommendations herein do not necessarily reflect the official views and opinions of JICA.

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Table of Contents

Sri Lanka

Greater Colombo Flood Control and
Environmental Improvement Project Phases (II) (III)

External Evaluator：Tomoko Tamura
(Kaihatsu Management Consulting Inc.)

Field Survey: From February 2009 to April 2009

1． Project Profile and Japan's ODA Loan

Map of project area
(Entire Sri Lanka)

An improved drainage in Kaudana area

1.1 Background

Sri Lanka is an island country located 30km southeast of India. The total area of the country is approximately 0.8 times the size of Hokkaido, Japan. The target area of the project, Greater Colombo, covers Colombo City (area of Colombo Municipal Council), which is the largest commercial city in the country, and the area of four surrounding local authorities. The target area has a total extent of 104 km^2 and population of 1.2 million[1]. The population size is similar to that of Saitama City, Japan, and the area extent is similar to the total area of Setagaya-ku and Nerima-ku in Tokyo, Japan.

Greater Colombo has been vulnerable to flooding, as most of its area consists of low-lying land, which is less than 6 meters above sea level, and some of the areas of less than 1 meter above sea level, which had functioned as "retention areas" to keep rainwater temporarily, were reduced by the need for land-fillings for development activities. Citizens of the area have suffered from frequent floods every year, and their economic and social activities have often been interrupted by inundation.

1.2 Objective

The objective of this project is to mitigate flood damages by improving old or undeveloped drainages in the most affected area (five in Colombo Municipal Council (CMC) area and two in Dehiwala Mount Lavinia Municipal Council (DMMC) area), thereby contributing to the improvement

[1] Census of population and housing 2001, Department of census and statistics, Sri Lanka.

of the living environment of the area. Additionally, the phase II[2] aimed at improving the living standards of low-income communities in the project area through provision of basic infrastructure, such as water-supply, sewerage system and electricity-supply facilities.

1.3 Borrower/Executing agency Democratic Socialist Republic of Sri Lanka/ Sri Lanka and Reclamation and Development Corporation：SLLRDC

1.4 Outline of the Loan Agreement

Approved amount/ Disbursement amount	(II)：4,367 million yen/ 3,548 million yen (III)：6,180 million yen/ 5,874 million yen
Exchange of Notes/ Loan Agreement	(II)：July 1994/ July 1994 (III)：October 1996/ October 1996
Terms and Conditions -Interest rate, Repayment Period, (Grace period) -Procurement type	(II)：2.6%, 30 years (10 years) (III)：2.1%, 30 years (10 years) -General untied
Final Disbursement Data	(II)：October 2001 (III)：December 2005
Main Contractor	(II)：Kajima Corporation (Japan)/ Keangnam Enterprises, Ltd. (Korea) (III)：Jilin International Economic & Technical Corporation (China), Geo-Engineering Corporation (China)
Main Consultant	(II)：Nippon Koei Co., Ltd（Japan） (III)：Nippon Koei Co., Ltd（Japan）/ WS Atkins International Ltd.
Feasibility Study (F/S), etc.	1993 F/S: SLLRDC

2. Evaluation Results (Rating : C)

2.1 Relevance (Rating: a)

This project has been highly relevant with Sri Lanka's national policies and development needs at the same time of both the appraisal and ex-post evaluation; therefore relevance is high.

2.1.1. Relevance to national policies

At the time of the project appraisal, flood control was given priority in Sri Lankan national policies. The "National Environment Action Plan (1992-96)" was the guiding plan for implementing flood control.

[2] "Greater Colombo Flood Control and Environmental Improvement Project Phase II" hereinafter referred to as "the phase II" and "Greater Colombo Flood Control and Environmental Improvement Project Phase III" referred to as "the phase III".

Flood control was still given priority in the national policies at the time of the ex-post evaluation. "Mahinda Chintana (2006-2016)", a national development policy plan of the present government, specifies the implementation of active flood mitigation measures.

2.1.2. Relevance to sector policies

At the time of the project appraisal, flood control in the Greater Colombo area was identified as the most urgent issue in the policies of the urban environmental and flood control sector. The government developed its "Metropolitan Environmental Improvement Programme (MEIP)[3]," and was actively involved in flood mitigation measures in Greater Colombo.

Flood control was identified as an urgent issue in the policies of the urban environmental and flood control sector at the time of the ex-post evaluation as well. SLLRDC has been implementing flood mitigation measures in the area continuously based on the "Study on Storm Water Drainage Plan for the Colombo Metropolitan Region" formulated in 2003 by a JICA Expert Team[4].

2.1.3. Relevance to needs

There was urgency and a critical need for flood control in the target area at the time of the project appraisal. The level of inundation damage in the five areas of the phase II was the most serious within the area of CMC. In addition, the level of inundation damage in Attidiya, one of the two areas of the phase III, was the most serious in Greater Colombo. It was advised that drainages in Kaudana, another area of the phase III, should be improved together with those in Attidiya, as they belonged to the same drainage system.

Low-income families were living along the open drainage in the Serpentine area of the phase II. There was an urgent need to improve their living conditions by provision of basic infrastructure, such as piped water- and electricity-supply facilities.

There was a critical need for flood control in the target areas at the time of the ex-post evaluation as well, as the area had become further urbanized and more populated. Living conditions in the area along the drainage canal in Serpentine have been improved to a certain extent; however, as well as in St. Sebastian, which is also one of the target areas of the phase II, there is still significant need to improve the sanitation conditions there.

2.2 Efficiency (Rating: a)

The implementation period of the phase II was longer than planned while that of the phase III was carried out almost as planned. The total period of these projects was slightly longer than expected. The project cost was lower than that of planned for both phases II and III. If taking only these factors into consideration, the rating for effectiveness could have been a "b". However, it was finalized as an "a", taking into consideration the fact that the phase III had created several additional outputs, such as additional civil construction works and implementation of the Integrated Environmental

[3] The Programme aimed at flood control of Greater Colombo region, improvement of living standard of the poor families, improvement of solid waste management, improvement of sewerage system and improvement of environment of Beira Lake.

[4] SLLRDC implemented the dredging and cleaning of drainages in the Kolonnawa area and the construction of the Mutuwel Tunnel recently based on the JICA Study. Currently, SLLRDC is participating in the "Lunawa Emviromental Improvement and Community Development Project", which is implemented with the assistance of an ODA loan from JICA.

Management Programme, of which necessity was identified during the course of project implementation.

2.2.1 Outputs

"Civil construction", "Community Development Programme", "Procurement of O&M equipment" and "Consulting services" were the four planned output components of the projects. In addition to these, the "Integrated Environmental Management Programme" was conducted under the phase III. Achievement of each component is described below.

(1) Civil construction

As shown in Tables 1 and 2, improvement of the five drainage systems under the phase II and the two systems under the phase III was conducted as planned. For easy operation and maintenance of the system, small scale underground drainages, including underground drainage pipes and underground box culverts, were replaced by open drainages or side drains in the detailed design of the phase III. Construction work was done according to the revised designs.

Table 1 Planned and Actual Outputs of the phase II

Name of drainage system	Plan at the time of project appraisal (total extension)	Actual (total extension)
St. Sebastian 2	Underground drainage pipes and box culvert and side drains（1,074m）	Underground drainage pipes and box culvert and side drains (1,449m)
Dematagoda	Underground box culvert (563m)	Underground box culvert (533m)
Unity Place	Underground drainage pipe (850m)	Underground drainage pipe (835m)
Torington West	Underground box culvert and pipe (2,469m)	Underground box culvert and pipe (2,049m)
Serpentine	Upgrading of existing open drainage (widening and deepening of the drainage and heightening of the banks) (1,686m)	Design changes adopted. Along the middle of the drainage length, where a lot of houses of low-income families were lined close together, the widening and deepening of the drainage were not conducted. Instead, flow in the upper system was diverted through a newly constructed underground box culvert in the upstream of the drainage. (1,877m)

(Source: Final Design Report and Project Completion Report of the phase II)

Table 2 Planned and Actual Outputs of the phase III

(Unit : m)

Items	Attidiya scheme		Kaudana scheme	
	Plan	Actual	Plan	Actual
Underground drainage pipes	27,840	2,603	14,935	460
Underground box culverts	4,020	3,527	390	0
Open drainages	0	9,503	0	3,612
Side drains	2,590	52,773	3,090	20,050

(Source: Project Completion Report of the phase III)

As mentioned earlier, several additional works, of which necessity was identified during project implementation, were conducted under the phase III through the balance of the fund. By the additional works, the remaining areas of the drainages in the upper stream of the two drainage systems were improved. These drainages were not included in the original scope of the projects due to the limitation of funds. The walls of several open drainages were strengthened with concrete trough or wet masonry. The Waras Ganga (Waras River), which is located downstream of the two drainage systems, was dredged. An irrigation anicut in the river was removed, and a bridge was constructed.

Improvement of the drainages in upper stream was conducted to prevent local flooding in the area. Strengthening of walls with concrete trough was conducted to improve efficiency of maintenance. Deposits and anicut in the Waras Ganga were blocking the flow of the river, and there was a risk that discharged water from the drainage systems improved by the project would stagnate at that point. Dredging of the river and removal of the anicut were conducted to reduce such risk. A new bridge was constructed in order to ensure that people living in the community around the river could have convenient travel and transport access, even after the removal of the anicut.

It was confirmed by the external evaluator during site inspections that these additional works contributed to the realization of the expected effects of flood control in the target area of the project.

Open side drains with slab lids for easy operation and maintenance (Attidiya)

Underground drainage pipe at Unity Place

(2) Integrated Environmental Management Programme

The “Integrated Environmental Management Programme”, of which necessity was identified during a course of project implementation, was conducted additionally under the phase III as available funds remained in the balance of the budget of the project. The major activities of the programme were as follows:

- Situation analysis of water quality and environment of the target area and water quality monitoring
- Construction of community-based solid waste management centers
- Quality improvement of industrial waste water
- Solid waste management programme
- Improvement of quality of domestic waste water and construction of sanitation facility
- Clean up campaigns and awareness programme

It is considered that the programme has been contributing to the improvement of the environment of the area, in light of the fact that DMMC has been conducting recycling programme and awareness

creation programme and that the community-based solid waste management centers and sanitation facility constructed under the programme is presently being used as well.

Clean-up campaign

Auditing of industrial waste water

(3) Community Development Programme

The Community Development Programme planned under the phase II was conducted only partly. The reasons for this incompletion could not be identified, as SLLRDC does not have any documents explaining the reasons. The TOR for the consulting services of the phase II stipulated that the Community Development Programme was to be planned and implemented not by the team providing consulting services of the phase II, but by the experts, who were in charge of the resettlement programme, on the team providing consulting services for the "Greater Colombo Flood Control and Environmental Improvement Project phase I", which was implemented in parallel with the phase II. There is no record to show how the experts in the phase I contributed to the Programme; however, SLLRDC deemed that the Programme was not completely implemented as the project itself did not have the necessary allocation of human resources with expertise.

(a) Programme for families to be relocated

It was planned to implement vocational training and provide loans for an income generation programme by introducing a "community development fund" for 41 households in Serpentine area, which were to be relocated. None of these activities were implemented.

(b) On-site upgrading for families living along the canal

It was planned that water supply and electricity would be provided for 400 households living along the drainage in Serpentine area. However, the plan was not implemented. The provision of sewerage connections for several houses, improvement of an O&M road of the drainage and construction of a public toilet were conducted under the component of civil construction work.

(4) Procurement of equipment for operation and maintenance

The procurement of equipment was implemented almost as planned with minor adjustments in the selection items after reviewing the needs.

(5) Consulting Services

The TOR of the consulting services for the phase II included a review of the F/S and supervision

of civil works of the target five areas, a review of the F/S of the other urgent areas[5], water quality monitoring, development of environmental conservation action plans and capacity building of SLLRDC. The consulting services of the phase III included detail design of the two target areas, support in the tendering process of the main civil works, supervision of civil works and water quality monitoring.

Consulting services of both the phase II and III were conducted as planned. Table 3 below shows the planned and actual MM of the services. The total MM of the phase II and III in actuality was slightly fewer than the planned MM.

Table 3 Planned and Actual MM of the Consulting Services

	Plan		Actual	
	Foreign	Local	Foreign	Local
Phase II	160MM	378MM	148MM (93%)	313MM (83%)
Phase III	245MM	456MM	252MM (103%)	488MM (107%)
Total	405MM	834MM	400MM (99%)	801MM(96%)

(source：Project Completion Reports)

(6) Project period

The implementation period of the phase II was planned as 63 months, i.e. from July 1994 to September 1999, and that of the phase III was planned as 86 months, i.e. from October 1996 to November 2003. The total period of implementation of the phases II and III was planned as 149 months. The actual implementation period of the phase II was 84 months, i.e. from July 1994 to June 2001, and that of the phase III was 87 months, i.e. from October 1996 to December 2003. The total actual implementation period of the phases II and III was 171months, which is 114% that of the original plan and slightly longer than expected. The actual implementation period of the phase III was 101% that of the original plan, which is only one month longer than expected. However, the actual implementation period of the phase II was 133% that of the original plan, which was 21 months longer than expected. The main reasons for the delay in the phase II were as follows:

- During the course of procurement of a civil contractor, detailed investigation of and re-evaluation for one of the contractors which applied to the procurement became necessary, as the technical level of the contractor was in question.
- The evaluation committee had to deal with a law suit filed by an unsuccessful civil contractor.
- There were not enough applicants for procurement of O&M equipment. For the first tender call, there was only one applicant for some packages. Therefore, the procurement method was changed to an item-wise tender from a package-wise tender in order to realize a proper competitive bidding. However, there were still no applicants for some items for the second tender call. Eventually, tenders had to be called three times in total.

[5] Colombo Municipal Council area, which have serious inundation damages and were not included in the target area of the phase II, Dehiwala Mount Lavinia Municipal Council area and Moratuwa Municipal Council area and so on.

2.2.3 Project cost

The project cost for the phase II was planned as 5,173 million yen, including the JICA loan portion of 4,367 million yen and that of the phase III was planned as 7,859 million yen including the JICA loan portion of 6,180 million yen. The actual project cost was 4,234 million yen, including the loan portion of 3,548 million yen, and 7,640 million yen, including the loan portion of 5,875 million yen, for the phase II and III respectively. The total cost of the phase II and III was 91% that of the original plan thus lower than planned. Actual costs vs. originally planned costs were 82% and 97% for the phase II and III respectively. The said cost of the phase III includes the cost of the additional works. The effective awarding of contracts by international competitive bidding was the main factor that contributed to the reduction of the project cost.

2.3 Effectiveness (Rating: b)

The effectiveness of the project is moderate, as considerable degree of inundation damages remain in several target areas, although the damages were reduced in every area. Inundation damages remained mostly in the areas of the phase II, mainly because secondary drainages and side drains in shanties[6] in the areas, which were not included as targets of the project, had not been improved adequately by responsible authorities, namely Colombo Municipal Council and Road Development Authority respectively, although population density in the areas had became higher. Lack of adequate operation and maintenance of the drainage systems of the phase II, due to the absence of a responsible authority, which will be explained later, is another main cause for the remaining of inundation damages.

2.3.1 Operation and effect indicators

The effectiveness of the projects could not be examined by operation and effect indicators, as SLLRDC and local authorities in the target areas did not have historical data on functions of the drainage systems, such as water levels and water discharge amounts. Thus the external evaluator could not determine whether the projects had achieved the expected levels of fold control by examining water levels of the drainages and amounts of water discharged per second on the days of heavy rain, which tended to occur once every two years[7].

The effectiveness of the projects could also not be examined by using inundation damages as an effect indicator, as neither SLLRDC nor local authorities kept any records of the damages or complaints in the target areas.

Taking the above mentioned limitations into consideration, the external evaluator determined the effectiveness of the projects by referring to a questionnaire survey conducted by the external evaluator, with samples drawn from 250 households randomly selected in the target areas. The main findings of the survey are shown below.[8]

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[6] "Shanties" are the areas where houses of low-income families are lined up close together.

[7] The design report of the phase II and the project appraisal document of the phase II said that the drainage systems would be designed with a return period of two years, which means the facility would have a registrant against heavy rainfall expected to occur once every two years. This should be considered as the "expected level of flood control" of the projects. The possible heavy rainfall every two years is defined as "rainfall more than 72mm per hour"

[8] It should be noted that the findings of the questionnaire survey do not represent measured data, but show the summary of the replies given by the respondents. During the survey, enumerators tried their best to obtain accurate information from the respondents by discussing the questions with the respondents; however, the replies depended on the respondents' memories, knowledge and perception.

(1) Changes in frequency, depth and duration of inundation

Table 4 shows changes in frequency, depth and duration of inundation based on responses from 228 sample households of the questionnaire survey[9]. All of these 228 households, out of 250 sample households in total, had experienced inundation of their houses before the project. It was ascertained that inundation damages were reduced in every aspect in all the areas. The target areas of the phase III show remarkable improvement, although St. Sebastian 2 and Torington West in the phase II still have inundation to some extent.

Table 4 Changes in Frequency, Depth and Duration of Inundation Before and After the Projects

		Phase II					Phase III	
		Serpentine	St. Sebastian 2	Dematagoda	Torington West	Unity Place	Attidiya	Kaudana
Frequency of inundation (times/year)	Before	2.6	3.0	2.1	4.7	1.9	3.4	3.5
	After	0.8	1.8	0.7	2.2	0.7	0.5	0.2
Inundation depth (cm)	Before	42	35	24	60	27	28	23
	After	9	19	5	21	4	3	1
Inundation duration (hours)	Before	123.2	68.5	46.9	104.7	18.3	7.5	16.6
	After	33.4	43.4	5.2	20.6	1.0	1.1	0.3

(Source: Questionnaire Survey)

Flooding before the project (1998)
(De Soysa road in Attidiya : phase III)

Inundation damages were reduced drastically after an underground drainage was constructed by the project (De Soysa road)

(2) Beneficiaries' perception of reduction of inundation damages and its reasons

Figure 1 shows the replies in the questionnaire survey to the question of "Were inundation damages to your house reduced after the project?" Most of the respondents in the areas of the phase III and Unity Place in the phase II acknowledged reduction of inundation damages after the project; however, 19% – 47% of the respondents in other areas did not acknowledge the reduction of inundation. On average, 78% of the respondents acknowledged the inundation reduction.

[9] The figures in Table 4 show averages of the samples of the areas; therefore, they do not represent figures of every area, where localized flooding remains.

(Unit : %)

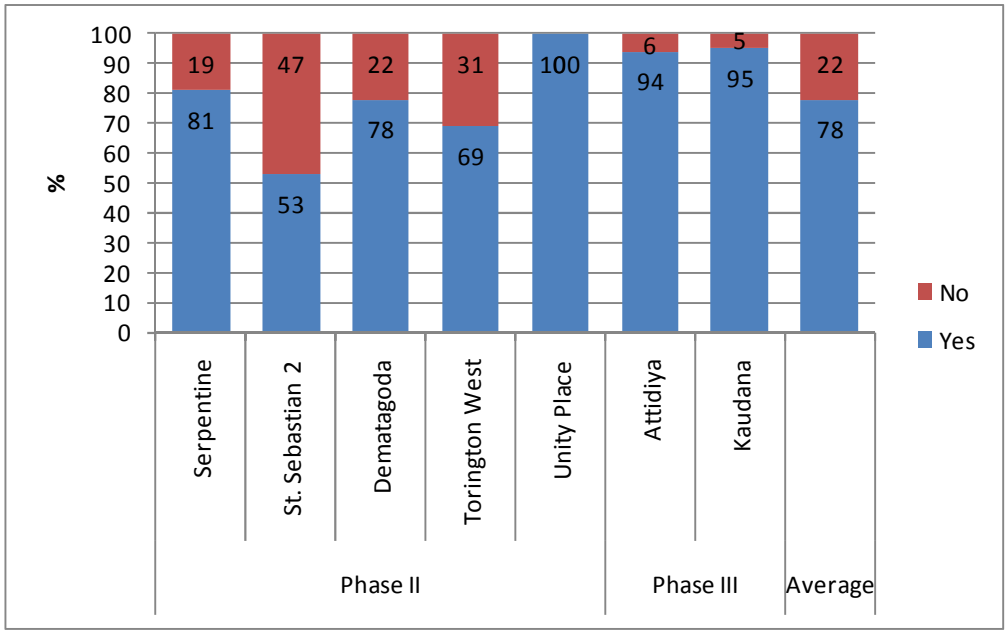


Figure 1 "Were inundation damages to your house reduced after the project?"
(Source: Questionnaire Survey)

93% of the respondents who replied positively to the above-mentioned question (total of 178 households) mentioned that the reduction of inundation was realized because of the "development of nearby drainages", which confirmed that the reduction was effected owing to the projects. Effects of the phase III are more significant because not only main drainages but also secondary drainages and side drains were developed in the phase III. Regular operation and maintenance of the drainage systems conducted by DMMC also contributed to the significant improvement.

(3) Reasons for remaining of inundation damages

After the questionnaire survey, engineers representing SLLRDC and the external evaluator visited the area, where inundation damages remain to some extent, and analyzed main causes of the damages. The following is the result of the analysis:

<Secondary drainages, storm water drainages and side drains were not developed adequately>

- Although drainages developed by the projects are functioning most of the time, flooding still occurs because secondary drainages, storm water drainages and side drains are not properly functioning as they are old or have not been developed adequately. This situation was observed mostly in shanty settlements in the areas of phase II, particularly St. Sebastian 2, Dematagoda and Serpentine.
- In the phase II, it was expected that secondary drainages and side drains would be developed by CMC and by Road Development Authority, while the main drainages would be developed by the project (see the Figure 2)[10]. However, it was observed during the ex-post evaluation that the above-mentioned objectives had not been realized. As a result, waste, storm and road surface

[10] An appraisal document mentioned about the assumption, however, it was difficult to say whether CMC and Road Development Authority had agreed with the assumption, as there was no document to show it.

water are not being treated properly, making some areas vulnerable to flooding.

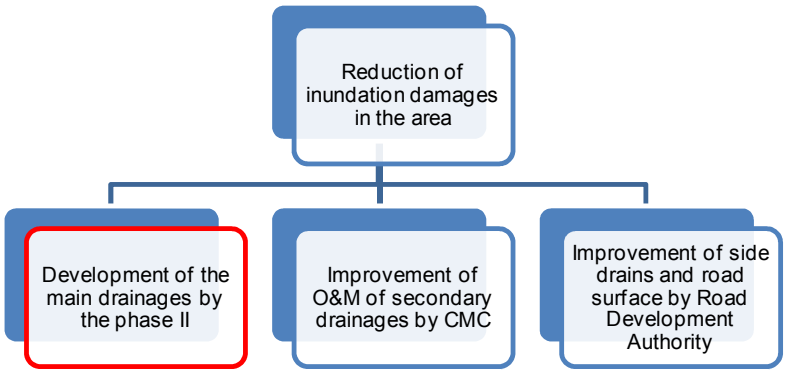


Figure 2 Expected measures for reduction of inundation damages at the time of project appraisal (phase II)

These problems have become more serious as the areas have now a lot of unauthorized construction, with houses and shops constructed on the drainages and drains, and the areas have become more over-crowded by illegal occupations. Measures taken by relevant authorities, such as local authorities, to prevent the above-mentioned problems have not been effective enough. In this way, the areas still suffer from flood and inundation damages, as the expected integrated measures for flood control were not implemented adequately.

<Inadequate O&M of the drainages developed by the project>

- The open drainage in Serpentine area, which was renovated in the phase II, is often overflowing, causing flooding during heavy rains, as the drainage, especially its downstream sections, is blocked by garbage and deposits.
- The underground drainage at Torington West (Slaiman Terrace), which was constructed in the phase II, sometimes overflows and causes flooding during heavy rains. The overflow seems to be happening mainly because sediment deposits built up where the underground drainage flows into an old drainage have not been removed.

Drainages with garbage
(Open drainage in Serpentine area)

<Mixed factors>

- Several houses around the open drainage in Sattisara Mawata in Attidiya, which was constructed by the phase III, still experience inundation once or twice a year. Possible reasons for the inundation are: elevation of the said houses is relatively low, deposits and garbage stuck at the iron grill (trash rack) in the drainage were not removed regularly, and the capacity of the drainage at this place may not be adequate to treat heavy flow from upstream.
- Shanties along Torrington Avenue in Torington West in the phase II often experience flooding

when the Torington South Canal, which runs along the east side of the area, overflows during heavy rains because the capacity of the Canal has been reduced due to the lack of dredging for several years. In addition to that, the area is vulnerable to flooding, as side drains and secondary drainages are either old or undeveloped and not functioning properly.

2.3.2 Results of Economic Internal Rate of Return (EIRR)

Economic Internal Rates of Return (EIRR) for the phases II and III at the time of the project appraisal were 9.1% and 14.1% respectively. The rates were calculated with the following conditions:

- Cost: Cost of the project and O&M cost for the facility developed by the project
- Benefit: Reduction of inundation damages and increase of land value
- Project life: 30 years after the completion of the projects

The EIRR for the phases II and III re-calculated at the time of the ex-post evaluation with the same conditions mentioned above were 19.3% and 7.5% respectively. As for the phase II, although the delay in the completion of the project gave a slight negative impact on the EIRR, the reduction of the project cost largely contributed to an increase in the EIRR. As a result, the EIRR was increased. As for the phase III, the EIRR was reduced since the creation of benefit of the project was delayed as a whole, although the planned civil works were completed within the expected time period. This was because, in some places, benefits were not created until the completion of the additional works, which opened up the entire drainage systems, while benefits were gradually created before that in other places.

2.4 Impacts

2.4.1. Impacts to project areas and target communities

(1) Improvement of living environment due to reduction of flooding

As Figure 3 shows, the results of the questionnaire survey indicate that 52% and 76% of the beneficiaries of the phases II and III respectively replied positively to the question: “Was the living environment around your house improved after the project?” Respondents who replied negatively to the question gave examples of environmental problems they still have, such as, garbage dumping in drainages and road sides nearby their houses, unpleasant odors and mosquito breeding in the drainages.

(2) Reduction of diseases caused by inundation

- Statistical analysis on reduction of diseases caused by inundation could not be carried out as institutions of public health in the target areas did not have necessary data on the numbers of patients contracting the relevant diseases before and after the projects. Recent data on the numbers of patients hospitalized with Dengue fever in the target areas did not show significant improvement after the projects. Dengue fever is observed by public health officers working in the area to occur more frequently in communities living along drainages and canals.

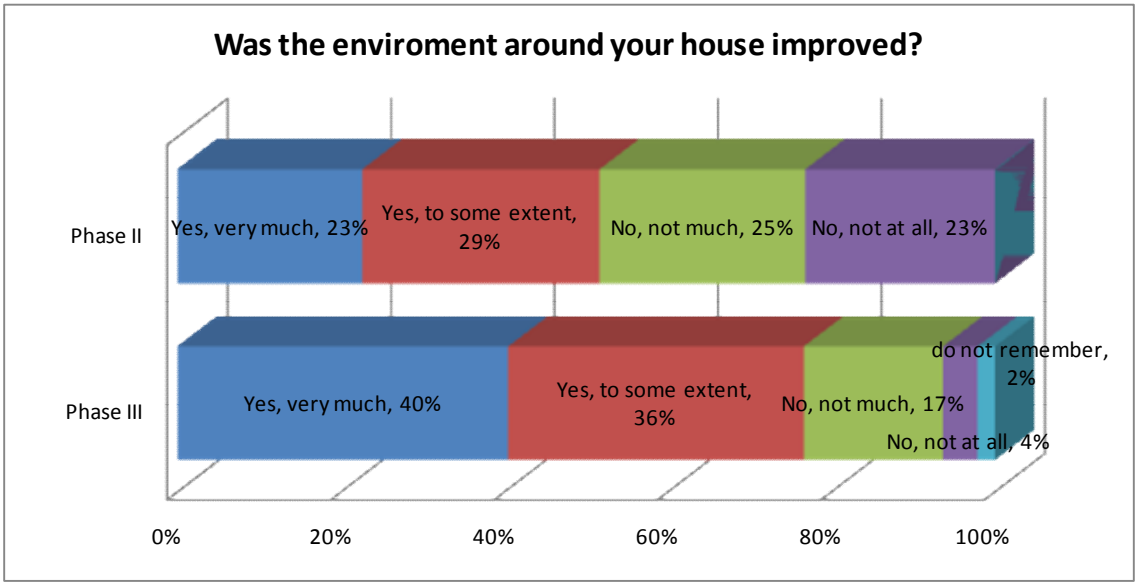


Figure 3 Improvement of Living Environment

(Source: questionnaire survey)

- In the questionnaire survey, 52% and 62% of the beneficiaries of the phases II and III respectively replied positively to the question: "Was the health situation of your family improved after the project? Reduction of inundation damages contributed to the improvement of the health situation of the families to some extent; however it was not a dominating factor, as only 62% of the beneficiaries replied positively to the above-mentioned question; while more than 95% of them acknowledged reduction of inundation damages in the phase III (see Figure 1). The beneficiaries explained in the questionnaire survey that in addition to reduction of inundation damages, regular garbage collection, prevention of odors and mosquito breeding in drainages by improving water quality were necessary to improve the health situation of the families.

(3) Promotion of economic activities by flood mitigation

The case studies conducted for a factory, a hospital and a school in the target areas indicated that the project contributed to the reduction of inundation damages and the improvement of the operation of the institutions.

(4) Reduction of cleaning workload after inundation

It was found by the questionnaire survey that households in the areas spent 17 hours on average for cleaning after an inundation, and 69% of them replied positively to the question: "Was your cleaning workload after inundation reduced after the project?" These replies include "reduced significantly (42%)" and "reduced to some extent (27%)". At the time of project appraisal, it was expected that the project would reduce the "workload of female members of families" on the assumption that female members mainly engage in cleaning work. However, the questionnaire survey revealed that both male and female family members engaged in cleaning work, as the most common reply to the question of "Who engaged in cleaning work?" was "husband" and then "wife", "son" and "daughter".

(5) Reduction of hindrances to commuting and schooling

According to the questionnaire survey, 85% of the households had difficulty in commuting on days of heavy rain due to frequent floods before the project. However, the number was reduced to 43% at the time of ex-post evaluation. In addition, 85% of the households had a difficulty in sending their children to school on days of heavy rain before the projects; however this was reduced to 39% at the time of ex-post evaluation.

2.4.2. Impacts on the natural environment

(1) Deterioration of water quality of the drainages

Water in the open drainage in Serpentine in the phase II area is polluted by garbage, deposits and sewerage, and is causing sanitation problems, such as odors and breeding of mosquito, to the residents living along the drainage. In addition to the absence of regular cleaning of the drainage, discharge of sewerage overflow from the nearby Prison Headquarters into the drainage at night and garbage dumping by the residents living along the drainage are the main reasons for deterioration of the water quality[11].

In the phase II, the "Environmental Conservation Action Plan" was developed for CMC and the communities with an aim of preventing garbage dumping into the drainage. However, it is not known to what extent the plan was implemented. Water quality tests were conducted in the Phases II and III, but no improvement was observed during the project implementation periods. Since the completion of the projects, testing has not been done.

(2) Mosquito breeding by stagnation of water in side drains

At the time of the questionnaire survey, residents in several areas of the phase III indicated the problem of mosquito breeding in side drains, where water is stagnated. They believed that although they clean the drains and remove deposits often, water is stagnated in the drains because declination of the drainage is not sufficient. However, the problem was not recognized at the time of the joint inspection, which was conducted when SLLRDC handed over the responsibility of O&M to DMMC. There is a need to identify the reasons for stagnation by conducting a technical investigation and then to take necessary actions to solve the problem.

2.4.3. Resettlement and land acquisition

The total number of households to be resettled was planned as 82, 41 households each for Phases II and II. The Project Completion Report of the phase II noted that 37 households were resettled, and the same report for the phase III does not mention anything about the resettlements.

At the time of the ex-post evaluation, basic information about the resettlements, such as lists of the households resettled, addresses of the original and new residences and procedures for resettlement, was not available and staff in charge of the resettlements at the time of implementation had left SLLRDC due to retirement or changes in their jobs. Therefore, the external evaluator could not confirm the actual number of households resettled and procedures for resettlement or examine the

[11] Sewerage from the Prison Headquarters is directly connected to the drainage. The residents explained that the reason they dump garbage in the drainage is because there is no regular garbage collection by CMC.

current living environment of the affected families.

2.5. Sustainability (Rating: c)

Sustainability is evaluated to be low, as it is not clear whether the responsibility for the O&M of the drainages of the phase II belongs to SLLRDC or CMC, and O&M work for the drainages has been conducted only sparsely, although O&M of the drainages developed by the phase II are conducted satisfactorily to some extent.

2.5.1. Executing agency

(1) Structural aspects of operation and maintenance

The O&M of the drainages developed by the phase II was planned to be done by SLLRDC at the time of project appraisal. The O&M was actually conducted by the organization for several years after the completion of the project. Thereafter, in 2007, SLLRDC considered that it was more appropriate for CMC to conduct the O&M work, and they had several discussions and a joint inspection with CMC. During the series of discussions, CMC agreed to undertake the O&M work. However, after that, CMC did not go through necessary procedures for taking over the work. Therefore, currently, it is not clear whether the responsibility for the O&M for the drainages belongs to SLLRDC or CMC.

Considering various factors, it seems that CMC has a certain responsibility for the O&M of the drainage; however, the project appraisal documents do not mention whether the roles of CMC in this regard were duly discussed or not. According to the interviews conducted with the stakeholders of the project, it was found that CMC had not been involved in the project adequately at the time of implementation. As a consequence, CMC does not have a sense of ownership of the drainages and its O&M work. This hindered the smooth transfer of the responsibility for the O&M, as mentioned above.

Phase III utilized the lessons learned from the phase II. Several measures were taken during the project implementation period for a smooth transfer of the responsibility for the O&M of the drainages developed by the phase III from SLLRDC to DMMC. As a result of these measures, responsibility of the O&M was taken over by DMMC after the completion of the project, without any problem. Currently, the newly established “Drainage Unit” of DMMC is implementing the O&M.

(2) Technical aspects of operation and maintenance

So far, there have been no particular technical problems for both Phases II and II with regard to the O&M of the drainages.

(3) Financial aspects of operation and maintenance

There have been no particular issues on the financial aspects of O&M of the drainages for both phases II and III. As the amount of funds disbursed by the Treasury to SLLRDC was often inadequate for the organization to implement the O&M work for the canal and drainage networks, it has been spending its own funds as well. During the years 2007 and 2008, the organization spent a

large amount only for the O&M. Except for those years, the amount of expenditure for the O&M on average in recent years has been around 80 million rupees, which is equal to around 65 million Japanese yen, using the exchange rate at the time of the ex-post evaluation. Most of the expenditure was for the O&M of the canals developed by the "Greater Colombo Flood Control and Environmental Improvement Project phase I". SLLRDC is of the opinion that around 10% of the total expenditure has been spent for O&M of the phase II.

DMMC has been allocating funds for the O&M of the drainages developed by the phase III on a priority basis. The O&M budgets have been increasing due to inflation. Currently, the Drainage Unit of the DMMC does not feel there are any problems in implementing the O&M work based on the present amount of allocation.

2.5.2. Current Status of operation and maintenance

The main tasks for O&M of the drainages of phases II and III are inspection of the drainages and cleaning of deposits and suspended solids in the water of the drainages.

The following are the tasks currently implemented for the drainages of the phase II:

- SLLRDC has been cleaning out deposits and suspended solids from the outfalls of the drainages, where the water of the drainages runs into canals, when necessary.
- CMC has cleaned the open drainage of Serpentine around once every two years[12].
- Neither inspection nor cleaning of the underground drainages in Dematagoda, St. Sebastian-2, Unity Place and Torington West has ever been conducted after the completion of the project.

As for the drainages developed by the phase III, the Drainage Unit of DMMC is conducting the O&M work, mainly cleaning, according to the annual plans. The Unit also removed deposits on a priority basis in response to complaints made by the residents. Repair works have also been conducted; for example, broken lids on the side drains were replaced by new ones.

The results of the questionnaire survey showed that 65%–83% of the respondents were dissatisfied with the cleaning currently conducted by the local authorities and relevant government institutions. Residents of the phase II areas were especially unhappy about the current situation. For example, the residents in Serpentine believe that it is absolutely not sufficient to clean the drainage only once every two years.

3. Conclusion, lessons learned and recommendations

3.1. Conclusion

Relevance and efficiency of the projects are high and effectiveness is moderate; however some problems have been observed in terms of sustainability. In light of the above, this project is evaluated to be fairly satisfactory..

3.2. Lessons learned

[12] CMC cleaned the drainage in Serpentine in response to frequent complaints made by residents of the area, although it considers that it does not have responsibility for O&M of the drainage.

(1) It is unclear which institution has responsibility for O&M of the drainages of the phase II. Therefore, cleaning of the drainages has not been implemented adequately. This is one of the factors hindering the effectiveness of the project in the areas of the phase II. Considering the fact that not only SLLRDC, but also local authorities have responsibility for O&M of the drainages, it is necessary for projects on flood control to duly study roles and responsibilities of the local authority in the area regarding the O&M. It is also necessary for the projects to assist organizational and technical capacity building of the local authorities, if needed, in order to establish an efficient system of O&M.

(2) Effectiveness of the phase III, which implemented not only the main drainages but also secondary drainages and side drains, activities to improve water quality and environment, and dredging of the downstream of the drainages, was found to be higher than that of the phase II. It is necessary for a flood control project to adopt a comprehensive approach, which includes activities not only for main drainages but also for other related matters, such as development of secondary drainages and side drains.

(3) Based on the current situation of the open drainages developed by the project, it was recognized that an open drainage may create environmental and sanitary problems, if garbage dumping and deterioration of water quality of the drainage are not prevented. Therefore, for the construction or improvement of an open drainage, it is necessary to encourage the relevant local authority to conduct periodical garbage collections, not only during the project implementing period, but also after that, as well as urge superior authorities and the Ministry of Environment to conduct effective monitoring and follow-ups of the local authority.

(4) Evaluation of resettlement programme could not be conducted in the ex-post evaluation for both phases II and III due to the unavailability of information. An executing agency of a project that includes resettlement programme is advised to keep a list of the people resettled, addresses of old and new residences, resettlement procedures, etc, for a certain period, in order to follow up on the living conditions of the resettled people.

3.3 Recommendations

<To the executing agency>

(1) It is recommended that SLLRDC and CMC resume discussions about the transfer of the responsibility of the O&M of the drainages developed by the phase II, and promptly designate a responsible institution for the O&M. It is also suggested that the superior authorities of the two institutions, namely, the Ministry of Urban Development and the Ministry of Local Government, sufficiently facilitate and follow-up the above-mentioned process.

(2) If it is found that the above-mentioned transfer process will take a long time, it is advised that SLLRDC starts cleaning the underground drainages, which has never been done, and also start periodical cleaning of the open drainage, in consultation with the Ministry of Urban Development. CMC should cooperate in the above-mentioned clean-up work by SLLRDC by offering laborers or budget.

(3) In order to solve the sanitary problems caused by the open drainage in Serpentine, periodical cleaning of the drainage, regular garbage collection and continuous creation of awareness among

the community by strengthening the integrated efforts of the relevant institutions, mainly CMC, are needed. It is also advised that CMC and SLLRDC urge the Prison Headquarters to remove their sewerage connection to the drainage.

(4) For further reduction of inundation damages to the shanties in the phase II areas, collective efforts by CMC, SLLRDC and other officials are required to develop secondary drainages and side drains, create awareness among the community and control illegal occupation.

(5) DMMC is advised to enhance the progress management of O&M works and further promote regular inspections and cleaning.

(6) SLLRDC and other responsible institutions are advised to conduct technical investigations and take necessary actions to improve the situation for the particular places in the phase III areas, where frequent inundation remains (e.g., Sattisara Mawatha), and where discharged water is stagnated in the drains and causing mosquito breeding.

(7) SLLRDC and other responsible institutions are advised to implement inundation studies and measurement of water levels at selected observation points regularly in order to examine inundation damages and evaluate effects of flood control.

(8) SLLRDC is recommended to identify the households that were resettled by the projects and investigate whether they have any complaints.

<To JICA>

(1) It is recommended that JICA continues advising responsible Sri Lankan officials to designate a responsible institution for the O&M works of the drainages developed by the phase II and also monitor whether the transfer process is completed and an appropriate system for O&M work has been established.

(2) The target areas of the phases II and III are different and the effects of the projects do not have any continuity or relationships, although these projects have a common name. Therefore, there is no need to implement a combined ex-post evaluation for these two projects. As the project appraisal of the phase II was conducted around 15 years ago, and the project was completed around 8 years ago, it was not surprising that SLLRDC did not have sufficient and detailed documents of the project, and the officers of SLLRDC involved in the project did not remember precise details about the project at the time of the ex-post evaluation. Effects of the phase II had never been evaluated officially for the last 8 years until the ex-post evaluation was conducted, although there were several issues with regard to the sustainability of the effects of the project, such as the remaining of inundation damages and sanitary problem. With these factors taken into consideration, in order to implement more meaningful and efficient ex-post evaluations, it is recommended that the evaluation should be conducted no later than two years after the completion of each project, as defined in the rules of JICA, even though the names of the projects are the same, as long as there is no particular benefit in conducting a combined evaluation.

Comparison of Original and Actual Project Scope

Item	Original	Actual
(1) Project Output	**＜Civil construction＞** • Phase II : Improvement of the five target drainage systems • Phase III : Development of the two target drainage systems	**＜Civil Construction＞** • Phase II : Improvement of the five target drainage systems • Phase III : Development of the two target drainage systems with design changes taking the convenience of operation and maintenance into consideration • Additional works were conducted as follows: ▫ Improvement of the upper stream of the drainage system ▫ Dredging of Waras Ganga River, which is located downstream of the two drainage systems. ▫ An irrigation anicut in the river was removed and a bridge was constructed at a downstream location of Waras Ganga River.
	<Community development programme> • Programme for families to be relocated • On-site upgrading for families living along the canal	**<Community development programme>** • Programme for families to be relocated was not conducted • A part of on-site upgrading for families living along the canal was conducted
	<Procurement of equipment for O&M> • Vehicles and tools for cleaning of drainages	**<Procurement of equipment for O&M>** • Vehicles and tools for cleaning of drainages
	<Integrated Environmental Management Programme> • Not planned	**<Integrated Environmental Management Programme>** • Conducted as additional work
	<Consulting Services> (phase II) Foreign: 160MM, Local: 378MM (phase III) Foreign: 245MM, Local: 456MM	**<Consulting services>** (phase II) Foreign: 148MM & local: 313MM (phase III) Foreign: 252MM & local: 488MM
(2) Project period	• Phase II: July 1994 - September 1999 (63 months) • Phase III: October 1996 - November 2003 (86 months)	• Phase II: July 1994 - June 2001 (84 months)(133% vs. plan) • Phase III: October 1996 - December 2003 (87 months)(101% vs. plan)
(3) Project cost Phase II	Foreign currency: 3,330 million yen Domestic currency: 1,843 million yen (830 million rupees) Total: 5,173 million yen ODA loan portion: 4,367 million yen Exchange rate: Rs.1.0=¥2.22 (as of July 1994)	Foreign currency: 2,639 million yen Domestic currency: 1,594 million yen (1,009 million rupees) Total: 4,234 million yen ODA loan portion: 3,548 million yen Exchange rate: Rs.1.0=¥1.78 (Average between 1994 and 2001)
Phase III	Foreign currency: 3,899 million yen Domestic currency: 3,960 million yen (2,052 million rupees) Total: 7,859 million yen ODA loan portion: 6,180 million yen Exchange rate: Rs.1.0=¥1.93 (as of October 1996)	Foreign currency: 4,129 million yen Domestic currency: 3,511 million yen (2,317 million rupees) Total: 7,640 million yen ODA loan portion: 5,875 million yen Exchange rate: Rs.1.0=¥1.41 (Average between 1997 and 2005)

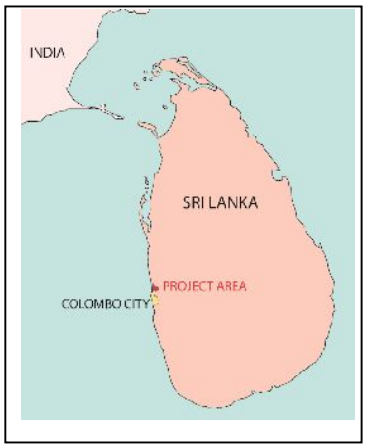
Sri Lanka

Towns North of Colombo Water Supply Project

External Evaluator：Tomoko Tamura
(Kaihatsu Management Consulting Inc.)

Field Survey: From February 2009 to April 2009

1. Project Profile and Japan's ODA Loan



Map of the project area
(Entire Sri Lanka)

Tower and pump house in Mahara distribution center

1.1 Background

Sri Lanka is an island country located 30km southeast of India. The total area of the country is approximately 0.8 times the size of Hokkaido in Japan. The target area of the project in Towns North of Colombo[13], has a total extent of 14.3 km^2 and a total population of 530,000. The population is similar to the population of Meguro-ku in Tokyo, and the extent of the area is similar to the area of Himeji City in Hyogo Prefecture in Japan.

Most of the residents of the target area used wells or common taps as only small-scale water supply systems from springs and wells or extensions of neighboring water supply systems were available in the area. Some wells in the area, especially in the industrial area, were contaminated by industrial waste water, and others in the coastal area were often contaminated by salt water. The area has a lot of industrial estates; however, the unavailability of stable water supply was an obstacle to production activities.

In this way, the absence of water supply was a burden for residents and a hindrance to economic development of the area. Therefore, it was urgently necessary to construct water transmission and distribution facilities and enhance water supply capacity in the area.

1.2 Objective

The objective of this project is to enhance the water supply capacity of Towns North of Colombo,

[13] "Towns North of Colombo" is not an administrative area of the government of Sri Lanka but an administrative area of the National Water Supply and Drainage Board. It is in Gampaha District and bordered on the south by Colombo City. The target area of the project was a part of the Towns North of Colombo. See the map in Annex 1 for details.

where there is increasing water demand, by constructing transmission and distribution facilities, thereby contributing to the industrial development and improvement of public health in the area.

1.3 Borrower/Executing agency

Democratic Socialist republic of Sri Lanka/ National Water Supply and Drainage Board (NWSDB）

1.4 Outline of the Loan Agreement

Approved amount/ Disbursed amount	5,308 million yen/ 5,122 million yen
Exchange of Notes/ Loan Agreement	May 1996/ October 1996
Terms and Conditions -Interest rate, Repayment Period, (Grace period) -Procurement	2.1%, 30 years (10 years) -General untied
Final Disbursement Date	February 2007
Main Contractor(Over 1 billion yen)	Beijing Municipal Engineering Corporation (China)
Main Consultant(Over 100 million yen)	Nihon Suido Consultants Co. Ltd.
Feasibility Study (F/S), etc.	1995 : Proposal : NWSDB

2. Evaluation Results (Rating: B)

2.1 Relevance (Rating: a)

This project has been highly relevant with national policies of Sri Lanka and development needs at the times of both appraisal and ex-post evaluation, therefore its relevance is high.

2.1.1. Relevance with national and sectoral policies

The Government of Sri Lanka implemented various water supply projects actively at the time of project appraisal. The target at that time was to provide piped water supply to all the population by 2000. The Project was listed as the first priority in the water supply master plan updated in 1991 and was identified as the most urgent task in the water supply sector.

The water supply was also a highly prioritized issue in national development policies at the time of the ex-post evaluation. The Government of Sri Lanka set the target of achieving a coverage of 85% of population with access to safe drinking water by 2015 and 100% by 2025 in line with the Millennium Development Goals. To achieve the targets, NWSDB has set the strategies to achieve pipe water supply coverage 40% of the total population in their corporate plan of 2007 – 2011.

2.1.2. Relevance with needs

The need for water supply services and urgency of its expansion were high in the target area at the time of project appraisal as well as the ex-post evaluation, as the population was increasing and industrialization was accelerating.

2.1.3. Relevance of the project planning

It was agreed at the time of the project appraisal that an overall review of the F/S, review of water demand for the entire Colombo North area, selection of the most urgent target area, determination of project scope and detailed design of the facility should be conducted by consulting services during the early stage of the project, before starting civil work. The reasons for this determination were as follows:

- There was a limitation on the amount of treated water supplied to Colombo North area at the time of appraisal. Therefore, water demand of the area should be minimized until an additional water source is ensured.
- Investment in the project should be minimized in order not to worsen the financial status of NWSDB, which was in need of further investment for the development of new water-sources in the future.
- Design criteria of maximum day demand and maximum hour demand specified in the F/S should be reviewed. Water demand in each distribution area and capacity of reservoirs and towers specified in the F/S should also be reviewed.

In this way, the loan agreement for the project was signed before a final decision of the project scope was made. This arrangement enabled the project to select the most urgent needs of the area, which was developing rapidly, whereas it had only limited negative influence on the progress of the project.

2.2 Efficiency (Rating: b)

Although the overall project cost was almost as planned, the project period was longer than planned; therefore efficiency of the project is fair.

2.2.1 Output

(1) Transmission and distribution facilities

As Table 1 shows, all the planned works for transmission and distribution facilities were conducted almost as planned. At the time of the change of the project scope, the anticipated scope was divided into two, “Stage I” and “Stage II”. Considering the limited amount of yen loans as well as the time period, it was decided that the project would implement only the work in “Stage I”. However, a part of “Stage II”, which was urgent, was also conducted under the project.

(2) Procurement of O&M equipment

Procurement of O&M equipment was conducted almost as planned, after a review of the needs of the O&M work.

Table 5 Comparison of planned and actual outputs

Item			Detail of the items		
			Temporary plan at the time of project appraisal	**Plan after the revision of project scope**	**Actual**
Transmission facility	Pump		50,000 m^3/day × 3 units	27,000m^3/day x 2 units	27,000m^3/day x 2 units
	Clear water storage		9,090 m^3	6,000 m^3	6,000 m^3
	Transmission main pipeline		From Ambatale water treatment plant to Church Hill Reservoir	From Ambatale water treatment plant to Church Hill Reservoir	From Ambatale water treatment plant to Church Hill Reservoir
	Ground reservoir		18,000 m^3	18,000 m^3	18,000 m^3
	Gravity transmission pipeline		From Church Hill Reservoir to the six distribution centers	From Church Hill Reservoir to the six distribution centers	From Church Hill Reservoir to the six distribution centers
Distribution facility	**Name of distribution centers**	**facility**	**Temporary plan at the time of project appraisal**	**Plan after the revision of project scope**	**Actual**
	Welisara	Tower	1,000 m^3	1,500 m^3	1,500 m^3
		Distribution network	20km	12km	10km
	Kandana	Reservoir	2,000 m^3	—	—
		Tower	1,000 m^3	1,000 m^3	1,000 m^3
		Pump	576 m^3/hour × 3 units	—	—
		Distribution network	36km	24km	27km
	Ragama	Reservoir	4,000 m^3	2,500 m^3	2,500 m^3
		Tower	1,000 m^3	1,000 m^3	1,000 m^3
		Pump	864 m^3/hour x 3 units	390 m^3/hour x 2 units	390 m^3/hour x 2 units
		Distribution network	74km	20km	17km
	Ja-Ela	Reservoir	2,000 m^3	450 m^3	450 m^3
			—		2500 m^3 (additional work)
		Tower	1,000 m^3	—	—
		Pump	604 m^3/hour x 3 units	—	—
		Distribution network	54km	14km	14km
	Mahara	Reservoir	3,500 m^3	—	6,000 m^3 (additional work)
		Tower	1,000 m^3	—	1,500 m^3 (additional work)
		Pump	936 m^3/hour x 3 units	—	—
		Distribution network	73km	—	8km (additional work)
	Total length of distribution network		257km	70km	76km

(Source: Project appraisal document, final design report and project completion report)

(3) Consulting Services

Review of F/S, detail design, supervision of construction and training were planned under the consulting services. The services were conducted as planned. Planned and actual MM of the services were somewhat different, as the actual MM was longer than the planned MM, due to extension of the project period.

- Plan: Foreign: 91MM, Local: 190MM
- Actual: Foreign: 101.3MM, Local: 270MM

2.2.2. Project period

The implementation period of the project was planned as 68 months, i.e. from October 1996 to May 2002. The actual period was 98 months, i.e. from October 1996 to November 2004. The additional work was completed in November 2006. Consequently, the actual period was longer than the planned (144%), even without counting the period spent for the additional work. A 35-month delay in the commencement of the civil work was the main reason for the delay of the project period. The delay in the civil work occurred because of a contractor cancellation and the necessity of holding a re-bidding to select another civil contractor. There was also a little delay in the process of the selection of a consultant; revision of project scope and detailed design.

2.2.3. Project cost

The planned project cost was 6,245 million yen, including 5,308 million of yen-loan portion. The actual project cost was 6,474 million yen, including 5,122 million of yen-loan portion. The actual cost was thus 104% of the planned cost. The actual cost should be considered almost as planned, as it was 94% of the planned cost if the cost of the additional work is excluded. The funds for the additional works became available as there was a balance of approximately 400 million yen in the project budget due to the effective procurement procedures that ensured competitive bidding. Efficient project management, such as timely instructions to the contractor, frequent progress monitoring at the sites, rejection of unreasonable claims, etc. also contributed to the reduction of the project cost.

2.3. Effectiveness (Rating: b)

The rating for the effectiveness of the project could have been “c: low”, as the size of the population newly-connected to water supply and the average water consumption per day were less than half of that planned. However, considering the various factors mentioned below, this project has somewhat achieved its objectives, therefore its effectiveness is fair.

Firstly, the above-mentioned low level of achievement of targets was caused by a factor outside the control of the project. That factor was the limited amount of water supplied to the area, due to the long delay in the construction of the Kelani River Right Bank Water Treatment Plant, which should have been constructed in parallel with the project. Secondly, the project created various positive impacts. For example, water supply services for the existing customers were significantly improved by the extension of water supply hours and increase in water pressure. There was a positive impact to the industries in the area, and an improvement in the sanitation and living conditions of the people in the area.

2.3.1. Operation and effect indicators

Tables 2 and 3 show the newly-connected population and average consumption per day expected at the time of the change in the project scope and the actual numbers at the time of the ex-post evaluation.

The figures are 12%-27% and 44%-46% respectively. The actual number of newly-connected population was calculated by multiplying the number of new domestic connections in the target area given from 2006 up to March 2009 by five[14].

Table 6 Number of newly-connected population in the target area

	Planned (persons)	Actual (persons)	Achievement (%)
Dec. 2006	82,995	9,615	12%
Dec. 2007	96,757	19,680	20%
Dec. 2008	110,518	30,105	27%

(Sources: Final design report of the project and documents provided by NWSDB)

Table 7 Average consumption per day in the area

Year	Planned (㎥/day)	Actual (㎥/day)	Achievement (%)
2006	28,030	12,471	44%
2007	30,090	13,365	44%
2008	32,243	14,944	46%

(Sources: Final design report of the project and documents provided by NWSDB)

The source of the piped water supply for Colombo District and its suburbs, including the target area of the project, used to be the Kelani River. The Ambatale water treatment plant, of which capacity was enhanced under the project, was treating all the water to be supplied to the entire area. At the time of the project appraisal, water demand was continuously increasing as the population of the area was increasing year by year. However, it was difficult for NWSDB to make an additional intake at the Ambatale water treatment plant as there was a risk of saltwater contamination.

Under these circumstances, in order to meet the water demand in the future, NWSDB was planning to implement several projects for the development of water sources and the construction of water treatment plants. The figures showing planned newly-connected population and average consumption per day shown in Tables 2 and 3 were projected on the assumption that the following projects would be realized in time.

(a) Construction of Kalu Ganga water treatment plant

As a part of the Kalu Ganga (a river called “Kalu Ganga”) Development Project, the Kalu Ganga water treatment plant will be constructed. After the completion of the plant, treated water from the Kalu Ganga plant will be supplied to South Colombo, which is located near the Kalu Ganga. Therefore, the Ambatale plant will be able to reserve its capacity, and a larger volume of water will be sent to North Colombo, including the target area of the project. Eventually, the amount of treated water supplied to the project area will be increased.

(b) Construction of Kelani River Right Bank water treatment plant

[14] In the consumer survey conducted as a part of the ex-post evaluation, the average number of family members per household was considered as five.

The Kelani River Right Bank water treatment plant will be constructed with financial assistance from the Government of Denmark. The volume of treated water supplied to the Towns North of Colombo area, including the target area of the project, will be greatly increased, as the plant, in addition to the Ambatale water treatment plant, will supply treated water to the area.

(c) Implementation of the stage II of the Towns North of Colombo Water Supply Project

Stage II of the Towns North of Colombo Water Supply Project will be implemented in parallel to the project (Stage I). Facilities to be constructed in Stage II will be commissioned from 2005 onwards, and thereafter, the number of connected households will be increased dramatically.

However, the volume of treated water supplied to the target area was not increased as expected, as only a part of the above-mentioned assumptions were realized at the time of the ex-post evaluation, as explained as follows, and there is still a limitation on the capacity of the Ambatale water treatment plant due to the risk of salt water contamination, as mentioned earlier.

(a) Construction of Kalu Ganga water treatment plant

The Kalu Ganga Development Project was postponed due to the financial situation of NWSDB. At present, Phase I of this project (Kalu Ganga Water Supply for Greater Colombo Project; L/A signed in 1996), which was implemented with the support of an ODA loan from JICA (former JBIC), has been completed. However, Phase II (Water Sector Development Project II; L/A signed in 2008), including the construction of a water treatment plant, has just commenced. Therefore, the Ambatale water treatment plant does not have the extra capacity to supply more water to the target area.

(b) Construction of Kelani River Right Bank water treatment plant

Construction of Kelani River Right Bank water treatment plant became more urgent for NWSDB as construction of the Kalu Ganga water treatment plant was delayed as mentioned above. This project was funded by the Government of Denmark as planned. However, construction of the plant was delayed for five years due to problems in the process of the procurement of a civil contractor. Currently, the construction of the plant has not been completed; therefore, water supply from the plant to the Towns North of Colombo area has not been started.

(c) Implementation of Stage II of the Towns North of Colombo Water Supply Project

Stage II of the Towns North of Colombo Water Supply Project was not implemented in parallel to Stage I, as the implementation of the project (Stage II) was not considered to be urgent, because the above-mentioned (a) and (b) projects were delayed. At the moment, the project is being implemented with the assistance of an ODA loan from JICA as a part of the Water Sector Development Project I, signed in 2007, and the facility which will be constructed by the project is planned to be commissioned in 2011.

NWSDB considers that the delay in the construction of the Kelani River Right Bank water treatment plant, which was supposed to supply a large volume of water to the target area, should be the main reason behind the shortage of treated water in the area. NWSDB has stopped the extension of the distribution network and the provision of new connections at present due to the shortage of treated water[15]. Therefore, it is not in a position to improve the levels of achievement shown in Table 2 and 3.

[15] After the field survey of the ex-post evaluation, the external evaluator was informed by NWSDB that NWSDB resumed giving extensions and new connections in the target area from July 2009 due to improvement of water supply from Ambatale to the area.

2.3.2 Results of Financial Internal Rate of Return (FIRR)

The Financial Internal Rate of Return (FIRR) calculated at the time of the project appraisal was 7.6% with the following conditions:

- Cost: Project cost, cost of O&M and water treatment.
- Benefit: Income from water bill payments by consumers
- Project life: 33 years (40 years from the commencement of the project)

The FIRR recalculated at the time of the ex-post evaluation was 4.1%. The FIRR was decreased mainly because there was a delay in the creation of benefits for the period of around three years, including the period for additional works, due to the delay in the completion of the project, and because benefits from the project were less than expected, as income from water bill payments by consumers was limited due to the limitation of the volume of treated water supplied to the area.

2.3.3. Qualitative effects

To examine qualitative effects of the project, a consumer survey of 250 selected households in the area was conducted. The results of the survey confirmed that water supply services for the existing customers, such as service hours and water pressure, were improved drastically by the project.

In response to the question of "Do you think water supply services were improved after the project?", 81% of the respondents answered "Yes", while only 13% chose the response, "There was no need for improvement as the services were good before the project." Only 6% replied, "No". Those who replied "Yes" to the question cited an "increase of service hours" and an "increase of water pressure" as examples for the improvement of the services.

As shown in Figure 1, service hours in the entire target area were increased after the project by three to seven hours, compared with the figures before the project. The average increase in the number of service hours per day was 4.1 hours.

(Unit: hours/ day)

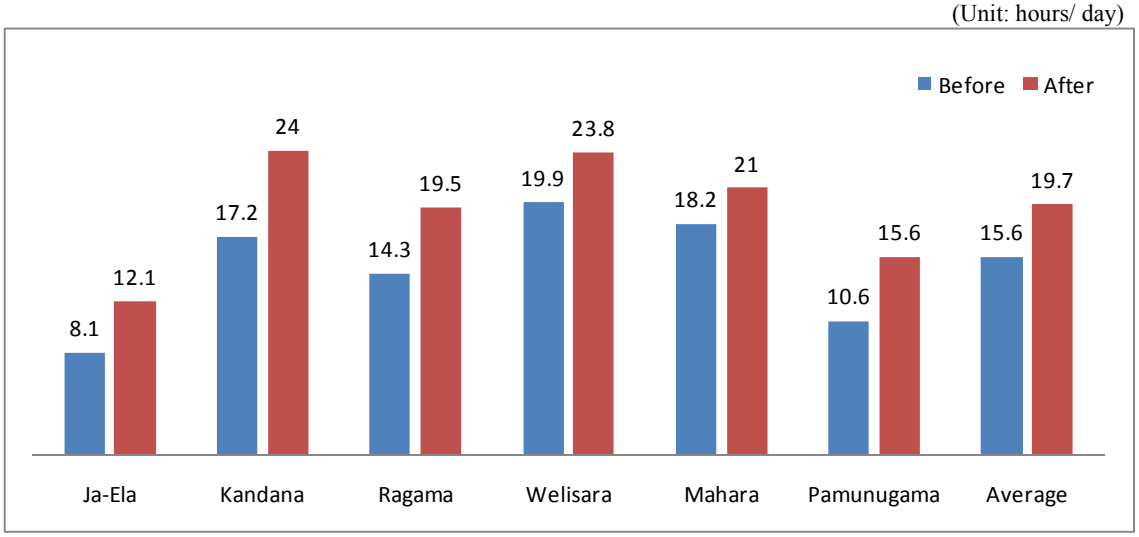


Figure 4 Service hours – Before and after the project

(Source: Consumer survey)

Figure 2 shows the distribution of households according to the service hours both before and after the project.

(Unit: hours/day)

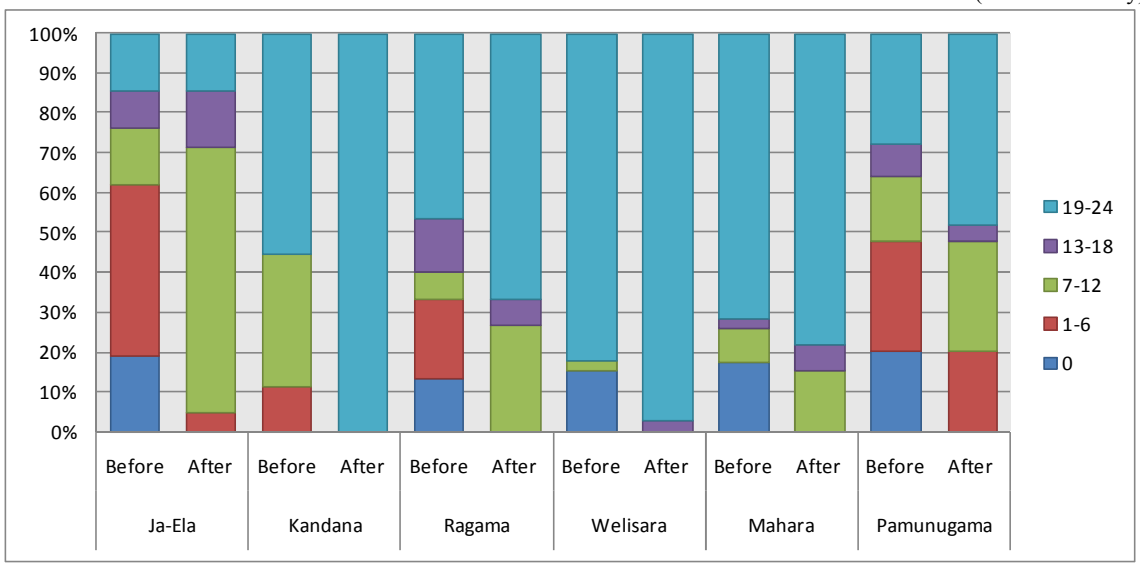


Figure 5 Distribution of service hours – Before and after the Project

(Source: Consumer survey)

Figure 2 shows that there was a significant improvement for the households, which had very limited service hours before the project. Details of the improvement are described below.

- Before the project, there were many households that were connected but did not have any service. After the project, there are no such households.

  In every area, except for Kandana, 12% – 20% of the households among the samples were connected but did not have any water supply. This was a significant problem in Ja-Ela, where the ratio of such households among the samples was 20%. This was a particular problem seen for the households located at the end of the distribution network or where water pressure was very low. They had water supply at the time they were connected to the distribution network several years ago, but they gradually lost the service when water demand in the neighboring areas was increased due to population increases and urbanization. After the project, all these households obtained several hours of water supply per day and there are no households that do not receive any supply at the moment.

- The number of households that have less than six hours of service was reduced

  The number of households that have less than six hours of service per day was drastically reduced, in addition to the above-mentioned benefit to the households that did not have any supply. For example, in Ja-Ela, the ratio of the households that had less than six hours of service per day was 43% among the samples before the project, but this was reduced to 8% after the project. In Pamunugama, too, the ratio of such households was 30% before the project, but it was reduced to 20% after the project.

2.4 Impacts

The project contributed to the development of commercial and industrial activities and the improvement of sanitary and living conditions of the community in the target area, and thus it is evaluated that the project produced the expected impacts.

2.4.1. Impacts to project area and target community

(1) Contribution to development of regional industry

According to the documents provided by NWSDB, the following industrial estates and development areas in the target area were examples of areas that benefitted from the project:

- New connections were provided to the Muthurajawela Industrial Zone, which has a natural gas and petroleum storage facility and a terminal power station.
- Preparation work for water supply to the Katunayake Industrial Zone was conducted. Provisions were made at the distribution facility at the Ja-Ela Distribution center to supply water to the industrial zone in the future.
- Preparation work for water supply to the Biyagama Industrial Zone was conducted. The water supply will be enhanced by the transmission main pipeline constructed by the project and the distribution facilities to be constructed in Towns North of Colombo Water Supply Project Stage II.
- Preparation work for water supply to the Ekala Industrial Zone was conducted. The water supply will be realized to the area by distribution mains laid to Ekala by the project and distribution facilities to be constructed by the Stage II project.

At the moment, NWSDB gives priority to the benefits for general consumers, and could not answer requests from factories in the area for new connections due to the limitations on the amount of treated water. Meanwhile, the following case study confirmed that a factory in the target area, which already had a connection, benefitted from the project because of the increase of service hours and improvement of water pressure.

A Case Study – Sanmyan Lanka Ceramic (a ceramic factory)

(The followings are the summary of the interview with a production manager of Sanmyan Lanka Ceramic)

Sanmyan Lanka Ceramic is a ceramic production factory with Korean capital and located in "Aniyakanda Industrial Estate" in Kandana City. The factory produces ceramic ornaments to be exported mainly to Japan, England and U.S.A. It was established around 16 years ago.

Ground water is not available by digging a well in and around the industrial estate. Therefore, factories in the estate depended on piped water supplied by NWSDB. The factory had a connection of piped water; however water pressure was very low. Water came out from a tap like a thread when opening a tap. As service hour was limited, the factory stored water to an underground storage, however the amount of water supplied for a day was far from enough to necessary amount for a daily production, hand wash and toilet use by staff of the factory

The factory needs a large amount of water during the production process. For example, they need to mix water continuously to a mill at the time processing ingredients. Until several years ago, the factory used to purchase water from a private company. The company bought water by bowsers. They usually need a bowser or two for a day, according to the amounts to be produced. The production manager used to wait for a bowser eagerly at the gate of the factory, as the delivery was always delayed. It was a serious problem for the management of the factory that the production

schedule was often disturbed when bowser comes late, that the quality of water from bowsers was not good, and that the cost of purchasing water from bowsers was expensive.

After 2007, soon after the commissioning of the distribution facility in the Kandana distribution center by the project, water supply became available to the factory 24 hours a day. Since then, they have not had any problems with water pressure and quality. In this way, their water problems were solved completely by the project. Currently, they do not need any additional supplies by bowsers. Their water needs are completely fulfilled by piped water supply. The production manager highly appreciates the project as production efficiency of the factory has improved very much owing to the project.

(2) Improvement of sanitary and living condition of residents

In addition to the consumer survey of 250 households mentioned above, to study the impact produced by the project on sanitary and living conditions of the residents in the target area, the external evaluator conducted interviews with 39 households, which may have problems with groundwater[16]. Figure 3 shows the result of the interviews.

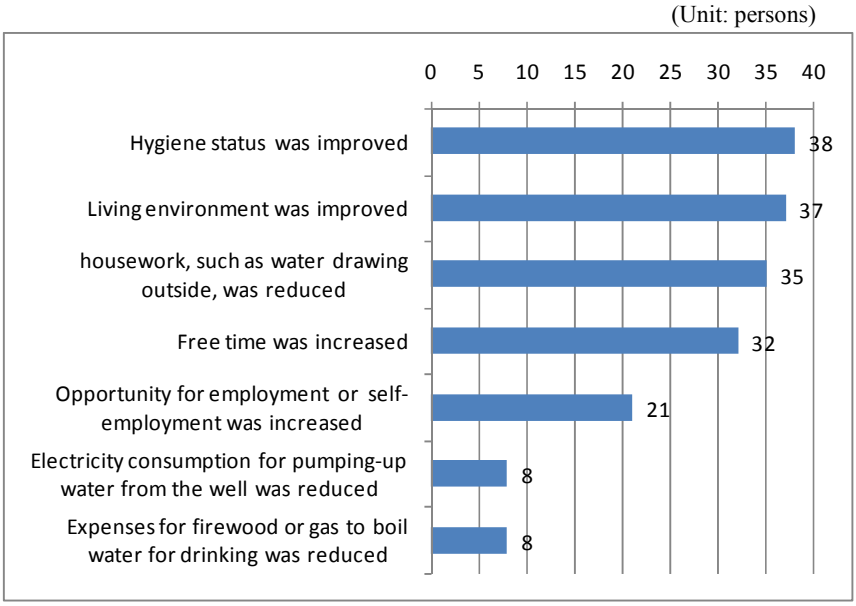


Figure 6 Impact on sanitary and living conditions owing to the supply of piped water

(Source: interview with the selected 39 households)

Figure 3 shows that most of the respondents recognized that "sanitary and living conditions were improved owing to the supply of piped water". It is assumed that the supply of piped water solved the above-mentioned problems because they were able to obtain adequate amounts of good quality water.

According to the interviews, 90% of the respondents mentioned that their "workload, such as water drawing outside of their premises, was reduced". As 74% of the respondents had a well

[16] Places which may have problems with groundwater were identified by the information from the OICs (officers' in-charge) of NWSDB in the target area. It was confirmed that the survey included a considerable number of households which have problems with groundwater, as 40% of the respondents replied that "water in the well is dried up during dry seasons" and 33% replied that "there were problems with the quality of water in wells, such as odor and color" in response to a question about the situation of their well water.

within their premises, what they mentioned was assumed to be a reduction of the workload of drawing water from a well on the premises and carrying the water to the kitchen and bathroom.

There were comparatively fewer households that recognized a reduction of electricity consumption spent for pumping up water from a well, and a reduction of expenses for firewood or gas spent for boiling water for drinking. Results from the questionnaire survey showed that around 40% of consumers boiled water for drinking before and after they obtained new connections of piped water supply; it is thus understood that there is no particular relationship between a reduction of expenses for electricity, firewood and gas and the supply of piped water with regard to the households in the target area.

A half of the respondents replied that opportunities for employment or self-employment were increased after they obtained piped water supply. This is because they had more time available because of the reduction of their workload for drawing and carrying water.

(3) Benefit for medical institutions

The following case study shows that the project improved water supply services to a main medical institution in the target area.

A case study – Ragama Teaching Hospital

(The following is a summary of an interview with the nursing staff of Ragama Teaching Hospital)

Ragama Teaching Hospital is one of the largest general hospitals in the Gampaha District. It has 1,350 beds and treats around 1,200 outpatients per day. The hospital first obtained piped water supply in 1987 by a water supply scheme for "Ragama hospitals water supply scheme". A distribution main was laid to the area from the Welisara Reservoir. In 1993, the volume of water supply was increased by the Stage II of the same scheme. A gravity transmission main was laid and a water storage tank and a water pump were installed in the hospital.

After a while, because of a population increase, urbanization and industrialization, water demand in and around the area was increased steadily. Distribution networks under the scheme were extended and new connections were provided. In the hospital, too, water consumption continued increasing as new hospital wards and medical facilities were added.

In this way, as water demand increased, the volume of water supplied to the area and the capacity of the distribution facility became insufficient at all to meet the demands. The hospital had a serious water shortage problem. The water supply was disrupted from around 10 o'clock at night until 4 o'clock in the morning every day. They did not have enough water necessary for the management of the hospital during the daytime as water pressure was low and the volume of supply was insufficient. For example, they often could not use operating theaters, flush water in toilets, wash their hands after nursing services and wash linens for inpatients. In particular, disruptions of water supply at night disrupted emergency surgeries and treatment of emergency patients. They sometimes had turbid water during dry seasons.

The project constructed a water tower at the Ragama distribution center. The project also laid a gravity main to the center, which permitted gravity transmission from Church Hill to the Ragama area. Due to these improvements, the hospital has been enjoying a daily 24-hour water supply since 2007. The head nurse at the hospital confirmed that the hospital has been freed from the problems of water

supply, and that the improved water supply is contributing much to the efficient management of the hospital.

(4) Benefit to non-target area

Water supply services to the Pamunugama area were improved by the project. The area is located northwest of the target area and was not included in the target area of the project. NWSDB recognized the urgent needs of the community in Pamunugama and connected a transmission line constructed by the project to distribution networks of the area. The volume of water supply to the area was subsequently increased by the arrangement.

A case study – Talahena village in Pamunugama area

(The following is a summary of interviews with residents in Talahena village)

Talahena is a coastal village located northwest of the target area. It was not included in the project area. Ground water under the village has been contaminated with mud and become turbid and brownish in color from long ago. Residents of the village pump up the ground water from wells in the gardens, filter it and use it for domestic use. They use hand-made filters made of gravel and pebbles. They said that the filtered water can be used for domestic use, but it is not suitable to use for drinking at all.

The village obtained piped water supply around 15 years ago. However, from around 2000, the water pressure and volume of water were extremely reduced due to increase of demand caused by the growing population and increase in the number of connections in the area. From around 2002 onwards, the water was not supplied at all to the households located at the end of the distribution network. In other words, these household had connections, but did not receive even a drop of water from the supply. Other households in the village also had very low water pressure. Water was not delivered up to taps in kitchens and bathrooms due to the low pressure. They had to dig out a pipe laid under the gardens, attach a tap, and obtain water at night and store it in a tank for drinking. If they could not obtain water by such means, they had to bring water from a common tap several kilometers away from their residences. This situation continued for around five years.

NWSDB recognized the serious problem of the residents, and made an arrangement to connect a transmission line constructed by the project to the distribution network of the area. The volume of water supplied to the area was subsequently increased by the arrangement. As a result, the villagers were again able to obtain water supply for several hours a day. Households located at the end of the distribution network were able to obtain water for drinking. Other households became able to obtain water even for kitchens and bathrooms.

However, some of the residents still have to store water at night from a tap attached to a pipe in the ground, store it in a tank and pump it to the taps in the house, as water pressure is still very low. The residents use water from wells, too, as the volume of piped water supply is not sufficient. They greatly hope the volume of piped water supply will be increased soon, so that they can become freed from the costly and troublesome work of pumping muddy water from a well, filtering it, and pumping it again to the house. There are several households that do not have connections to the piped water supply, and they must obtain water for drinking from neighboring households. They are eagerly

awaiting connections to the piped water supply.

<Reference>

- Assumed number of direct beneficiaries : Around 130,000 persons (water supply–connected domestic population in the target area)
- Assumed number of indirect beneficiaries : Around 200,000 persons (users of hospitals, schools, factories, shops, government institutions, religious facilities, etc.)

2.4.2. Impact on Natural Environment

(1) Impact by the construction work

There was no impact on the natural environment caused by the construction work of the project.

(2) Saltwater contamination

Saltwater contamination in Kelani River, which is a source of water supply to the target area, is a serious problem, which happens every year during the dry season due to a reduction of the flow pressure of the river. As a countermeasure, NWSDB used to provide sandbag-protection every year. However, such a temporary solution does not solve the problem, and the construction of a "rubber dam system" has been planned as a permanent solution. A part of the plan is under construction at the moment.

(3) Increase of discharged water

There has been no increase of discharged sewerage water in the project area, as the number of connections and volume of consumption are limited.

(4) Deterioration of water quality of water source

The deterioration of the water quality of the Kelani River is a serious problem. The Ministry of Environment has appointed a committee to carry out periodical monitoring of the water quality of the Kelani River and facilitate responsible local authorities in conducting on-site investigations of discharges of polluted water from factories and illegal connections to sewerages.

2.4.3 Land acquisition and re-settlement

Two unauthorized houses beside the Kelani River were relocated at the time of construction of the gravity transmission mains. The relocation was conducted lawfully by the local authority in the area. No issues were risen by the affected people. Land acquisition was carried out in accordance with the Land Acquisition Act of Sri Lanka to obtain land for construction of the distribution facility. There were no houses or establishments on the acquired land, and appropriate compensatory payment was made to the land owner.

2.5. Sustainability (Rating: a)

No major problem has been observed in the capacity neither of the executing agency nor its operation and maintenance system, therefore sustainability of the project is high.

2.5.1. Executing agency

(1) Structural aspects of operation and maintenance

The present operation and maintenance arrangements of the target area, including treatment, transmission and distribution, is conducted under the overall supervision of the Deputy General Manager (Western – North) of NWSDB. The Ambatale Production Unit of NWSDB under the Deputy Manager of Western Province is in charge of water treatment and transmission. Distribution is undertaken by each OIC office and Area Engineer's Office of NWSDB. The manager of Towns North of Colombo Manager's Office has the overall responsibility for distribution. Around 200 staff in total are engaged in O&M work for the target area, including treatment, transmission and distribution of water. There are no particular issues with regard to institutional aspects of O&M. Responsibilities of the above-mentioned production unit and offices for distribution are clearly defined, and the organizational structure for O&M is well established.

(2) Technical aspects of operation and sustainability

Two posts for mechanics and one post for an electrician were not fulfilled at the Ambatale Production Unit. NWSDB is going to fill these posts very soon. Posts for technical staff necessary for O&M work were filled at the offices in charge of distribution, such as OIC offices, Area Engineer's Office and Manager's Office of Towns North of Colombo. NWSDB considers that the technical level of their staff is adequate, and there have been no problems in this regard. The pumps installed in the Ambatale treatment plant were the biggest pumps NWSDB had ever used. The project conducted a training course on operation of these pumps as a part of consulting services. Currently, staff members of NWSDB are operating the pumps without any problem.

(3) Financial aspects of operation and sustainability

(a) Cost of O&M and financial revenue generated by payment of service charges

As Table 4 shows, in the target area, the cost of O&M is covered by financial revenue generated by the payment of service charges. It is expected that the financial situation will be further improved by the tariff revision introduced in 2009 and the increase of new connections from 2010 onward.

According to the consumer survey, 81% of the respondents said they pay their monthly water bills regularly. The rest of the respondents (19%) said that they pay the accumulated charge once every two or three months, mainly because they said the amount of monthly bills is too small. There were no respondents who did not pay the bills. Accordingly, it appears that the payment of water bills by consumers is proceeding smoothly.

Table 8 O&M cost and income of target area

(Unit: Rs. 1000)

Year	O&M Cost			Income	Difference
	Production cost	O&M cost	Total		
2006	18,156	43,818	61,974	66,615	4,641
2007	21,353	64,153	85,506	92,621	7,115
2008	31,978	69,878	101,856	108,627	6,771

(Source: Documents submitted by NWSDB)

(b) Financial status of NWSDB

The financial status of NWSDB had been improving until 2006. However, in 2007, the financial status, such as operating profit, net profit and assets-operation income ratio, suffered a reverse mainly because the cost of inputs, such as electricity, chemicals, fuel and salaries, became extremely high. According to an interview with senior officials of NWSDB, the financial status in 2008, which was not officially revealed, did not show improvement. The Water Sector Development Project, for which an agreement for a Japanese ODA loan was signed in 2007, is assisting the enhancement of the management and financial capacity building of NWSDB.

(c) Increase of water tariff

Recently, the water tariff was increased in every three years in 1999, 2002 and 2005. However, the tariff was not revised in 2008. In February 2009, NWSDB introduced a new tariff, as the financial status of NWSDB will definitely become more fragile if there is no revision of the tariff.

(d) Non-Revenue Water Ratio

Table 5 shows the Non-Revenue Water (NRW) ratio of Towns North of Colombo, including the target area. The ratio is lower than that for the Colombo Municipal Council area and Greater Colombo, but it needs improvement. NRW ratios were worsened in 2006 and 2007 because there was a temporary loss of water at the time of the pipe-laying work and the connection of the new system to the old system by the project. NWSDB does not measure the NRW ratio only for the target area.

Table 9 Non-Revenue Water (NRW) Ratio for Towns North of Colombo

(Unit : %)

Year	2003	2004	2005	2006	2007	2008
NRW	24.3	20.1	20.5	27.5	24.8	21.7

（Source: Document submitted by NRW unit of NWSDB）

Table 6 shows NRW ratio for Colombo Municipal Council area and for Greater Colombo. They are slightly improving, but they are still very high.

Table 10 Non-Revenue Water Ratio for Colombo City and Greater Colombo

(Unit :%)

Year	1997	2000	2005	2007
Colombo Municipal Council area	57.0	53.7	51.3	52.7
Greater Colombo	47.0	38.7	35.9	37.84

（Source: Document submitted by NWSDB）

The Water Sector Development Project II, for which a Japanese ODA loan agreement was signed, is

going to assist NWSDB in improving the NRW ratios by implementing civil construction in the city. A technical cooperation project of JICA for the improvement of the NRW ratios will be implemented from late 2009 onwards for a period of three years.

2.5.2. Current status of operation and maintenance

(1) O&M for distribution facility

At present, the distribution of water is conducted by gravity as the number of connections is still limited. Therefore, the pumps installed at the distribution centers are not operated, and O&M for electrical and mechanical parts has not been necessary. The reservoirs constructed by the project were also not used for the same reason as mentioned above.

The Area Manager's offices and OIC offices are conducting the following O&M work based on public complaints: observation of meter readers and analysis of bills, leakage repairs of pipe lines and water meters, replacement of water meters and investigation and disconnection of illegal connections. The offices are conducting disconnection programmes once every three months to encourage consumers to pay their bills regularly. Under the programme, consumers are given notice to settle their bills immediately to avoid disconnection. Water Towers are operated by care-takers. The main task of the operator is to operate valves to avoid overflowing of water. Towers are cleaned around once every three months.

(2) O&M conducted at water treatment plant

Preventive maintenance of the pumps is carried out at the Ambatale water treatment plant in accordance with the planned schedule.

(3) Usage of vehicles for O&M procured by the Project

All the vehicles provided by the project for O&M activities are utilized well by staff of NWSDB at the Manager's office of Towns North of Colombo, Ambatale Water Treatment Plant and Head Office.

(4) Water leakage at water pipe bridges

Leakages were found in the pipe joints at three river, lake and canal crossings at the time of sudden and frequent power failures. As a result of the study conducted by the consultant team and NWSDB, it was found that the flywheels fitted to new pumps were not able to fully counteract high upsurge pressures and that the 90-degree dimensional pipe configurations adopted at the crossings had less endurance to the pressure.

NWSDB repaired the pipe joints and stopped the leakages at the crossings. Two pressure vessels were fabricated and installed at a location 70 meters downstream from the pump house to supplement the function of existing flywheels and enhance endurance to the upsurge pressures at the time of power failures. NWSDB believes that the leakages will be completely stopped once the pressure vessels are commissioned by the middle of May 2009[17].

(5) Conversion of the pumps installed at Ambatale Water Treatment Plant and gravity transmission

[17] After the field survey of the ex-post evaluation, in November 2009, NWSDB informed the external evaluator that the two surge vessels have been commissioned and are working satisfactory.

mains from Ambatale to Church Hill

Treated water will be supplied to the target area of the project mainly from the Kelani River Right Bank Water Treatment Plant once it is completed. NWSDB is working out a plan for future usage of the two pumps installed at the Ambatale Water Treatment Plant and the transmission mains from Ambatale to Church Hill. There is an idea to use the pumps to enhance water supply to the Greater Colombo area under the Greater Colombo Water Supply Improvement project, which is one of the components of the Water Sector Development Project currently being implemented with the financial support of an ODA loan from Japan. There is an idea to use a part of the transmission mains from Ambatale to Church Hill to transmit water from the Kelani River Right Bank Water Treatment Plant to the Church Hill Reservoir and the rest of them to transmit water from the Kelani River Right Bank Water Treatment Plant to the Ambatale Water Treatment Plant for water supply to the Colombo City area. NWSDB have to study technical viability of these ideas in due course.

<Reference> Level of satisfaction of consumers to water supply services

Figure 4 shows the result of the consumer survey on the level of satisfaction of consumers to water supply services. The survey showed that 16% and 22% of the respondents wished to have improvement in water pressure and service hours respectively. A considerable number of consumers expressed their concern about the new tariff system introduced just a few weeks prior to the time of the survey. The levels of satisfaction regarding other factors, such as water quality, behavior and attitude of meter readers, convenience in bill payment and response to complaints, were generally high.

(Unit: %)

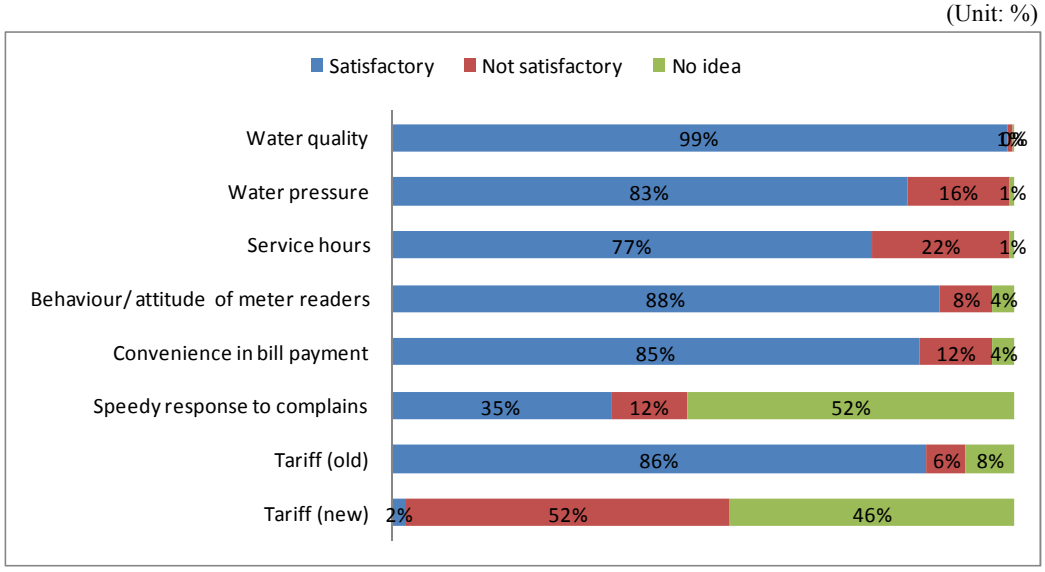


Figure 7 Satisfaction with the services of NWSDB

(Source: Consumer survey)

3. Conclusion, lessons learned and recommendations

3.1. Conclusion

As stated above, the relevance and the sustainability of the project were high, although the effectiveness and the efficiency of the project were moderate. Therefore, this project is evaluated to

be satisfactory.

3.2. Lessons learned

- Some expected effects of the project were not produced, as several projects, which were planned to be implemented in parallel to the project, especially construction of the water treatment plants, were delayed. It is crucial in water supply projects to implement integrated efforts as scheduled, including projects for the development of water sources, water treatment, transmission and distribution, in order to meet increasing demand.
- A review of planned target figures or achievement forecasts could be made by the conducting of a mid-term review of the project, in case important assumptions or external conditions of the project were drastically changed during the period of project implementation due to delays of other projects and other factors.

3.3 Recommendations

- It is recommended that the effects and impacts of the project and status of usage of the facility constructed by the project should be studied after completion of the Kelani River Right Bank Water Treatment Plant and phase II of Towns North of Colombo Water Supply Project[18], when effects of the project will be fully realized.
- It is recommended that the improvement of the financial status of NWSDB and the NRW ratios also should be confirmed by continuous monitoring in the future as well, even though several measures have already been taken.

[18] Signed in 2007 as one of the components of the Water Sector Development Project , which is financed by a Japanese ODA loan.

Comparison of original and actual project scope

Item	Original	Actual
(1) Output	**<Civil construction>** (Plan after the project scope change) Transmission facility (a) Pump (b) Clear water storage (c) Transmission main pipeline (d) Ground reservoir (e) Gravity transmission pipeline Distribution facility (a) Welisara (tower and distribution network) (b) Kandana (tower and distribution network) (c) Ragama (reservoir, tower, pump and distribution network) (d) Ja-Ela (reservoir and distribution network) (e) Mahara (no plan) **<Procurement of O&M equipment>** Procurement of vehicles **<Consulting Services>** Foreign: 91MM, local: 190MM (a) Review of F/S (b) Detailed design (c) Supervision of construction (d) Training	**<Civil construction>** Transmission facility (a) Pump (b) Clear water storage (c) Transmission main pipeline (d) Ground reservoir (e) Gravity transmission pipeline Distribution facility (a) Welisara (tower and distribution network) (b) Kandana (tower and distribution network) (c) Ragama (reservoir, tower, pump and distribution network) (d) Ja-Ela (Two reservoirs and distribution network. One of the reservoirs was constructed as an additional works) (e) Mahara (reservoir, tower and distribution network were constructed as additional works) **<Procurement of O&M equipment>** Procurement of vehicles **<Consulting Services>** Foreign: 101.3MM, local: 270MM (a) Review of F/S (b) Detailed design (c) Supervision of construction (d) Training
(2) Period	October 1996 – May 2002 (68 months)	October 1996 – November 2004 (98 months)（144% of plan） Note: additional works were conducted for 24 months from November 2004 onwards. Completion of the project was November 2006.
(3) Cost Foreign currency Domestic currency Total ODA loan portion Exchange rate	 4,679 million yen 1,566 million yen (811 million rupees) 6,245 million yen 5,308 million yen Rs.1.0=¥1.93(as of October 1996)	 3,991 million yen 2,483 million yen (2,269 million rupees) 6,474 million yen 5,122 million yen Rs.1.0=¥1.11 (Average between 1998 and 2007)

Pakistan

Karachi Water Supply Improvement Project

External Evaluator：Chiyo Mamiya
Kaihatsu Management Consulting, Inc.
Field Survey：March to May 2009[19]

1. Project Description and Outline of the ODA Loan Assistance

Location of the project

Manghopir Pumping Station

1.1 Background

With a population of about 15 million in 2005, Karachi is the commercial and financial center of Pakistan. However, it has been plagued by chronic water shortages as well as deterioration of water quality as a result of rapid urbanization and population increases.

In 1994, Karachi supplied 1.6 million ㎥ of water per day, which is around 181ℓ/day per person. This amount is considerably lower than around the 340ℓ/day provided in Islamabad, the capital city of Pakistan and around the 250ℓ/day supplied in Delhi, India. In addition, out of 1.6 million ㎥ of water supplied per day, only 955,000 ㎥/day was treated while the remaining 645,000 ㎥/day was chlorinated as an emergency measure.

Based on a demand and supply forecast for water in Karachi until 2025, the Feasibility Study (F/S) conducted by Mott Macdonald of U.K. in 1985 proposed to increase water supply by 910,000 ㎥/day by 2000 and expand water treatment capacity at the existing facilities by 523, 000 ㎥/day.

1.2 Objective

The objective of this project is to improve the water supply system in Karachi city by expanding the capacity of treatment works and pumping stations, thereby contributing to the prevention of diseases caused by drinking water and the improvement of public health.

[19] The two field surveys were carried out for 19 days between 8 and 26 March 2009 as well as for 8 days between 16 and 23 May 2009 respectively. The feedback seminar was held on 19 May 2009.

1.3 Borrower/Executing agency

The Government of Islamic Republic of Pakistan/Karachi Water and Sewerage Board (KWSB)

1.4 Outline of the Loan Agreement (L/A)

Approved Amount / Disbursed Amount	10,300 million yen / 5,836 million yen
Date of Exchange of Notes / Date of Loan Agreement	November 1994 / November 1994
Terms of Conditions	Interest rate: 2.6% Repayment Period (Grace Period) : 30 years (10years) Conditions for Procurement: General Untied
Final Disbursement Date	August 2006
Main Contracts	Biwater International Limited (UK) ／China Beijing Corporation for International Economic Cooperation (China) ／China Liaoning International Cooperation (Group) Holdings Ltd. (China)
Main Consultants	Mot Macdonald Internationals Limited (UK)・Nippon Koei (Japan) (JV)
Feasibility Study (F/S) etc	Mott Macdonald of U.K conducted F/S and Detailed Design of the project facilities in 1985, as a part of World Bank project.
Related Projects	World Bank, Asian Development Bank and the Government of U.K. co-financed the Second Karachi Water and Sanitation Project.

2. Finding (Overall Rating: C)

2.1 Relevance (Rating: a)

The project has been highly relevant with the country's national policies and development needs at the times of both appraisal and ex-post evaluation, therefore its relevance is high.

2.1.1 Consistency with Policy/Measures

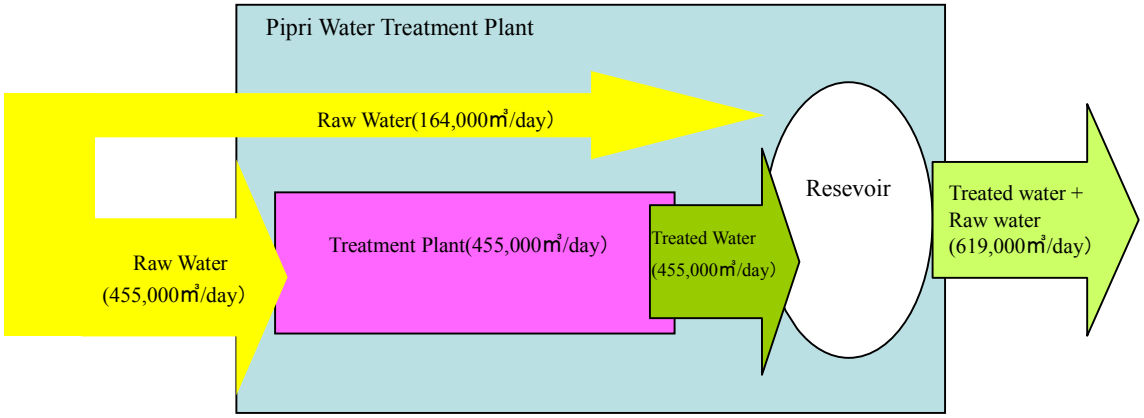
A high priority was given to the supply of safe drinking water due to its positive impact on not only health but also the economy and the environment in the Eighth Five Year Development Plan (1993-1998) at the time of appraisal.

At the time of post-evaluation, the Mid-Term Development Framework (MTDF) 2005-2010, which replaces the five-year development plan, stresses the importance of supplying safe drinking water by constructing more water treatment plants. In addition, both the National Drinking Water Policy (draft) and the Karachi Strategic Development Plan 2020 place high priority on the improvement of water quality. The objective of the project is still highly consistent with the relevant policies at the time of post-evaluation.

2.1.2 Consistency with Development Needs

Water shortages in Karachi were extremely serious compared with other cities. Increasing water supply as well as improving water quality was a pressing issue at the time of appraisal.

At the time of post-evaluation, out of 2.869 million ㎥/day of water supplied to Karachi at the end of FY 2006, 868,000 ㎥/day were not treated. This shows the high need for more water treatment plants. In fact, the supply of raw water exceeds the capacity of facilities constructed under the project. The surplus water after chlorination is mixed with treated water and supplied to the cities in Karachi.



Source: KWSB

Figure 1 Relation between raw water and treatment capacity at Pipri Water Treatment Plant

2.1.3 Relation with Other Donor-funded Projects

The project was originally a part of the Second Water Supply and Sanitation Project (KII), which was proposed in the F/S conducted in 1985 and co-funded by the World Bank, the Asian Development Bank and the Government of United Kingdom. In 1993 the cost overruns in the KII project made it necessary to review the project scope, and the component of constructing water treatment plants was dropped due to the high possibility that other donors could finance this portion[20]. It is the component that JICA (then Overseas Economic Cooperation Fund [OECF]) decided to finance as a separate project.

The KII project, which added 455,000 ㎥/day of water supply in Karachi, was completed in 1998. This was followed by the Third Water Supply and Sanitation Project (KIII), which aimed to increase water supply in Karachi by 455,000 ㎥/day, started in 2002 and ended in 2006.

Although these two projects increased water supply in Karachi by 909,000 ㎥/day, no new water treatment plant has been constructed since the project was completed.

In Karachi, expanding water supply has been given higher priority than improving water quality due to serious water shortages. Consequently expanding water treatment capacity and improving the water distribution network have lagged behind. Therefore the importance of and need for the project in aiming to secure water safety are still high.

[20] According to appraisal documents, the Government of UK, which had experience supporting construction of water treatment plants, showed its interest in supporting new plants.

2.2 Efficiency (Rating: b)

Although the project period was significantly longer than planned, the project cost was lower than planned, therefore efficiency of the project is fair.

2.2.1 Output

Two water treatment plants (WTP) and a pumping station (PS) were constructed under the project. A comparison between the original plan and the actual results is shown at the end of the report. These facilities were not new constructions but the expansion of existing facilities. The conditions and planned work under the project at the time of appraisal are summarized below.

Table1 Conditions of project facilities and planned works at the time of appraisal

	Pipri WTP	Hub WTP	Manghorpir PS
Conditions at appraisal	A 227,000 ㎥/day water treatment plant taking raw water from Indus River	A reservoir which received water from Manghorpir PS and sent it after chlorination to Karachi City. Capacity of taking raw water is 405,000 ㎥/day.	A 405,000 ㎥ /day pumping station taking raw water from Hub Dam and sending it to a reservoir at Hub
Bottleneck	Lack of treatment capacity	Absence of treatment plant	Lack of pumping capacity due to outdated facilities and design fault
Planned works under the project	Constructing additional facilities to increase the treatment capacity by 114,000 ㎥/day	-Constructing a water treatment plant with a capacity of 455,000 ㎥ /day -Constructing staff housing	Constructing a new pumping facility with a capacity of 478,000 ㎥ /day within the same premises

(Source) KWSB

However, there were the following two major changes in the project scope during the course of implementation:

1) The capacity of Pipri Water Treatment Plant was augmented from 114,000 ㎥/day to 227,000 ㎥ /day due to the increase of raw water supply,
2) The capacity of Hub Water Treatment Plant was reduced from 455,000 ㎥/day to 364,000 ㎥/day due to the declining water availability at Hub Dam.

The adjustment of treatment capacities at Pipri and Hub is considered rational, taking into account the prevailing weather conditions between 1999 and 2003 when Karachi was suffering from historical drought, the technical evaluation of the Hub Dam as a sustainable water source by a JICA

study[21], and the addition of raw water supply to Pipri in 1998[22].

2.2.2 Project Period

The project took 139 months between November 1994 and June 2006 against the original plan of 58 months between November 1994 and September 1999. That is 239.7% of the original plan. The major reasons for delays are summarized below.

① The original plan was unrealistic since it did not include the time required for tendering equipment/machinery suppliers, which normally takes around 20 months. The procurement package was divided between equipment/machinery and civil works in order to make the monitoring of project costs and schedules efficient and ensure competition among civil contractors. Since the equipment/machinery suppliers were supposed to develop the specifications for the facilities, the civil contractors should have been selected after the specifications for the facilities were developed by the suppliers. However, the original schedule assumed that the equipment/machinery suppliers and the civil work contractors would be selected in parallel. As a result, the project period delayed the time for the selection of civil work contractors.

② The project was suspended by the Government of Sindh for 14 months between February 1999 and March 2000 due to the non-availability of water at the Hub Dam resulting from severe drought. After the resumption of the project, the review of the project scope based on the lower water availability of the Hub Dam necessitated the review of the pre-qualification results for civil contractors. The review of the pre-qualification which was submitted in March 1999 was completed in September 2000.

③ Three civil works took 40 to 50 months to complete. In particular, the construction of the Manghopir pumping station, which was supposed to be completed in 30 months, took 50 months since the contractor had cash flow problems, necessitating the delay of the construction of staff housing.

④ The selection of equipment/machinery suppliers and civil work contractors took longer than planned since the appropriateness and credibility of bidders had to be carefully examined.

Although the original plan contained some weaknesses, an 81-month delay is considered inefficient. In particular, the division of the procurement package into four components, one for equipment/machinery and three for civil works, caused a prolonged tendering process and complicated and time-consuming project supervision and coordination.

2.2.3 Project Cost

The actual project cost was 55.7% of the original cost.

[21] According to the Study on Water Supply and Sewerage System in Karachi (JICA 2008), at the 95% level of reliability the corresponding yield from the Hub Dam is 340,000 m^3/day.

[22] Although the change of project scope did increase the project cost, the increase was minimized by shifting equipment/ machinery procured for Hub WTP to Pipri WTP, low contract prices, and the weakening Pakistani rupee, which reduced the contract price in rupees (see 2.2.3). In addition, the delays caused by changes in design and specifications were not significant compared with other causes for delays (see 2.2.2). Therefore, it is considered that there were more benefits than demerits resulting from the changes of project scope.

Planned	Actual
12,117 million yen (including Japanese ODA Loan of 10,299 million yen)（1PKR=3.71 yen)	6,725 million yen (including Japanese ODA Loan of 6,316 million yen)（1PKR=1.97 yen)

A comparison of project costs between the planned and actual costs is shown below:

Table 2 Comparison of project costs between planned and actual costs

	FC (million yen)			LC (million Rs)			Total（million yen)		
	Planned	Actual	Gap	Planned	Actual	Gap	Planned	Actual	Gap
1. Equipment/ Machinery	3,740	2,578	-1,162	557	342	-215	5,806	3,253	-2,553
2. Civil Work	644	0	-644	670	1,043	373	3,129	2,059	-1,070
Hub WTP	431	0	-431	449	528	79	2,096	1,042	-1,054
Pipri WTP	168	0	-168	174	312	138	815	616	-199
Manghopir PS	45	0	-45	47	203	156	218	401	183
3. Contingency	252	0	-252	96	0	-96	603	0	-603
4. Consulting Service	439	515	76	87	83	-4	763	678	-85
5. Interest during construction	735	735	0	0	0	0	735	735	0
Total	5,810	3,828	-1,982	1,410	1,468	58	11,036	6,725	-4,311

*Excluding tax of 1,080million yen
Exchange rate applied: 1Rs=3.71yen for planned costs, 1Rs=1.97yen for actual costs
（Source）JICA/KWSB

The reasons for the more than 20 % difference between the originally planned and actual costs are as follows:

- Equipment/ Machinery (about 2.5billion yen, 44% reduction): The cost was reduced due to competition among bidders. It is also possible that the quotation at the time of the appraisal was overly high.[23]
- Civil works of Hub Water Treatment Plant (1billion yen, 50% reduction): The cost was reduced due to competition among bidders. The capacity adjustment reduced the volume of work.
- Civil works of Pipri Water Treatment Plant（about 200 million yen, 24% reduction）: The cost was reduced due to competition among bidders. The increased cost in Pakistani rupees due to the capacity adjustment was absorbed by the depreciation of the rupee against the Japanese yen.
- Civil works of Manghopir Pumping Station (about 200 million yen, 84% increase) : The additional construction of staff housing increased the cost.

Since the actual project cost was significantly lower than the original estimate, it can be said that the financial resources of the project were utilized efficiently. Although there were several factors which increased the project cost such as changes of the project scope and delay of construction, the

[23]The project cost was estimated based on the unit costs of a similar project supported by the World Bank at the time of appraisal. Equipment and machinery for the treatment plant on which the cost of the Project was supplied through direct procurement with UK suppliers.

financial management of the project was prudent and effective enough to minimize cost escalations.

2.3 Effectiveness (Rating: a)

The project has largely achieved its objectives, therefore its effectiveness is high.

2.3.1 Operation/ Effect Indicator

No targets for operation/effect indicators were set at the time of appraisal. The amount of water supplied/treated water, utilization capacity of the project facilities, and water quality were evaluated as basic operational indicators for water supply projects.

(1) Amount of Water Supplied and Treated

The project increased the amount of treated water by 590,000 ㎥/day against the planned amount of 546,000 ㎥/day. The amounts of supplied and treated water in Karachi, including the project facilities, are summarized below:

Table 3 Amount of water supplied and treated in Karachi

（Unit :㎥/day）

Indicator	Base Year (1994)	Actual（2006）
Amount of supplied water	1,600,000	2,869,000
Amount of treated water	955,000	2,000,000

（Source）KWSB

(2) Capacity Utilization

There were no meters installed to measure the volume of water supplied to the facilities constructed under the project and thus no data on capacity utilization of the project facilities has been collected. The only data available at the time of the post-evaluation was the water volume pumped from the pumping stations to the water treatment plants between November 2008 and March 2009. In addition, since the amount of raw water supplied to the water treatment plants constructed under the project exceeds their design capacity, these facilities are considered to be fully utilized when the volume of pumped water exceeds the design capacity of the facility. Therefore, this report adopts the following formula as a substitute for a capacity utilization rate:

- If the amount of raw water exceeds the design capacity of the facility, the capacity utilization rate of the facility is100%.
- If the amount of raw water is lower than the design capacity of the facility, the capacity utilization rate of the facility is calculated as follows:

  the amount of raw water/ the design capacity of the facility×100

Average capacity utilization rates between November 2008 and March 2009 based on the above formula are shown below:

Table 4 Capacity Utilization Rate[24]

	Design Capacity	Average amount of raw water supply	Capacity Utilization Rate
Pipri WTP	227,000 ㎥/day	604,000 ㎥/day	100%
Hub WTP	364,000 ㎥/day	453,000 ㎥/day	109%
Manghopir PS	477,000 ㎥/day	453,000 ㎥/day	94%

（Source）KWSB

The capacity utilization rates for the Manghopir pumping station were low only in March when the main canal from the Hub Dam was closed for cleaning and the raw water supply was reduced. The capacity utilization rates for the Pipri and Hub water treatment plants exceeding 100 % in actuality suggests that these facilities are fully utilized.

(3) Water Quality

There was no target indicator for water quality at the time of appraisal. The average water quality at water treatment plants in Karachi between November 2008 and January 2009 is shown below.

Table 5 Quality of treated water at water treatment plants in Karachi

	Indus (including Pipri)		Hub		WHO standard	
	Min.	Max.	Min.	Max.	Min.	Max.
Turbidity（NTU）	1	1	1.7	2.5	5	10
Color (TCU)	2	2	4	6.3	10	20
PH	7.6	7.6	7.7	8.1	7	8.5
Chloride (mg/l)	40	42	72	82	200	250
Alkalinity (mg/l)	100	102	107	115	200	250
Total Solid (mg/l)	270	280	280	297	200	1500
Hardness (mg/l)	120	125	73	84	--	250

（Source）KWSB

Water quality at treatment plants satisfied the WHO standards, which are used as criteria by KWSB. KWSB conducts regular water quality checks at treatment plants and several points within the distribution network, so that it can take necessary measures whenever it detects any irregularities in water quality.

However, the shortage of chemicals which are necessary for water treatment due to the lack of budget is a serious concern. Owing to the improvement of raw water quality due to canal lining and other reasons, there have been no obvious problems to date. Nevertheless, there is a risk that the sudden deterioration of water quality may not be treated well.

[24] Although the design capacity of the Hub water treatment plant is 364,000 ㎥/day, the treatment of 400,000 ㎥/day was approved by the technical authority, including project consultants. Therefore, the maximum utilization rate at Hub is 109%.

2.3.2 Results of Financial Internal Rate of Return (FIRR)[25]

Financial Internal Rate of Return (FIRR) was recalculated at 12.33% against 10.77% at the time of appraisal[26]. However, if it is calculated to include salaries and electricity, which were not taken into account at the time of appraisal, the FIRRs become 9.98% at the time of appraisal and 5.58% at the time of post-evaluation. The latter post-evaluation FIRR decreased because of increasing electricity expenditures and salaries in recent years.

However, as the water charge revenue assumed as profit is not considered additional revenue produced by the project, even the recalculated FIRR including salaries and electricity cannot be accurate.

2.3.3 Qualitative Effect

The beneficiary survey was conducted to investigate users' satisfaction with water quality[27]. The survey consists of an interview for industrial users and a questionnaire survey for retail users.

(1) Interview of Industrial users

Interviews were conducted for six industrial users, three each in the distribution areas of the Pipri and Hub water treatment plants[28].

All users interviewed acknowledged the improvement of water quality after 2006. The outcome of water quality tests conducted by one user clearly showed that the water supplied to the company was suitable for drinking. Most of these companies install their own treatment facilities since the quality of water has a significant impact on the quality of their products. They noted that the improvement of water quality had a positive impact on their operations since it eased the burden on their treatment facilities and reduced the chances of water quality–related damage and the cost of operations.

The interviews with industrial users showed a clear recognition of the improvement of water quality compared with the perception before 2006. Since illegal tap-ins into the distribution system for industrial users are not as easy as those for retail users, there is less possibility for contamination within the distribution system. This enabled users to realize the benefit of the project more directly.

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[25] Economic Internal Rate of Return (EIRR) was not calculated since it was considered difficult to calculate improvement of public health or prevention of water-born diseases, which were defined as economic benefits for the Project.

[26] The benefit, cost and project life adopted for FIRR at the time of appraisal are as follows:

① Benefit: Relative percentage of water subject to quality improvement by the Project to the overall water charge revenue of KWSB. Unaccounted-for water rate was 30%。

② Cost: Construction works, consulting services, annual operation and maintenance costs. The appraisal document did not specify the breakdown of operation and maintenance costs. However, the project documents from the Pakistani government with details of operation and maintenance costs showed that the amount specified in the appraisal documents for operation and maintenance corresponds to the sum for maintenance and chemicals costs in the project documents.

③ Project life : 30 years

[27] The accurate number of beneficiaries of the Project is unknown. It is estimated that around 3.77 million people have been benefited from the Project if the beneficiaries are defined as population with water main connections in the distribution areas of the Project facilities as a relative percentage of water supplied from the Project facilities to the total amount of water supplied to the areas.

[28] The users were selected in consultation with KWSB, on the basis of their water usage and the importance of water quality in their operation. The six users selected are two textile companies, one oil refinery, one pharmaceutical company, one beverage and one ceramic company.

(2) Questionnaire Survey for Retail Users

Various documents suggest that the supplied water in Karachi is contaminated by ground water and nearby sewerage pipes due to the negative pipe pressure. Therefore, the area which is less affected by the negative pressure was selected for the questionnaire survey in order to exclude those factors other than the effects of the project influencing the perception of beneficiaries[29].

The outcome of the questionnaire survey does not show any clear recognition of the improvement of water quality as 147 persons (52.5%) answered that the water quality 'improved', while 133 persons (47.5%) answered that there was no change or water quality had worsened.

This unclear recognition may be because of factors such as contamination of storage tanks within the residential premises, deterioration of distribution pipes, illegal tap-ins into the distribution network which prevent the supplied water from keeping its level of quality from the treatment plant to the end-user level. In addition, chronic water shortages and general mistrust among end-consumers towards KWSB[30] may also make it difficult to accurately assess the perception of consumers regarding water quality.

2.4 Impact

The project site is located far from the Karachi city center, and it has neither a major human settlement nor natural environment which is sensitive to development works. In addition, most of the project works were extensions of existing facilities and thus did not involve additional land acquisition, resettlement and major construction works.

The impact of the improvement of water quality due to the improvement of public health as well as the living environment was surveyed by the questionnaire described above. However, the survey showed no clear indication of the impact of the project[31]. It is not realistic to expect an impact, such as improvement of water quality at the end-user level and associated improvement of public health and living environment by the project without any improvement of the distribution network.

2.5 Sustainability (Rating: c)

Some problems have been observed in terms of the low financial sustainability of KWSB, therefore sustainability of the project is low.

2.5.1 Executing Agency

2.5.1.1 Structural Aspects of Operational and Maintenance

The Electrical and Mechanical department of KWSB is in charge of the daily operation and maintenance of the project facilities. Allocation of staffs at the project facilities is shown in the table

[29] Based on the advice from KWSB, 280 households were selected in Landhi Town, Korangi Town, Malir Town, SITE Town, Baldia Town, and Sargani, and they were interviewed using a standardized questionnaire.

[30] A Citizen Report Card on Water and Sewerage Services in Karachi conducted as a part of the Water Support Program supported by the World Bank indicated that the average satisfaction with drinking water distribution among households obtaining water through main lines was 6.74 out of 10. But it is reduced to 3.93 among households obtaining water outside the household.

[31] For instance, as for the question asking the frequency that interviewees suffer from water-borne diseases, such as diarrhea, typhoid, hepatitis and cholera, 125 persons (45%) replied 'reduced', while 155 persons (55%) replied 'no change/ increased'. For the question on the workload for obtaining safe water, 79 persons (28%) replied 'reduced', while 172 person（62%） replied 'no change' and 29 persons (10%) answered 'increased'.

below.

Table 6 Allocation of staffs at the project facilities

	Before Project	Proposed at appraisal[1]	Present situation
Pipri WTP	N.A	97	272*2(50)
Hub WTP	N.A	131	50
Manghopir PS	N.A		101*2 (50)

（Source）KWSB

*1：It is not clear if this number includes staff for old facilities.

*2：Including those who work for non-project facilities. The number of staffs for the project facilities is 50.

All the project facilities are extensions of old facilities,[32] and the exact number of staffs for the project facilities could not be obtained. However, if the number of staffs proposed at the time of appraisal includes those staffs for old facilities, the present number of staffs at all the facilities is larger than that of proposed at the time of appraisal. There may be a possibility of overstaffing. The number of staffs at the project facilities is relatively large compared with other water treatment plant in Pakistan[33]. As there are several indications of political appointments at KWSB, the appointment of staff is considered to lack transparency.

2.5.1.2 Technical Aspects of Operation and Maintenance

Training sessions were organized by the equipment/machinery suppliers during the test operation of the project facilities and all staffs could join. However, since these sessions were conducted by foreigners in English, those who could not understand English did not always participate in them. No other training was provided to the staffs.

There have been no major accidents at the project facilities to date and all the facilities are in good operating condition. Nevertheless, additional efforts may be required to improve their operations and strengthen the staff capacity through basic data collection on operation and maintenance and the development of a mechanism to constantly improve the operation system.

2.5.1.3 Financial Aspects of Operation and Maintenance

Table 7 shows the financial situation of KWSB at the time of appraisal as well as for the last five fiscal years. Although the financial balance at the time of appraisal shows a surplus, huge losses have been recorded in the past five years. The reasons are two-fold:

① The Sindh Local Government Ordinance (SLGO) 2001 removed KWSB from the Government of Sindh and transferred it to one department of the City District Government of Karachi (CDGK). As a result, the subsidy from the Sindh Government, which had constituted an important part of revenue for KWSB, was abolished. CDGK is obliged to allocate 2% of its revenues to KWSB for its operating budget. However, it has not made any

[32] Only a reservoir had existed before the project.

[33] Kanpur water treatment plant in Islamabad has 0.4 staffs per 4,546 ㎥/day. Hub and Pipri treatment plants have 0.6 and 1.0 staffs per 4,546 ㎥/day in the project.

allocation to date.

② The increase of revenues from water charges could not keep up with the increase of expenditures, which rapidly increased due to the recent expansion of water supply. More in-depth analysis of KWSB's financial balance is shown below.

Table 7 Financial Balance of KWSB

(Million Rupees)

	93/94*1	01/02	02/03	03/04	04/05	05/06
Total Revenue	1,501	2,456	2,311	2,355	2,519	2,985
Income from water	1,075	2,405	2,272	2,331	2,232	2,664
Subsidy	366	0	0	0	0	0
Total Expenditure	1,046	3,296	3,820	3,689	3,745	3,999
Operational Balance	455	-840	-1,509	-1,334	-1,226	-1,014
Financial Charges	245	1,190	1,183	1,183	1,183	1,183
Total Balance	210	-2,030	-2,692	-2,517	-2,409	-2,197

(Source) KWSB

*1: Including sewerage

The table below shows the trends of major expenditure items:

Table 8 Trends of expenditures

(million Rs.)

	93/94*1	01/02	02/03	03/04	04/05	05/06	06/07*2
Total expenditure	1,046	3,296	3,820	3,689	3,745	3,999	3,375
Salaries	461	632	773	819	874	1,038	1,130
Electricity*3	300	1,232	1,368	1,621	1,641	1,687	500
Maintenance	243	134	108	185	161	237	618
Chemicals	12	24	29	16	29	27	63
Fuels	NA	60	62	39	45	54	54

(Source) KWSB

*1: No data for O&M. Data for 'Others' is indicated.

*2: Draft as of 16 March 2009

*3: Excludes arrears

Except for fiscal year 2006/07, salaries and electricity charges account for about 60% of total expenditures. Salary expenditures greatly increased in 2005/06 due to the revision of staff salaries. In 2008, unconfirmed information suggests that 6,000 staffs were newly hired[34]. If it is true, the salary expenditures may go up further.

Since the revenues from water charges have not been sufficient to cover all the expenses, there are accumulated arrears of electricity payments. In addition, the reduction of budgets for chemicals

[34] There were multiple accounts on this issue. However, no written documents were obtained to prove various allegations. It has also been suggested that these staffs were politically appointed and some were appointed as engineers even though they did not have relevant qualifications.

and fuels may impact on the smooth operation of facilities. In particular, although the need for chemicals increased after the start of the operation of project facilities in 2006/07, the actual budget allocation for chemicals has not been increased as required due to the financial crisis. This may have a negative impact on the smooth operation of the facilities.

The main factors leading to stagnated water charge revenues are the obsolete tariff structure and low recovery rates. Although the Government of Sindh approved a 9% annual increase of the water tariff in 2001, the decision has not been implemented. KWSB is planning to implement an accumulated 63%（9%×7 years）increase in the water tariff from 2009/10. In addition, it is also trying to install meters for bulk users, who account for 60% of total water charge revenues, to detect illegal tap-ins in order to improve recovery rates. Furthermore, KWSB has started discussions on a comprehensive tariff reform, which would enable KWSB to cover both investment and operation/maintenance costs.

Although the efforts for improving revenues are commendable, improving the financial situation requires not only improving recovery rates, but also strengthening the institutional capacity of KWSB, including human resources and operational efficiencies. Aiming for the sustainable operation of KWSB, the Study on Water Supply and Sewerage System in Karachi (July 2008), assisted by JICA, proposes institutional reforms consisting of the following components:

- Formulation of a business plan with a clear strategy, targets and indicators
- Separations of bulk and retail supplies and zone-wise management of retail supply
- Introduction of a volume-based tariff structure with the installation of meters
- Reduction of illegal tap-ins and water loss
- Implementation of a plan for the improvement of the distribution network to put KWSB on a financially sustainable footing
- Improvement of customer relations
- Introduction of equitable career progression and promotion based on merit
- Introduction of a formal policy and system for staff training

KWSB fully understands the needs for comprehensive reform and has taken several steps to implement the recommendations given by the JICA study, such as the setting up of a special committee. However, its efforts have not produced any concrete action plans, and the necessary coordination for the reforms involving the City Government of Karachi and Provincial Government of Sindh have yet to be made.

Since no clear direction for outcomes has been made for KWSB's institutional reforms, the sustainability of the project is considered unsatisfactory.

2.5.2 Current Status of Operation and Maintenance

The project facilities are operated and maintained based on the operation manuals provided by the suppliers. The facilities are in good conditions.

However, there was a case where the non-availability of an original part on the local market

resulted in the delay of repairs when a mechanical part in the Manghorpir pumping station was damaged due to silt included in the raw water. The concerned part was manufactured locally due to the non-availability of foreign exchange for procuring the part on the international market. Since it is not possible to avoid silt mixing with raw water, similar damage can happen again. The difficulty of obtaining original parts due to a shortage of foreign exchange may hamper smooth operations. In addition, the lack of budget may also disrupt smooth operations by hampering procurement of necessary chemicals and fuel for generators.

Lack of budget is a serious concern since it affects various aspects of operation, including the procurement of chemicals, fuel and spare parts.

3. Conclusion, Lessons Learned and Recommendations

3.1 Conclusion

The relevance as well as the effectiveness of the project is highly satisfactory while the efficiency is satisfactory. However, there are several concerns about the sustainability of the project. In light of the above, this project is evaluated to be fairly satisfactory.

3.2 Lessons Learned

- Since the project separated the contract for equipment/machinery from that for civil works, the specifications for facilities to be constructed were decided by the supplier of the equipment/machinery. Therefore, the civil work contractors had to be selected after the equipment/machinery supplier was selected and the said supplier developed the specifications of the facilities. However, the original schedule assumed the equipment/machinery supplier and the civil work contractors would be selected in parallel. The unrealistic implementation schedule, which did not include the 20 months normally required for selecting an equipment/machinery supplier, became the major reason for the delay of the project. An implementation schedule should be formulated carefully taking into account the relation of the procurement package with construction procedures and the implementation schedule.
- The project separated the contract for equipment/ machinery from that for civil works to ensure efficient project supervision by the implementing agency and competition among bidders for civil works. However, this procurement method caused the delay in implementation since 1) the tendering process took longer since the specifications for the civil works were not decided until after the equipment/machinery supplier was selected; 2) implementation took longer since the project required extra time for mobilization and demobilization between the stage of the project handled by the equipment/machinery supplier and that by the civil work contractors. On the other hand, although the project cost was lowered, selecting a contractor with low financial capacity caused further delays. As KWSB has already done for the projects, the procurement package should not be separated between equipment/machinery and civil works for a project whose specifications for facilities to be constructed change depending on the equipment/ machinery supplied.
- The project cost and implementation schedule of the project were not carefully estimated and examined at the time of appraisal. It may be preferable to double check these elements from

technical and financial viewpoints at the time of appraisal.

- In this project, there was a case where the non-availability of an original part on the local market due to a shortage of foreign exchange. Possibility and readiness of procured parts should be considered when selecting suppliers.

3.3 Recommendations

＜For the Executing Agency＞

- The project facilities have been put under the unusual circumstances where the treatment plants are being supplied with raw water exceeding their capacities. Although the priority is given to expanding the volume of water supply, the augmentation of water treatment capacity should also be considered in parallel with other urgent issues.
- In order to ensure the efficient and effective operation of the project facilities, recruitment and promotion procedures for human resources should be transparent, and the technical level of staffs should be upgraded through effective mechanisms for technical transfer.
- The effectiveness of the project will not be apparent if the water polluting factors at the end-user level, such as defects and deteriorations within the distribution network and illegal tap-ins, remain unsolved. Improving the distribution network as well as raising consumer awareness of appropriate water handling should be promoted. Since the chronic water shortages and lack of confidence in KWSB are the part of the reason consumers are engaged in the illegal tap-ins, attempts should be made to win consumer confidence in KWSB through continuous efforts and long-term engagement.
- Lack of financial sustainability does have a serious impact on the smooth operation of project facilities such as by causing shortages of necessary chemicals and fuels. In order to increase revenue from water charges, consolidated efforts, including the planned tariff reform, improving tariff recovery and installation of meters necessary for introducing the volume-based tariff structure, should be implemented properly.
- In order to ensure the sustainability of project effectiveness in the long term, the planned institutional reform should be carried out with strong commitment as well as ownership at the top level of KWSB.

＜For JICA＞

None.

Comparison of original and actual project scope

Item	Original	Actual
(1)Project Output	＜Pipri water treatment plant＞ ・ Dosing Facility (before filtration): acid, alum ・ 6 Filters ・ Backwashing system ・ Wash water recovery system ・ Chemical storage facilities ・ Staff housing ・ Other related works ＜Hub water treatment plant＞ ・ Distribution chamber ・ Dosing Facility (before filtration): chlorine, acid and alum ・ 20 Filters ・ Backwashing system ・ Dosing Facility (after filtration): chlorine, lime ・ Wash water recovery system ・ Chemical storage facilities ・ Administration building ・ Laboratory equipment ・ Staff housing ・ Other related works ＜Manghopir pumping station＞ ・ Inlet Works and Screen Chamber ・ Pump house, Bar and Bank screens ・ 5 Pumps -capacity 159,000 ㎥/day each ＜Consulting service> ・International :124MM ・Local :226MM	＜Pipri water treatment plant＞ ・ Dosing Facility (before filtration): acid, alum ・ 10 Filters ・ Backwashing system ・ Wash water recovery system ・ Chemical storage facilities ・ Other related works ・ Treated water forwarding pumping system ＜Hub water treatment plant＞ ・ Distribution chamber ・ Dosing Facility (before filtration): chlorine, acid and alum ・ 16 Filters ・ Backwashing system ・ Dosing Facility (after filtration): chlorine, lime ・ Wash water recovery system ・ Chemical storage facilities ・ Administration building ・ Laboratory equipment ・ Other related works ＜Manghopir pumping station＞ ・ Inlet Works and Screen Chamber ・ Pump house, Bar and Bank screens ・ 6 Pumps - capacity 4x: 159,000 ㎥/day, 2 x: 57,000 ㎥/day ＜Consulting service> ・International :299MM ・Local :974MM
(2) Project Period	November 1994 ～September 1999 （58 months）	November 1994 ～June 2006 （139months）
(3)Project Cost Foreign Currency Local Currency Total ODA loan portion Exchange Rate	 5,811 million yen 6,360 million yen （1,7000 million PKR） 12,117 million yen 10,299 million yen 1PKR＝3.71 yen （As of February 1994）	 3,828 million yen 2,897 million yen （1,468 million PKR） 6,725 million yen 6,316 million yen 1PKR＝1.97 yen （Average between Nov. 1994 and Aug. 2006）