EX-POST PROJECT EVALUATION 2010: PACKAGE IV-3 (CHINA)

DECEMBER 2011

JAPAN INTERNATIONAL COOPERATION AGENCY

SANSHU ENGINEERING CONSULTANT

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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, third-party evaluations conducted by experts will be enhanced.

This volume shows the results of the ex-post evaluation of ODA Loan projects that were mainly completed in fiscal year 2008, and Technical Cooperation projects and Grant Aid projects, most of which project cost exceeds 1 billion JPY, 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.

December 2011
Masato Watanabe
Vice President
Japan International Cooperation Agency (JICA)

Disclaimer

This volume of evaluations, the English translation of the original Japanese version, 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. JICA is not responsible for the accuracy of English translation, and the Japanese version shall prevail in the event of any inconsistency with the English version.

Minor amendments may be made when the contents of this volume is posted on JICA's website.

JICA's comments may be added at the end of each report when the views held by the operations departments do not match those of the external evaluator.

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People's Republic of China

Ex-Post Evaluation of Japanese ODA Loan Project
Kunming Water Diversion and Water Supply Construction Project

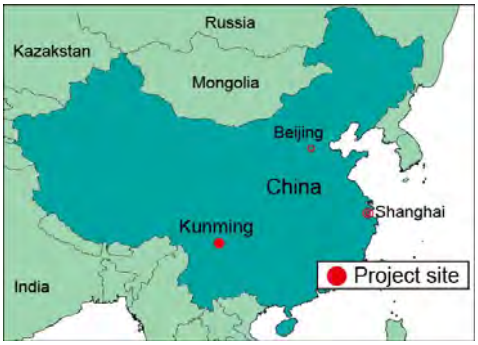
Yasuhiro Kawabata, Sanshu Engineering Consultant

0. Summary

The project objective was to contribute to the improvement of living conditions and sanitary environment, and to enhance the regional economic development through responding to the insufficient water supply capacity, as well as the ever increasing water demand, and providing stable supply of clean water by constructing the reservoir along the upstream of Zhangjiuhe river in the north of Kunming city, and a purification plant and its related water supply facilities. The project has been highly relevant because of its substantial impact to the Chinese and provincial development plans and needs, as well as Japan's ODA policies. The actual project cost exceeded the plan, and the project period was also longer than planned. Therefore, the efficiency is considered moderate. Regarding its effectiveness, the project has largely achieved its development objectives (to respond to the insufficient water supply capacity, as well as the increasing water demand, to provide stable supply of clean water for the improvement of living conditions and sanitary environment, and to enhance the regional economic development). Hence, its effectiveness is considered high. Since no major problems have been observed in the operation and maintenance system (organizational setup, technical capacity and financial status), sustainability of the project is considered high.

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

1. Project Description



Location of Project Site

No. 7 Purification Plant
(Sedimentation Pond and Office Buildings)

1.1 Background

Under China's reform and open-door policies which commenced in 1979, construction and improvement of the waterworks facilities, especially in large cities along the coastal regions, has been implemented as part of actions to improve the investment environment for attracting enterprises. The average water usage per person in 1998 was 214.1ℓ/day in urban areas, and reached the same level as that of Japan (248ℓ/day in Tokyo as of 1997). The coverage of the water supply system in urban areas has been steadily improving at the rates of 81% in 1980, and 89% in 1990. On the other hand, following the rapid economic development in the coastal areas, inland's medium to large cities have been suffering from the water supply and demand gap. This is due to increased water demand for industrial and home use as a result of rapid industrialization and urbanization which started in mid 1990s.

Kunming, the provincial capital of Yunnan Province, has been rapidly developing as a hub city of China's southwestern region, particularly as the current transit trade base with neighboring countries, such as Thailand. Regarding the urban infrastructure, particularly the water supply system, which supports the economy in Kunming, the gap between the water demand and supply capacity has been recently tight because of increase in population and industrial demand. In order to respond to the ever increasing water demand, there is an urgent need to enhance the facility's capacity. The city has long relied on Dianchi Lake (a fresh water lake) as the main water intake source. However, the water in Dianchi Lake has been severely polluted and was considered inappropriate as tap water.

1.2 Project Outline

The project objective is to contribute to the improvement of living conditions and sanitary environment, and to enhance the regional economic development through responding to the insufficient water supply capacity, as well as the ever increasing water demand, and providing stable supply of clean water by constructing the reservoir along the upstream of Zhangjiuhe river in the north of Kunming city, and a purification plant and its related water supply facilities. The project site is shown in Figure 1.

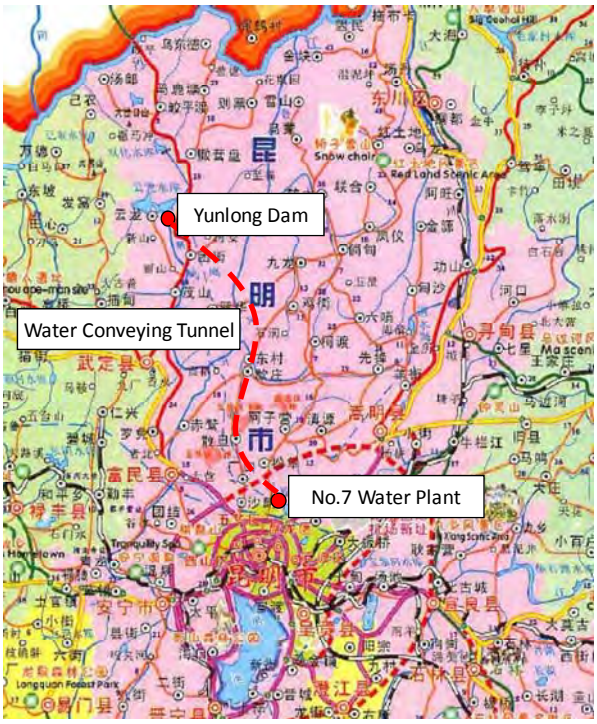


Figure 1 Location of the Project Site

Approved Amount/ Disbursed Amount	20,903 million yen/ 20,554 million yen
Exchange of Notes Date/ Loan Agreement Signing Date	March 2000/March 2000
Terms and Conditions	Interest rate 1.70%; Repayment period 30 years (Grace period 10 years); Conditions of procurement: General Untied, Consultant: Interest rate: 0.75%; Repayment period 40 years (Grace period 10 years), Conditions of procurement: Bilateral tied
Borrower/Executing Agency	Government of People's Republic of China/ Kunming Municipal Government
Final Disbursement Date	July 2008
Main Contractor (over 1 billion yen)	China Water Conservancy & Hydropower Engineering Bureau No.4 (CN), The 13th Engineering Bureau of China Construction Company (CN), Zhong Tie No.19 Engineering Bureau Co., Ltd. (CN), CNTIC International Business Company (CN), China Railway Engineering Corporation (CN), The 16th Engineering Bureau of CRCC (CN), Cooperativa Muratori & Cementisti C.M.C. Di Ravenna Soc. AR. (ITY), Shaanxi Provincial Bureau of Water & Electric Engineering (CN)
Main Consultant (over 100 million yen)	Electric Power Development Company

Relevant Studies (Feasibility Study and others)	Feasibility Study by Yunnan Province Hydrology and Hydro Power Survey and Design Institute (June 1997), EIA by Yunnan Province Environmental Science Research Institute (October 1998)
Relevant Projects	

2. Outline of the Evaluation Study

2.1 External Evaluator

Yasuhiro Kawabata, Sanshu Engineering Consultant

2.2 Duration of Evaluation Study

The subject ex-post evaluation assignment was implemented as follows:

Duration of the Study : December 2010 to December 2011

Duration of the Field Study : February 20-March 5, 2011 and May 15-28, 2011

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

3.1 Relevance (Rating: ③[2])

3.1.1 Relevance with the Development Plan

The China's 9th Five-Year Development Plan (1996-2000) stated that the waterworks infrastructure in rural cities was the most essential agenda, with the following targets to be achieved during the Five-Year Plan : i) increase the nationwide water supply by 40 million m^3/day; ii) raise accessibility ratio to portable water in urban areas to 96%; and iii) increase average water supply per person by 40ℓ/day. The facility capacity was increased by 13.15 million m^3/day by 1998 and consequently, the target should be achieved by year 2000 taking into account the facilities under construction. The target for raising accessibility ratio to portable water in urban areas had been achieved ahead of schedule in 1998. The average water supply per person in 1998 was 214 ℓ/day, which has exceeded the targeted volume of 210 ℓ/day. However, since the regions are still suffering from lack of water supply, the water supply development was one of the priority sectors in the urban development plan, as well as in the 10th Five-Year Plan that started in 2001.

In Yunnan's 9th Five-Year Plan (1996-2000) and the Provincial Development Objectives up to 2010, alleviation of poverty and promotion of regional economy had been emphasized. Particularly, the priority sectors to be promoted include economy in rural areas, energy, and tobacco/heavy electric machinery/food industries. In order to address these issues, it was considered essential to continue the development of urban infrastructure. Particularly in the water supply sector, it was proposed to implement the expansion of water supply pipelines,

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

2 ③: High, ②: Fair, ①: Low

water supply depending on the usage, and new construction/expansion of purification plants (No.1 and No. 6 Purification Plants) so that the water supply capacity in Kunming could be raised up to 830,000m^3/day in 2000 from the capacity of 490,000 m^3/day in 1995.

The China's 11th Five-Year Development Plan (2006-2010) included strengthening of the wellhead protection in urban areas, and promoting the construction of water supply facilities. The wellhead protection is also considered a priority agenda in the 12th Five-Year Development Plan (2011-2015). The following measures were proposed: i) expansion and rehabilitation of the aging small reservoirs; ii) rehabilitation of large/medium scale irrigation facilities; iii) countermeasure works against drought; iv) protection work for small scale reservoirs in rural areas; and v) countermeasure works for water resources for arable lands.

The Yunnan's 11th Five-Year Plan (2006-2010) states that construction of reservoirs needs to be accelerated in order to supply clean and safe water. In addition, it is proposed to raise accessibility ratio to portable water to the rural people, who do not receive the water supply services, and to increase water supply amount equal to urban areas.

In the National Development Plan and development plans for Yunnan Province and Kunming City at appraisal and post evaluation stages, the development/promotion of reservoirs and water supply facilities was a priority agenda. Thus, the project was in accordance with the National Development Plan and the development plans for the project target areas.

3.1.2 Relevance with the Development Needs

Regarding the urban infrastructure in Yunnan's capital city, Kunming, the expansion and enhancement of facilities, particularly water supply, was urgently needed in order to respond to the increasing water demand due to increased population and economic development. For the city, Dianchi Lake has been long an intake water resource. However, the water quality has recently deteriorated and thus, the water intake from the lake was considered inappropriate. The project's development objective is to respond to the water demand, involving construction of a reservoir along the upstream of Zhangjiuhe River in the north of Kunming city, installation of water conveying pipes up to Kunming, and construction of a purification plant and transmission/distribution pipes, was in accordance with the development needs of Kunming.

Kunming (city district) has a population of about 3.06 million as of 2008 and it is expected to be a metropolitan city with a population of 450-500 million by 2020. Thus, enhancement of water supply capacity is considered to be a top priority agenda for the development of the city. The water demand in the project target area is still increasing as population increases with the economic development, and thus the development needs in the project area was/is high at appraisal and at post evaluation.

3.1.3 Relevance with Japan's ODA Policy

According to the Overseas Economic Cooperation Implementation Policy (issued on December 1, 1999 and valid up to March 2002), the Japanese aid policy towards China focused on alleviation of disparity between regions, particularly giving priority to inland regions and the development of the economic and social infrastructure which would promote self-motivating economic development to advance the development of the private sector and democratic markets, as well as a well-balanced development to support a market-oriented economy. At the appraisal stage, the project was in accordance with the Japanese aid policies.

The project has made significant contributions to the Chinese development plan and needs, as well as Japan's ODA policies, and is therefore considered highly relevant.

3.2 Efficiency (Rating: ②)

3.2.1 Project Outputs

The project outputs (planned and actual) are summarized in Table 1.

Table 1 Comparison of project outputs (planned and actual)

Item	Planned	Actual
① Yunlong Dam[3] (Reservoir)	・ Crest length: about 240m ・ Dam height: about 80m ・ Reservoir capacity: about 400 millionm^3 ・ Reservoir area: 20km^2 ・ Reinforced concrete gravity dam	・ about 240m, as planned ・ 77.3m, almost as planned ・ about 484 million m^3 (about 20% increase) ・ 20km^2, as planned ・ as planned
② Water Conveying Tunnel[4]	・ from Yunlong dam to No.7 purification dam about 100 km	・ about 100 km, as planned
③ No.7 Purification Plant	・ Purification capacity: 400,000m^3/day (Phase I) ・ Condensed sedimentation rapid filtration	・ Purification capacity: 400,000m^3/day as planned ・ as planned
④ Distributing Facilities	・ Total length of distributing pipes: about 90km ・ Pumping station: 2 units with a capacity of 50,000m^3/day each	・ 93.4 km, almost as planned ・ Pumping station: as planned
⑤ Consulting Services	・ Detailed designs/preparation of bidding documents, assistance in bidding and advice ・ Supervision and assistance/advice on construction of difficult works ・ Technical assistance/advice (including safeguard issues) ・ Inputs (foreign) 3 persons, 40M/M, (local) 3persons, 10M/M	・ Scope of Work, as planned ・ Inputs (foreign) 8 persons, 44M/M, (local) 5 persons, 10M/M

Source: Response to the Questionnaire

Note 1: Phase 2 work of the purification plant (capacity of 200,000 m^3/day) commenced in 2007 and completed by end October 2010.

3 (for reference) Dimensions of the Miyagase Dam (multi-purpose dam), which is the water intake source for water supply serving for the 2/3 area of Kanagawa Prefecture including Yokohama, Kawasaki and Sagamihara are as follows: crest length: about 400m, dam height: 156m, reservoir capacity: about 193 million m^3 and reservoir area: 4.6km^2.

4 The length of 100km conveyance pipes is equivalent to the distance between Lake Ashinoko in Hakone and Tokyo downtown. As shown in the picture on page 8, pipes with a diameter of 3m were installed along the topography in the mountainous terrain. About 90km, which is 90% of the total length is tunnel sections and pipes were installed in tunnels. Thus, the construction work was a difficult one involving hauling the construction materials to the job site in the heavy mountainous terrain.

As shown in Table 1, the project outputs including the reservoir (Yunlong dam) and water supply facilities (conveyance tunnel, a No. 7 purification plant, and transmission/distribution facilities) have been constructed almost as planned.

Regarding the consulting services, even though at the appraisal stage three foreign engineers (two tunnel experts and a structural engineer) were planned to be involved, during the implementation it became clear that additional expertise (geology/soils, hydrology, and environment) was needed. Thus. the number of engineers was increased by 5. However, the input by foreign experts (M/M) slightly exceeded the original plan (by 10%).

Yunlong Dam (Reservoir and Intake Tower)

3.2.2 Project Inputs

3.2.2.1 Project Cost

The estimated total project cost at appraisal was 53.412 billion yen, of which the Japanese ODA loan was to be used only for the foreign currency portion amounting to 20.903 billion yen and the rest was to be financed by Yunnan Province and Kunming City. However, the actual total project cost was 69.076 billion yen, of which the Japanese ODA loan amount was 20.526 billion yen and the rest was funded by Yunnan Province and Kunming City. It exceeded the planned cost, equivalent to 129% of the planned project cost or 137% in Chinese yuan. The main reasons for the cost increase/decrease are as follows:

1) Yunlong dam: i) Due to the poor geological condition, design changes and variations were made during implementation; ii) Additional roads for maintenance were constructed along the reservoir; iii) In addition, a management office building and an apartment for the staff in charge of management and operation were constructed and iv) The equipment for transmitting water was also procured.
2) Water conveying facilities: The topographical and geological conditions were much worse than originally identified at the feasibility stage. Thus, the excavation volume

for conveyance tunnels has substantially increased and design changes/variations were made. One of reasons for cost increase was that the construction cost for temporary roads access to the job site for installation of conveyance pipes was not estimated at the planning stage.

Table 2 Comparison of Project Costs (Planned and Actual)

Item	Planned					Actual				
	Foreign	Local		Total		Foreign	Local		Total	
	Million yen	Million yuan	Million yen	Million yuan	Million yen	Million yen	Million yuan	Million yen	Million yuan	Million yen
Yunlong Dam	708	256	3,846	303	4,554	444	574	8,098	605	8,542
Conveying Facilities	14,180	326	4,889	1,271	19,069	16,552	1,116	15,757	2,289	32,309
Purification Plant	1,899	207	3,100	333	4,999	1,886	213	3,007	347	4,893
Distributing Facilities	2,057	111	1,671	249	3,728	1,490	168	2,376	295	4,166
Administration /taxes	0	229	3,435	229	3,435	0	73	1,037	73	1,037
Price Escalation	930	193	2,890	255	3,820					
Contingencies	989	96	1,446	162	2,435					
Consulting Services	140	0	0	9	140	154	0	0	11	154
Land Acquisition		605	9,080	605	9,080	0	834	11,766	834	11,766
Interest during Construction		144	2,156	144	2,156	0	440	6,209	440	6,209
Total	20,903	2,167	32,509	3,561	53,412	20,526	3,418	48,250	4,894	69,076

Source: Appraisal documents and Response to the Questionnaire

Note 1: Exchange rate at appraisal: 1 yuan=15 yen, Exchange rate at post evaluation: 1 yuan=14.114 yen (simple average figure between 2000 and 2008 checked by the evaluator)

Note 2: According to the JICA's record, the total disbursed amount is 20,554 million yen. According to the executing agency, 28 million yen was returned to the China Export and Import Bank.

3) Land acquisition and resettlement cost: Costs for the land acquisition were paid to individuals and the resettlement/compensation costs were paid for houses, arable lands, forest, orchards and others. With respect to resettlement of minority households, the cost for constructing facilities and infrastructure (including churches, cemeteries, and schools) for each community have also been accrued in order to maintain the minority group's culture, custom and life style.

4) Interest during the project implementation: The borrowed amount in local currency was tripled against the planned loan amount, and thus the interest amount was increased.

3.2.2.2 Project Period

The actual project period exceeded the plan. The project period planned at appraisal was from March 2000 (Loan Agreement signing month) to April 2006 (project completion) with a total period of 74 months. However, the actual project period was from March 2000 (Loan Agreement signing date) to March 2007 (commencement of water supply) with a total period of 85 months, or equivalent to 115% of the plan. Regarding the conveyance facility, which was considered to be a critical path in the total implementation plan, the commencement of work itself was delayed by about two years since sufficient time was spent for the geotechinical investigation, field surveys and detailed designs before the commencement of field work. However, since the actual construction period was shortened by 10 months, the delay of project completion (starting water supply) was delayed by 11 months. At the time when water supply started in March 2007, the total length of transmission/distribution pipes completed was 92.7 km. However, the remaining 0.7km section was completed with the local funds in June 2010 after the installation route was decided following the newly defined city planning of Kunming city.

Conveyance Pipes

Since the project cost exceeded the plan, and the project period was also longer than planned, the efficiency is therefore considered moderate.

3.3 Effectiveness (Rating: ③)

3.3.1 Quantitative Impacts

3.3.1.1 Results from Operation and Effected Indicators

(1) Improvement of Water Supply Facility Capacity in Kunming

The balance of water demand and supply capacity in urban Kunming City is shown in Table 3.

Table 3 Balance of Water Demand and Supply Capacity in Urban Kunming City

Unit: 0,000m^3/day

Year	2005	2006	2007	2008	2009	2010
Population water supplied (0,000 persons)	165	180	210	245	275	299
Water demand ①	114	117	122	130	140	152
Supply capacity ②	96.5	102.5	142.5	142.5	142.5	162.5
Balance between demand and capacity ②-①	-17.5	-14.5	20.5	12.5	2.5	10.5

Source: Response to the Questionnaire

Note 1: The reason for the capacity increase from 965,000m^3/day in 2005 to 1,025,00m^3/day in 2006 is due to the addition of a new plant with a capacity of 6m^3/day.

Note 2: Water supply from the purification plant (Phase 1 with a capacity of 400,000m^3/day) commenced in March 2007 and that from Phase 2 with a capacity of 200,000 m^3/day commenced in October 2010.

Upon completion of the project, the water supply capacity has exceeded the water demand, and thus the stable water supply has become possible. According to the executing agency, even with the drought in Yunnan Province in 2010, which has occurred only once in 100 years, the urban Kunming city did not experience any water stoppage because of the reservoir and the purification plant that were constructed under the project. The people's daily life was not affected either.

(2) Amount of Raw Water supplied from Yunlong Dam

The amount of raw water supplied from the Yunlong Dam is shown in Table 4.

Table 4 Amount of Raw Water Supplied from Yunlong Dam

Unit: 0,000m^3/day

	2005	2009	2010
Amount of raw water supplied	53.7	57.0	60.5

The amount of raw water supplied by Yunlong Dam has been increasing since 2005, and it is currently equivalent to the amount (600,000 m^3/day), which No. 7 purification plant can handle. The amount of water supplied by Yunlong Dam, which is less than the supply capacity, is about 70% of the water supplied to Kunming city. Thus, this water supply system is considered to be a life line for Kunming people.

(3) Supply of Safer Water

The water quality supplied by Yunlong Dam meets the Class 2 National Standards[5]. The water quality transmitted from No.7 Purification Plant also meets all the to-be- monitored items of the National Standards (turbidity, bacteria count, coli form count, manganese, iron, zinc content, etc.), and it has been proven to be suitable as tap water.

5 To be applied to the plant with a supply capacity of 500,000-1,000,000m^3/day.

3.3.1.2 Results of Calculations on Internal Rates of Return (IRR)

(1) Financial Internal Rate of Return (FIRR)

FIRRs at appraisal and at post evaluation are shown in Table 5.

Table 5 FIRRs at Appraisal and at Post Evaluation

	At appraisal	At post evaluation
FIRR	6.2%	1.84%

Benefits: Water charge revenue
(the current water charge is 2.45 yuan/m^3)
Costs: Construction costs, and operation/maintenance costs
Project Life: 50 years

The reasons for the lower FIRR at post evaluation were: i) the actual project cost was increased by 37% against the planned cost; and ii) the water charge rates were not increased to the level assumed at the planning stage (3.2 yuan/m^3).

3.3.2 Qualitative Effects

(1) Response to the still Increasing Water Demand

After the project was completed in 2007, the phase 2 work of No. 7 Purification Plant was also completed, and thus the stable water supply to the Kunming people became possible. The raw water of 600,000 – 700,000m^3/day has been transmitted to Kunming, and 600,000m^3 of water has been purified at No.7 Purification Plant, and the rest of water has been transmitted to other plants.

(2) Provision of Stable Supply of Clean Water

Since the raw water transmission from Yunlong Dam commenced in March 2007 and the water intake from Dianchi Lake, which had been long an intake supply, was prohibited, the water quality supplied to the people in Kunming has been tremendously improved.

The number of complaints from citizens in Kunming regarding water stoppage, insufficient water pressure, and water quality was 24,273 in 2006, of which 42% of the calls were received by the customers' service section of the water company. After the project was completed, the number of complaints was substantially reduced down to 7,891 in 2009 (about 70% reductions), of which only 5% of the calls were received by the customers' service section and most of calls were from outside the area not served. From these figures, it is considered that the stable water supply has contributed to the promotion of economic activities.

At the post evaluation stage, beneficiary surveys through interviews were conducted in the project targeted area. The total number of respondents was 100, including 7

businessmen, 61 company employees, 7 teachers, 2 students, 10 civil servants and 10 others. The classification of respondents by sex was 39% female and 61% male. From the surveys, it was confirmed that ninety-six (96) % of respondents has admitted that the project has contributed to enhancement of the living standards. Main other results of the beneficiary surveys are as follows:

1) Contribution to stable water supply: 91%
2) Perception on the sufficient supply amount: 94%
3) Perception on the substantial raise of water pressure: 93%
4) Perception on improvement of water quality (turbidity, taste, smell): 93%
5) Reduction of time needed for house work[6]: 95% (recognized reduction)

From the above results, it is considered that the project has contributed to the improvement of living conditions and sanitary environment.

Therefore, the project has largely achieved its development objective, and its effectiveness is considered high.

3.4 Impact

3.4.1 Appearance of Intended Impacts

(1) Contribution to the Regional Economic Development

The invested amount by enterprises outside the province to Kunming and the exported amount are shown in Table 6.

Table 6 Invested Amount by Enterprises outside the Province and the Exported Amount

	2006	2007	2008	2009	2010
Invested amount by enterprises outside the province (billion $)	151.95	197.13	251.12	346.13	467.289
Exported amount from Kunming (million $)	2,330	3,261	3,542	2,972	5,327

Source: Response to the Questionnaire

Since the stable supply of safer water to private households and also to the commercial and industrial purposes became possible by the project, the number of enterprises including foreign firms such as Pepsi Cola, Nestle, and Caterpillar and the investment have increased and thus, the export to the neighboring countries (Thailand, Vietnam, Laos and others) has increased as well. The reason for reduction of the export amount in 2009 is that the world economy was affected by the Lehman's fall.

6 Since before the project, water stoppage and lack of water pressure occurred during day time, extra time was needed to store water during night time. After the project, water is available any time needed by getting a faucet turned on.

3.4.2 Other Impacts (Positive or negative impacts)

(1) Impacts on the surrounding environment

At appraisal, the two concerned issues were: i) impacts to the downstream water (flow volume and water quality) due to the dam construction; and ii) the sludge comes up during the process of water purification. Regarding the impacts to the downstream water, since Yunlong Dam is a reservoir, in which the impurity settles down and the water is purified by itself, the water purified to some extent has been discharged so that no negative impacts have been observed. In addition, since one of objectives for the reservoir construction was to distribute water to the irrigation facilities along the downstream area, the water distribution to the irrigation facilities has been made during the drought season for the past few years. Thus, no issues are observed. The sludge that came up during the purification process has been dried and compacted in the treatment facility within the purification plant, and has been transported to the designated reclaimed area.

(2) Land acquisition and Resettlement

The actual figures, including the land area acquired mainly for dam construction (about 85ha), the number of resettled people (about 11,800 persons), and costs for land acquisition and compensation for resettlement (652.57 million yuan for land acquisition and 181.08 million yuan for compensation paid to individuals with a total amount of 833.65 million yuan) were almost equal to the estimate at the planning stage.

According to the executing agency, a Resettlement Action Plan was prepared for resettlement of people. Compensation was paid by item and according to its value, and standard unit prices for land, buildings/houses, forest, arable land, orchards and others have been set. Compensation to the private properties was paid to each household and assets that belonged to the local government or community was paid to its group. People totaling about 11,800 have resettled to Anning City, Guangdu District, Xishan District and other locations in the suburb of Kunming by December 28, 2002. Some of resettled people are family members of the minority group. According to the executing agency, sufficient consideration was made for them so that they could maintain their traditional custom, culture, and life style also in the newly resettled area. Construction of cultural facilities in the dwelling area is one of examples provided. This was confirmed by seeing the houses, a church and a meeting place by the evaluation team while visiting the resettled area (Xishan District) inspecting the evaluation team. Through interviews with people resettled, it was confirmed that they were satisfied with the compensation made.

The compensation and welfare contents provided by the local government or communities include the following:

1) arable land: 1,000～1,300m^2/person
2) land for dwelling: 100～150m^2/household (depending on number of family members)
3) house: 22m^2/person (brick house)
4) forest and cemetery: area taking into accounts the condition of the allocated site
5) access roads to the neighboring schools
6) continuous financial assistance: 600 yuan/person/year (for 20 years since July 2006)

Based on the above, it is considered that the social impact due to the land acquisition and resettlement has been well alleviated by provision of appropriate compensation and support.

3.5 Sustainability (Rating: ③)

3.5.1 Structural Aspects of Operation and Maintenance

In 2006, Kunming Tongyong Water Supply Company (KTWSC), jointly owned by Kunming Water Supply Company and French Veolia Water Company, was established. The operation and maintenance work for the No. 7 Purification Plant has been entrusted to KTWSC. The number of KTWSC staff engaged in the operation and maintenance work for No.7 Purification Plant is 61, including 15 administrative staff and 46 technical staff. The number of staff of the Maintenance and Management Section of KTWSC, responsible for the repair work including the regular maintenance and comprehensive inspection, is 34 and that of the Business Operation Section is 14.

When the project was completed in May 2009, Yunnan Fengyuan Water Supply Company (YFWSC), which is owned by Kunming Water Supply Company (60%) and Yunnan Urban Investment and Construction Company (40%), was established. Since then YFWSC has been responsible for operation and maintenance of the intake facility (Yunlong Dam) and for the overall management of No. 7 Purification Plant, including its operation and maintenance work and the loan repayment.

3.5.2 Technical Aspects of Operation and Maintenance

Of the 46 technical staff of No. 7 Purification Plant, 10 staffs are senior technicians, with associate degrees or above are responsible for water treatment, and the remaining 36 are technicians. Of the 34 staff of the Maintenance and Management Section of KTWSC, 21 staffs have professional certificates (high voltage operation, electrician, hazardous chemicals, and others). The company's Personnel Section has regularly provided a staff training program on the daily operation work. In addition, a few times a year the joint venture company, Veolia Water Company, send experts to KTWSC for training. In August 2010, a water specialist provided a special training program on water treatment process, and an equipment specialist on the equipment operation and maintenance. The specially selected staff has been also sent to a

special training program outside of Kunming, and thus the company has been eager to educate staff and strengthen its institutional capacity.

3.5.3 Financial Aspects of Operation and Maintenance

YFWSC, instead of Kunming Water Supply Company, which was the executing agency during project implementation, has been responsible for operation and maintenance of the intake facility and for the overall management of No. 7 Purification Plant, including its operation and maintenance work and the loan repayment. The main sources of income for YFWSC are sales from raw water to KTWSC and the subsidy from Yunnan Province and Kunming city, which is used to repay its loans. The revenue and expenditures of Yunnan Fengyuan Water Supply Company for 2010 is shown in Table 7.

Table 7 Revenue and Expenditures of Yunnan Fengyuan Water Supply Company (2010)

Item	Million yuan
Business revenue	114.69
Non business revenue	143.87
Operation and Maintenance cost	68.63
Depreciation of equipment and fixed assets	96.31
Financing expenses	65.31
Business revenue	28.32

The financial status of YFWSC recorded a surplus in 2010.

The major share holder of KTWSC and YFWSC is Kunming Water Supply Company (100% owned by Kunming City), and thus the water business has been controlled and managed by Kunming Municipal Government. Since the transmitted and distributed water from No. 7 Purification Plant, with Yunlong Dam as its water resource, has occupied about 70% of supplied water to Kunming, the financial status of YFWSC is considered to be stable. The present water charge rate is 2.45 yuan/m^3 (for home use), which is slightly lower than that in other cities. According to the beneficiary surveys, 90% of respondents answered that the present water rate was reasonable. The change of water charge rates is eventually determined by the city's Price Regulation Bureau, referring to the water company's financial status, charge rates of other public utilities and other factors. As the on-going sewage work has been completed, the review of water charge rates will be made.

3.5.4 Current Status of Operation and Maintenance

Currently, YFWSC is responsible for operation and maintenance of the intake facilities at Yunlong Dam, and the high-quality water has been transmitted to No. 7 Purification Plant,

adjusting the opening gates. The amount of transmitted water has been measured at the transmission gate of the intake facility and at the intake gates of No.7 Purification Plant. The maintenance work for the intake facilities has been regularly carried out according to the relevant regulations and manuals.

KTWSC has been responsible for operation and maintenance of No.7 Purification Plant. Minor problems during regular operation are generally resolved by the Plant. Only when the problem is difficult to be resolved by the Plant, the Operations Section of KTWSC handles the problems. The Maintenance and Management Section of KTWSC is responsible for repair work, including the regular maintenance and comprehensive inspection.

Based on the above, since no major problems have been observed in the operation and maintenance system (organizational setup, technical capacity and financial status), sustainability of the project is considered high.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

The project objective was to contribute to the improvement of living conditions and sanitary environment, and to enhance the regional economic development through responding to the insufficient water supply capacity, as well as the ever increasing water demand, and providing stable supply of clean water by constructing the reservoir along the upstream of Zhangjiuhe river in the north of Kunming city, and a purification plant and its related water supply facilities. The project has been highly relevant because of its substantial impact to the Chinese and provincial development plans and needs, as well as Japan's ODA policies. The actual project cost exceeded the plan, and the project period was longer than planned. Therefore, its efficiency is considered moderate. The project has largely achieved its development objectives (to respond to the insufficient water supply capacity and ever increasing water demand, to provide stable supply of clean water, to contribute to the improvement of living conditions and sanitary environment, and to enhance the regional economic development), therefore its effectiveness is considered high. Since no major problems have been observed in the operation and maintenance system (organizational setup, technical capacity and financial status), sustainability of the project is also considered high.

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

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

None.

4.2.2 Recommendations to JICA

None.

4.3 Lessons Learned

The project included construction of a reservoir (with a capacity of about 400 million m^3), water conveying tunnels (about 100km), a purification plant (400,000 m^3/day), and transmission/distributing facilities (with a total pipe line length of 90km). The actual total project cost was 69 billion yen. Each component was a huge civil work by itself. Due to lack of detailed technical investigations, major design changes/variations occurred during project implementation and the costs for land acquisition and resettlement exceeded the plan by about 40%. With respect to a huge project involving several major project components such as this project, it is recommended to invite external experts to the project appraisal team in order to improve the assessment and appraisal quality. It would be possible to reduce the design changes and variations and consequently to minimize cost increase and extension of the project period by undertaking more detailed review on the technical appropriateness to be applied.

Comparison of the Planned and Actual Scope of the Project

Item	Planned	Actual
① Outputs		
1) Yunlong Dam (Reservoir)	・ Crest length: about 240m ・ Dam height: about 80m ・ Reservoir capacity: about 400 millionm^3 ・ Reservoir area: 20km^2 ・ Reinforced concrete gravity dam	・ About 240m, as planned ・ 77.3m, almost as planned ・ About 484 million m^3 (about 20% increase) ・ 20km^2, as planned ・ As planned
2) Water Conveying Tunnel	・ From Yunlong dam to No.7 purification dam about 100 km	・ About 100 km, as planned
3) No.7 Purification Plant	・ Purification capacity: 400,000m^3/day (Phase I) ・ Condensed sedimentation rapid filtration	・ Purification capacity: 400,00m^3/day as planned ・ as planned
4) Distributing Facilities	・ Total length of distributing pipes: about 90km ・ Pumping station: 2 units with a capacity of 50,000m^3/day each	・ 93.4 km, almost as planned ・ Pumping station: as planned
5) Consulting services	・ Detailed designs/preparation of bidding documents, assistance in bidding and advice ・ Supervision and assistance/advice on construction of difficult works ・ Technical assistance/advice (including safeguard issues) ・ Inputs (foreign) 3 persons, 40M/M, (local) 3persons, 10M/M	・ Scope of Work, as planned ・ Inputs (foreign) 8 persons, 44M/M, (local) 5 persons, 10M/M
② Duration	March 2000 (L/A) ~ April 2006 (project completion) (74 months)	March 2000 (L/A) ~ March 2007 (Water supply) (85 months)
③ Project cost		
Foreign currency	20,903 million yen	20,526 million yen
Local currency	32,509 million yen 2,167 million yuan	48,250 million yen 3,418 million yuan
Total	53,412 million yen	69,076 million yen
Yen Loan Portion	20,903 million yen	20,526 million yen
Exchange rate	1 Yuan = 15 yen (as of June 1999)	1 yuan = 14.114 yen (Average of September 2000 ~ September 2008)

People's Republic of China

Ex-post Evaluation of Japanese ODA Loan Project

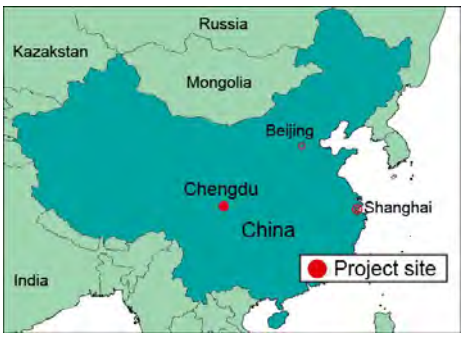
Chengdu Water Supply Project

Akemi Serizawa, Sanshu Engineering Consultant

0. Summary

This project to improve the water supply systems in Chengdu has been highly relevant with China's development plans, development needs, as well as Japan's ODA policy; therefore its relevance is high. The needs to enhance the water supply capacity were low during the originally-planned project period because the water demand in the central and suburban districts of Chengdu did not increase as much as anticipated after the relocation of factories following the new city planning policy since 2002. The water demand later increased and is now covered by the current supply capacity strengthened by this project. The project cost was lower than planned, but the project period was substantially longer than planned; therefore the efficiency is moderate. The project has largely achieved the development objectives, which were to enhance the water supply capacity and to respond to the water demand, thus to contribute to regular supply of safe water. Therefore, the effectiveness is high. Since no major problems have been observed in the operation and maintenance systems such as organizational setup, technical capacity and financial status, the sustainability of the project is considered high.

1. Project Description



Location of Project Site

Plant C,
Chengdu Sixth Water Purification Plant

1.1 Background

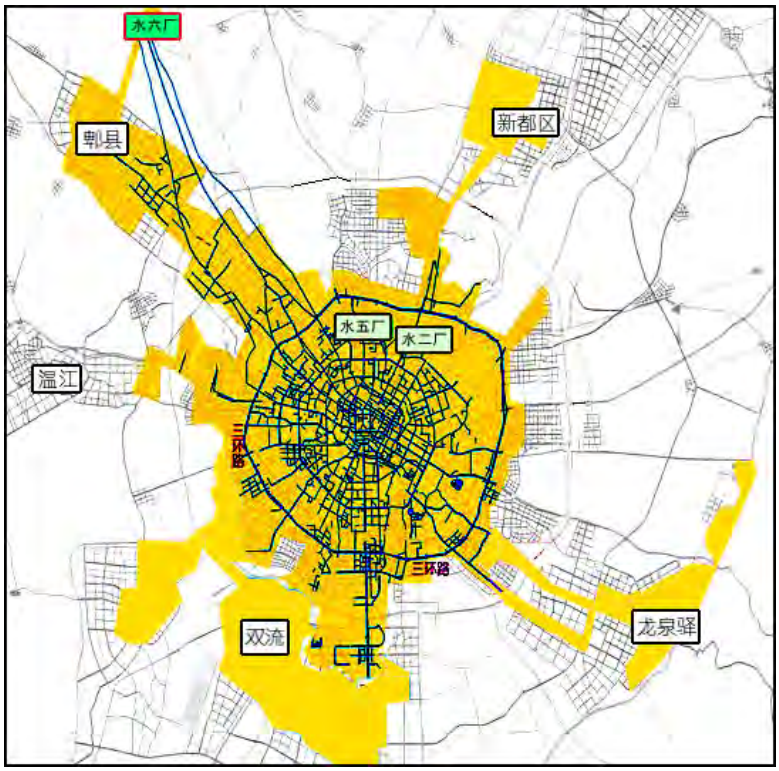
The demand-supply gap of water has been a problem in large cities in the inland China since the 1990s because of the rapid increase of the water demand for industrial and domestic use from the industrialization and the concentration of population.

Chengdu is the capital of Sichuan Province. In 1998, the population of the central districts, the suburban districts and the satellite cities was 9,890 thousand in total (the administrative

divisions of Chengdu are shown in Figure 2). Its main industries are machine, electronics, pharmaceutical products and agriculture, and its GDP growth rate was above 10% in the mid-1990s. The target areas of the project are the central and suburban districts of Chengdu, which had four water purification plants (first, second, fifth and sixth) with the total facility capacity of 1,053,000m^3/day at the time of appraisal in 2000. The capacity was not sufficient to cover the demand as shown by the fact that the maximum water supply record of 1,120,000 m^3/day exceeded the capacity. At the time of appraisal, the estimated water demand in 2005 was 1,730,000 m^3/day and it exceeded the anticipated water supply capacity of 1,453,000 m^3/day that included Plant B (400,000m^3/day) which was under construction at that time as the fourth phase of the Sixth Water Purification Plant project. In order to meet the needs to further enhance the water supply capacity, this project to construct Plant C (400,000m^3/day) as the fifth phase of the Sixth Water Purification Plant project was planned.

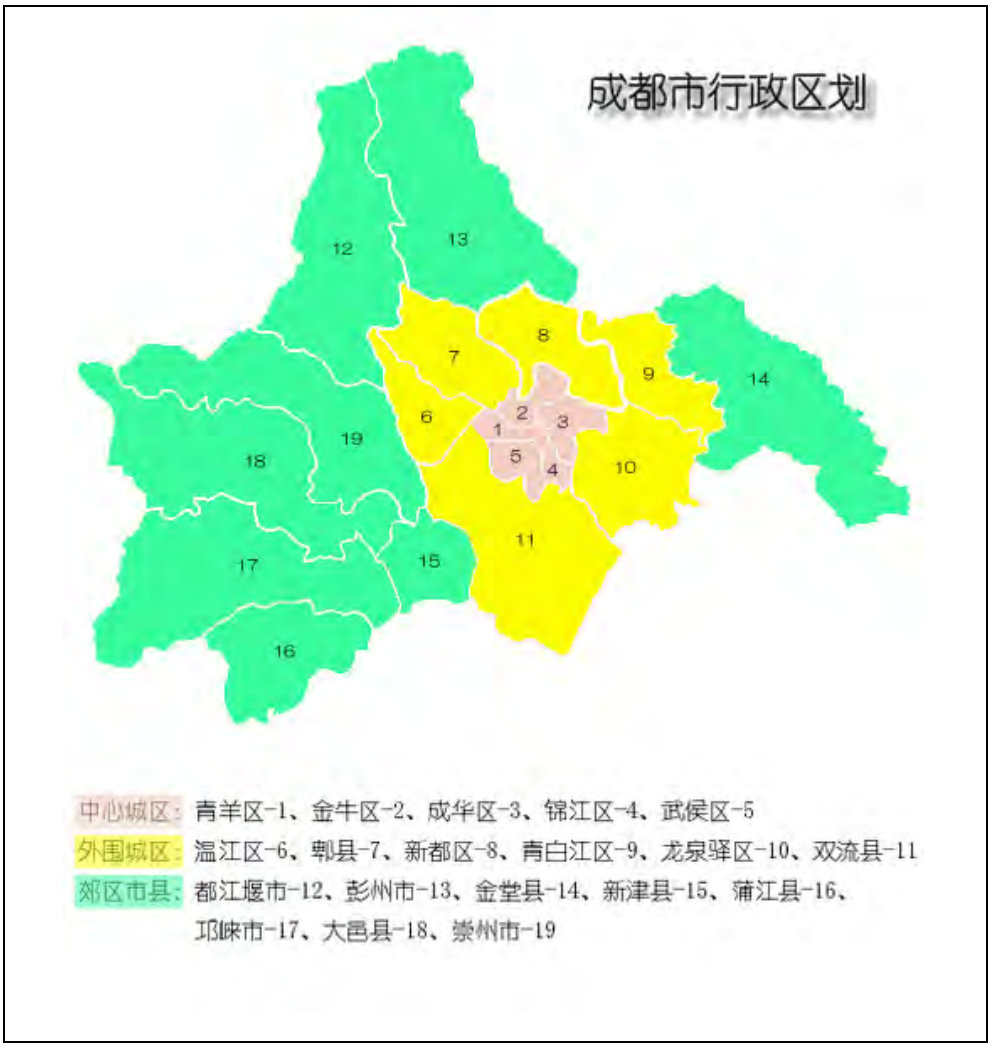
1.2 Project Outline

The project objective is to respond to the shortage of the water supply capacity and meet the demand in the future in the central and suburban districts in Chengdu and then to the stable supply of safe water through the expansion of the Sixth Water Purification Plant. The project areas are shown in Figure 1.



Source: Chengdu Municipal Waterworks Co., Ltd.

Figure 1. Project areas



Source: Wikipedia

Figure 2. Administrative divisions of Chengdu

The three water purification plants (Second, Fifth and Sixth) currently supply water to Chengdu central districts and five suburban districts (Wenjiang District, Pi County, Xindu District, Longquanyi District and Shuangliu County). The Second and Fifth Water Purification Plants are located in the central districts. The Sixth Water Purification Plant is in Pi County, about 27 km north-west from Chengdu central districts. It has three water purification plants, namely Plant A (600,000m^3/day), Plant B (400,000m^3/day) and Plant C (400,000m^3/day), with a total of 1.4 million m^3/day capacity. This project was to construct Plant C and install related transmission and distribution pipelines as the fifth phase of the Sixth Water Purification Plant project. The Second, Fifth and Sixth Water Purification Plants and pipelines form the water supply network of Chengdu central and suburban districts as a unit. Therefore, it is not possible to identify the specific areas served by Plant C constructed by this project.

Approved Amount/Disbursed Amount	7,293 million yen / 4,244 million yen
Exchange of Notes Date/Loan Agreement Date	March 2000 / March 2000
Terms and Conditions	Interest rate 1.70% Repayment period 30 years (Grace period 10 years) Condition of procurement: General Untied
Borrower/Executing Agency	Government of People's Republic of China / The People's Government of Chengdu City
Final Disbursement Date	December 2007
Main Contractor (over 1 billion yen)	-
Main Consultant (over 100 million yen)	None
Relevant Studies (Feasibility Study and others)	F/S by China Southwest Municipal Engineering Design Institute (November 1998)
Relevant Projects	Chengdu Générale des Eaux-Marubeni Waterworks Co., Ltd. "BOT Chengdu Water Supply" (Plant B, the fourth phase of the Sixth Water Purification Plant project, 400,000m^3/day) (started operation in February 2002) ADB "BOT Chengdu Water Supply" (Technical Assistance) (1997-2000)

2. Outline of the Evaluation Study

2.1 External Evaluator

Akemi Serizawa, Sanshu Engineering Consultant

2.2 Duration of Evaluation Study

The subject ex-post evaluation assignment was implemented as follows:

Duration of the Study: December 2010-December 2011

Duration of the Field Study: February 20-March 5 and May 15-28, 2011

2.3 Limitation of evaluation

The construction of the water purification plant (Plant C) started in 2009 using the local fund after the final disbursement date (December 2007), and it started operation in May 2010. At the time of ex-post evaluation in 2011, it was too early to obtain statistics of 2010 or to expect that the data reflect the impacts of this project. Therefore, the analysis of the impact largely depended on the qualitative information such as subjective opinions of the executing agency and the beneficiaries.

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

3.1 Relevance (Rating[2]:③)

3.1.1 Relevance with the Development Plan

The 9th Five-Year Development Plan of China (1996-2000) stated that the improvement of water supply systems in the regional cities was one of the most essential agenda, and set up the following targets to be achieved during the Five-Year Plan period: i) increase of nationwide water supply by 40 million m^3/day; ii) raise the water supply coverage in urban areas to 96%; and iii) increase the average water supply per person by 40ℓ/day. The water supply facility capacity increased by 13.15 million m^3/day by 1998, and thus the target should have been achieved by 2000 taking into account the facilities under construction. The target of water supply coverage in urban areas had been achieved by 1998, ahead of the schedule. The average water supply per person in 1998 was 214 ℓ/day, which has exceeded the target (210 ℓ/day). Since many areas still suffered from the shortage of water, however, the improvement of water supply systems was among the priorities in the urban development plan also in the 10th Five-Year Plan (2001-2005). The 11th Five-Year Development Plan (2006-2010) of China stated that the protection of water sources for urban areas was to be strengthened, and the construction of water supply facilities was to be further promoted. The ongoing 12th Five-Year Development Plan (2011-2015) also promotes the improvement of basic infrastructures including water supply and wastewater treatment systems to ensure supply of safe water.

The 11th and 12th Five-year Development Plans of Chengdu City prioritized the expansion of the water supply systems. The 12th plan aims that the percentage of population served should reach 100% in the central areas in two years and in the suburban and rural areas in five years.

The project was in line with the national policy of China and the development plans of Chengdu City because the improvement of water supply systems was among the priority areas, both at the appraisal and ex-post evaluation.

3.1.2 Relevance with the development needs

In 1998, the water supply capacity of the central and suburban districts of Chengdu was 1,053,000m^3/day in total. The maximum supply record was 1,120,000m^3/day, which exceeded the facility capacity by 7%. Due to the concentration of population into the central districts and the expansion of the water served areas in the suburban districts, it was estimated at the time of appraisal that the water demand in 2005 would reach 1,730,000m^3/day. However, it was anticipated that the total water supply capacity would be only 1,453,000m^3/day including the plant under construction at that time (Plant B, the fourth phase of the Sixth Water Purification

1 Overall rating: A: “very high”, B: “high”, C: “low in some aspects”, D: “low”
2 Rating: ③: “high”, ②: “moderate”. ①: “low”

Plant project). Therefore, this project to construct Plant C as the fifth phase of the Sixth Plant to add a 400,000m^3/day capacity was relevant to the development needs at the time of appraisal.

The growth of the water demand was slower than anticipated: it was only 1,147,500 m^3/day in 2003, the year in which the project was to be completed originally (the estimate was 1,620,000m^3/day). In 2007, the demand was 1,246,900 m^3/day, far below the estimate of 1,810,000m^3/day. The water supply capacity for Chengdu central and suburban districts had increased to 1,380,000 m^3/day with the completion of Plant B of the Sixth Water Purification Plant in 2002, and it was sufficient to cover the water demand in 2007. According to the executing agency, the reason for the slower growth of the water demand was that many factories relocated to the outside of the central and suburban districts following the Urban-rural Integrated Development policy of Chengdu (2002-2006), a new city planning policy to separate the residential and industrial areas. The relocated factories included a steel pipe factory, a geothermal power plant and a bearing factory among others of large to medium scale that had been in the eastern area of the central districts. Another reason for the slower growth of the water demand was the promotion of water-saving and recycling of water. While the original plan of this project was to start operation of Plant C in December 2003, its construction was postponed as it was not needed in terms of the actual water demand at that time, and the final disbursement date of the yen loan arrived in 2007.

Since then, the empty lots after the factories moved out became residential areas, and the water demand for the domestic use increased rapidly. The water demand of Chengdu central and suburban districts reached to 1,354,700m^3/day in 2008 and 1,512,800 m^3/day in 2009, which exceeded the supply capacity of 1,380,000m^3/day. Because of the insufficient capacity, water supply was short in the peak hours in the morning and evening as well as in summer, about which the customers complained. In order to respond to the increase in the demand, Plant C of the Sixth Water Purification Plant was finally constructed from 2009 to 2010 by the local fund. The water supply capacity of the city reached 1,780,000 m^3/day and it covers the demand 1,635,000 m^3/day in 2010. Chengdu City is planning to construct another water purification plant (the Seventh Plant) in order to respond to the increasing water demand.

From the above, the needs to expand the water supply capacity for Chengdu central and suburban districts existed both at appraisal and at the ex-post evaluation. During the planned project period, however, there were no urgent needs to expand the capacity because of the slower growth of the water demand in the central and suburban districts due to the relocation of the factories following the new city planning policy. However, as it was not possible to foresee at the time of appraisal the change in the city planning policy that led to the slower growth of the water demand, it was appropriate to postpone the construction of the plant according to the actual demand.

3.1.3 Relevance with the Japan's ODA policies

According to the Overseas Economic Cooperation Implementation Policy (issued on December 1, 1999 and valid up to March 2002), the Japanese aid policy towards China focused on the alleviation of the disparity between regions, particularly giving priority to the inland regions and the development of the economic and social infrastructure which would promote self-motivating economic development in order to promote the development of the private sector and democratic markets, and to urge the well-balanced development to promote the market-oriented economy. This project to improve water supply systems was in line with the Japanese aid policies.

The project has been highly relevant to the development policies in China, development needs, as well as Japan's ODA policies, and therefore the relevance of the project is high.

3.2 Efficiency (Rating: ②)

3.2.1 Project Outputs

The project outputs (planned and actual) are summarized in Table 1.

Table 1. Comparison of Project Outputs (Planned and Actual)

Item	Planned	Actual
① Intake facility (not included in this project. Constructed as a part of Plant B project)	・ Intake header 480,000m^3/day x 2 ・ Inlet pipes approx. 1.9km x 2	As planned. ・ Intake header 480,000m^3/day x 2 ・ Inlet pipes approx. 1.9km x 2
② Connection pipes (local fund)	・ Connection pipes approx. 0.16km	As planned. ・ Connection pipes approx. 0.16km
③ Water purification plant (it was to be funded by the yen-loan, but was funded by the local fund)	・ Plant C 400,000m^3/day (coagulation-sedimentation-rapid filtration system) Flocculation basin, sedimentation basin, filtration basin	As Planned. ・ Plant C 400,000m^3/day (coagulation-sedimentation-rapid filtration system) Flocculation basin, sedimentation basin, filtration basin
④ Water transmission facility (yen-loan fund and local fund)	・ Water transmission pipelines approx. 25km	Mostly as planned ・ 26km Water transmission pipelines approx. 26km (20 km of which used yen-loan)
⑤ Water distribution facility (yen-loan fund and local fund)	・ Water distribution pipelines approx.140km ・ Pressure station 40,000m^3/day	The distribution pipelines were 54 km shorter than the plan. The pressure station was cancelled. ・ Water distribution pipelines approx. 86km (42km of which used yen-loan) ・Pressure station was cancelled.

Source: Questionnaire responses

The planned outputs have been completed almost as planned. The revised items and the reasons for the change are as follows:

- The total extension of the distribution pipelines was 54 km shorter than the plan. The original plan was to install four pipes along the third ring road of Chengdu, but the design was revised and three pipes were sufficient.
- The pressure station was cancelled. The original plan was to construct it on the hill between the third ring road and Longquanyi District in order to obtain sufficient pressure to distribute water to the areas around the pressure station. It was confirmed later that it was possible to obtain sufficient water pressure without the pressure station. The water from the Sixth Water Purification Plant (560m above sea level) is sent to the central districts (500m above sea level around the third ring road) only by the gravity.

Water intake point

Chengdu Municipal Waterworks Co., Ltd.

3.2.2 Project Inputs

3.2.2.1 Project Cost

The project cost was lower than the plan. The estimated project cost at appraisal was 17,958 million yen, of which the Japanese loan was used only for the foreign currency portion amounting to 7,293 million yen and the rest was to be financed by Chengdu Municipal Waterworks Company's own-fund, loan from the China Construction Bank and investment from Chengdu Municipal Government. The actual project cost was 14,938 million yen, of which the Japanese loan covered the whole foreign currency portion amounting to 4,244 million yen, and the rest was financed by Chengdu Municipal Waterworks Company's own-fund, loan from the China Construction Bank and investment from Chengdu Municipal Government. The actual project cost was 83% of the plan in Japanese yen, and 89% of the plan in Chinese currency. The difference in Japanese yen was due to the shorter construction period of the water purification plant and the shorter total extension of the water distribution pipelines from the revision of the design, and the change of the exchange rate (1 yuan = 15 JPY at appraisal and 1 yuan = 14 JPY at ex-post evaluation), all of which were reasonable.

Table 2. Project cost

Item	Planned (million yen)			Actual (million yen)			Reasons for the difference
	Total	FC	LC	Total	FC	LC	
Land acquisition	1,973	0	1,973	652	0	652	A part of the cost of land acquisition is included in the cost of the water transmission facility (below) for an accounting reason.
Preparatory work	45	0	45	-	-	-	-
Water purification plant	3,948	2,024	1,924	3,113	0	3,113	The construction period of the water purification plant was only 15 months. The original plan was 36 months.
Water transmission facility	2,445	2,137	308	6,467	2,993	3,534	This item was larger than the plan because the law material price was high and a part of the cost of land acquisition is included here (see above).
Water distribution facility	6,040	2,628	3,412	4,706	1,311	3,395	The total extension of the distribution pipeline was 54km shorter than the plan.
Others	785	0	785	-	-	-	-
Price escalation	827	157	670	-	-	-	-
Contingency	803	347	456	-	-	-	-
Interest	1,092	0	1,092	-	-	-	-
Total	17,958	7,293	10,665	14,938	4,244	10,694	

Note: FC: foreign currency; LC: local currency
Source: Appraisal documents, questionnaire responses

Water purification plant (Plant C)

Water purification plant (Plant C)

3.2.2.2 Project period

The actual project period substantially exceeded the plan. The project period planned at appraisal was 46 months from March 2000 (signing of the Loan Agreement) to December 2003 (start of operation). The actual project period was from March 2000 (signing of Loan Agreement) to May 2010 (start of operation) with a total of 123 months, which was 267% of the plan. This prolonged project period is due to the postponement of the construction of the water purification plant, which took place from 2009 to 2010, as explained above.

The completion of the project is defined as the start of operation in May 2010. On the final disbursement date in December 2007, the construction of Plant C had not been commenced and only a part of the water transmission pipelines (17.8km) and the distribution pipelines were completed. These pipelines were installed between 2000 and 2004 almost as planned. The distribution pipelines were installed at the same time with road works in Chengdu City. The pipelines have been utilized as a part of the water supply network of the central and suburban districts of Chengdu even before the construction of Plant C.

From the above, the project cost was within the planned cost, but the project period was much longer than planned; therefore the efficiency is moderate.

3.3 Effectiveness (Rating: ③)

3.3.1 Quantitative effects

3.3.1.1 Results from Operation and Effect Indicators

(1) Enhancement of water supply capacity

Table 3 shows the balance of water demand and supply in Chengdu central and suburban districts.

Table 3. Balance of water demand and supply in Chengdu central and suburban districts

Year	1998	2003	2007	2008	2009	2010
Population served (10,000 persons)	209.5	261.7	301.0	307.6	309.6	(Note 2)
Water demand ($10,000m^3$/day)	135.0	114.9	124.7	135.5	151.3	163.5
Water supply capacity ($10,000m^3$/day) (Note 1)	105.3	138.0	138.0	138.0	138.0	178.0
Balance between water demand and supply capacity ($10,000m^3$/day)	-29.7	23.1	13.3	2.5	-13.3	14.5

Source: Appraisal documents, questionnaire responses

Note 1. In 2002, 400,000 m^3/day capacity of Plant B was added. The decrepit First Water Purification Plant of 73,000m^3/day capacity was closed down. In May 2010, Plant C of the Sixth Water Purification Plant of 400,000 m^3/day capacity was added by this project.

Note 2. Population data of 2010 was not available at the time of the ex-post evaluation because the population statistics of Chengdu are published in September.

Monitoring room

Water quality inspection room

At the time of ex-post evaluation, the water supply capacity has been enhanced as planned and the balance between the water demand (1,635,000m^3/day) and supply (1,730,000 m^3/day) has been improved. Chengdu City is planning to construct its Seventh Water Purification Plant to respond to further increase of the water demand in the future. The Environment Bureau of Chengdu City certifies that the quality of treated water in Plant C satisfies the national standard of drinking water (pH, turbidity, coli form, etc.) and it is adequate as tap water. The result of beneficiary surveys also confirmed that the water quality had been improved in taste, smell and turbidity.

3.3.1.2 Internal Rate of Return

(1) Financial Internal Rate of Return (FIRR)

The FIRR at appraisal was 2.4% and that at ex-post evaluation was 2.7%. The Benefit includes water charge revenue and the Cost includes construction costs and operation and maintenance costs. The project life is 30 years. The reasons for the difference of FIRR are the timing to post the Cost which was later than the plan and the amount distributed to each year. At appraisal, the Cost was posted mainly in the second and fourth years of the project life. At the recalculation at the ex-post evaluation, the Cost was distributed evenly to the first six years of the project life, which reduced the negative values of the cash flow in the first years of the project life and led to the larger FIRR.

3.3.2 Qualitative effects

As its qualitative effects, the project expected (1) response to the increasing water demand and (2) stable supply of safe water.

(1) Response to the increasing water demand

As Table 3 shows, the water demand in Chengdu central and suburban districts had almost overtaken the supply capacity by 2008 and the shortage of water had been experienced in the peak hours in the morning and evening and in the summer. The water supply capacity has been enhanced by this project to construct Plant C of the Sixth Water Purification Plant which started operation in 2010. The demand has been met and the shortage of water shortage in the peak hours and in the summertime has been eradicated.

(2) Stable supply of safe water

According to the executing agency, after the project was completed, safe water is available in the areas where there was only ground water of poor quality or the water pressure was insufficient. Before the completion of the project, water supply was cut off often for repair work because the supply capacity was limited. After the completion of the

project, repair work does not always require cut-off of water supply because the capacity is sufficient. Also, there are few complaints about the insufficient water pressure in the peak hours. Residents in the upper floors of apartments no longer have to go fetch water or store water in buckets as enough tap water is always available.

Beneficiary surveys were conducted through structured interviews in the project target areas. The respondents are 100 residents of Chengdu central districts and Pi County where the Sixth Water Purification Plant is located, of which 58 are men and 42 are women.

Table 4. Results of beneficiary survey

Stable supply of water	95%
Sufficient amount of water	91%
Improvement of water pressure	94%
Improvement of water quality (turbidity, taste, smell)	95-96%
Improvement of standard of living in sanitation	97%
Reduction of time spent for housework	95%
Economy of the city has been more active	100%

Also, four organizations including enterprises and universities were interviewed. They used to take ground water by their own water pumps and tanks. The quantity, pressure and quality of water were not satisfactory. They reported that water of good quality is always available after the completion of this project.

From the above, the project has contributed to the response to the increasing water demand and to stable supply of safe water.

Therefore, the project has largely achieved the anticipated effects, and its effectiveness is high.

3.4 Impact

3.4.1 Appearance of intended impacts

(1) Contribution to the regional economic development

Since the project just started operation in May 2010, no statistics were available yet to show its contribution to the regional economic development. Still, the executing agency confirmed that the project has contributed to the attraction of the enterprises, especially electronics and electric industries, to the Chengdu High-tech Industrial Development Zone. In the interview with Foxconn, a Taiwanese electronics manufacturer, they explained that they were settled in Chengdu as its water supply is stable as a result of a comparison with some other cities in the Western China. Therefore, it can be concluded that the project has

contributed to the regional economic development to a certain extent.

3.4.2 Other impacts (positive and negative impacts)

(1) Impacts on the natural environment

No negative impacts on the natural environment have been observed regarding the project.

Sludge from the water purification process is dewatered, compressed and disposed to the landfill in the suburban area. At the appraisal stage, recycling of the sludge was planned, but the executing agency explained that it was not implemented because the quantity of sludge is small. Wastewater from the plant goes through the appropriate treatment process, and as Chengdu City has 1,300,000m^3/day capacity of wastewater treatment as of 2010, wastewater and sludge from the plant do not cause pollution of water and soil.

(2) Resettlement and Land Acquisition

Table 5 shows the land area acquired, cost for land acquisition, resettlement and compensation. The process of land acquisition and resettlement was implemented by the government of Pi County (where the Sixth Water Purification Plant is located) according the regulations of the national and regional governments. According to the executing agency, no problems were observed in the process of land acquisition, resettlement and compensation. The appraisal documents stated that the land for Plant C had already been acquired and resettlement of about 100 residents had also been completed by the time of appraisal in 2000. The executing agency reported at the time of the ex-post evaluation that the resettled residents were approximately 400, but the reason for the difference in numbers was unknown because no supporting documents were included the appraisal documents. At the ex-post evaluation, interviews with the resettled residents were not implemented as all process had completed more than ten years ago.

Table 5. Land area acquired, cost for land acquisition, resettlement and compensation

Land area acquired	Number of resettled population	Cost for land acquisition/ compensation for resettlement
8.3ha	About 400	46,510,000 yuan

Source: Questionnaire responses

From the above, the project has contributed to the regional economic development, and there were no particular negative impacts observed.

3.5 Sustainability (Rating: ③)

3.5.1 Structural aspects of operation and maintenance

Chengdu Municipal Waterworks Co., Ltd., a public corporation under the government of Chengdu City, is responsible for the operation and maintenance of Plant C (constructed by this project) and Plant A of the Sixth Water Purification Plant, as well as the Second and Fifth Water Purification Plants. Plant B of the Sixth Water Purification Plant is operated by Chengdu Générale des Eaux-Marubeni Waterworks Co., Ltd. by Build Operate Transfer (BOT[3]). Plant B started operation in February 2002, and its concession period is 18 years (construction: 2.5 years, operation: 15.5 years).

Among the staff members of Plant C, 30 are responsible for operation and maintenance, of which 22 are technical staff.

3.5.2 Technical aspects of operation and maintenance

All technical staff members responsible for the operation and maintenance of Plant C are engineers who are graduates from junior colleges or above. The company conducts 15 training sessions every year, which includes units about technology and knowledge such as electric work, chemical treatment and sanitary management. The company recruits new graduates from universities and young engineers and does rotations of the senior engineers in order to maintain the technical level the operation and maintenance staff.

Plant C has an operation and maintenance manual, which regulates operation and maintenance procedures for each unit and process.

3.5.3 Financial aspects of operation and maintenance

The revenue and expenditures of Chengdu Municipal Waterworks Co., Ltd. are shown in Table 6 and the water tariff is shown in Table 7. There is no separate accounting framework only for Plant C. The company collects water charges including also wastewater treatment charges from the clients, and the portion for the wastewater treatment goes to Chengdu City government then to the wastewater treatment company.

Table 6. Revenue and expenditures of Chengdu Municipal Waterworks Co., Ltd.

Unit: million yuan

Item	2007	2008	2009	2010
Annual sales (total revenue)	484.64	738.53	831.01	998.79
Expenditures	20.29	23.33	42.69	43.93
Cost for sales and other expenses	56.28	56.98	46.77	59.94
Cost for operation and maintenance	336.98	586.08	580.65	676.99
Operational Profit/loss	73.09	72.14	160.90	217.93

Source: Questionnaire responses

3 BOT (Build Operate Transfer): A modality of business in which a private company constructs facilities and implements operation and maintenance for a certain period, and transfers the facility to a public entity.

Table 7. Water tariff (as of May 2011)

Unit: yuan/m^3

Category	Water supply	Wastewater treatment	Total
Domestic use	1.95	0.90	2.85
Commercial and industry	2.90	1.40	4.30
Special sector (public bath)	10.50	4.50	15.00
Special sector (car wash)	6.60	3.40	10.00

Source: Executing agency

The financial status of the company is in surplus and it covers the operation and maintenance cost of the water purification plants. The water tariff, which is the most essential factor for the profitability of the water business, is determined by the Price Regulation Bureau of the city government taking into account the financial status of water companies, the price escalation rates and the level of the other public utility charges. When the financial status of the water company is worsened, the city government is supposed to provide the subsidy. Therefore, the financial status of the water company is considered stable and no major issues exist in the financial sustainability of the project. The executing agency considers that its budget for operation and maintenance is appropriate.

3.5.4 Current status of operation and maintenance

Plant C of the Sixth Water Purification Plant has its own annual and monthly operation and maintenance plans which are in line with the water company's annual production plan. Each machine and facility is regularly checked according to the plan. An automated equipment operation system has been set up to conduct real-time monitoring of the operational status and responds quickly when problems occur. When the evaluator visited the project site for the ex-post evaluation, all facilities constructed or installed by the project seemed to be running normally without particular problems.

From the above, no major problems have been observed in the operation and maintenance in the aspects of organizational setup, technical capacity and financial status. Therefore, the sustainability of the project is high.

4. Conclusions, Lessons Learned and Recommendations

4.1 Conclusions

This project has been highly relevant with China's development plans, development needs, as well as Japan's ODA policy; therefore its relevance is high. The needs to enhance the water supply capacity were low during the originally-planned project period because the water demand in the central and suburban districts of Chengdu did not increase as much as anticipated

after the relocation of factories following the new city planning policy since 2002. The water demand later increased and is now covered by the current supply capacity strengthened by this project. The project cost was lower than planned, but the project period was substantially longer than planned; therefore the efficiency is moderate. The project has largely achieved the development objectives, which were to enhance the water supply capacity and to respond to the water demand, thus to contribute to regular supply of safe water. Therefore, the effectiveness is high. Since no major problems have been observed in the operation and maintenance systems such as organizational setup, technical capacity and financial status, the sustainability of the project is considered high.

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

4.2 Recommendations

4.2.1 Recommendations to the executing agencies

None.

4.2.2 Recommendations to JICA

The portion funded by the yen-loan was only the water supply pipelines that were completed in 2004, and the whole project, including the water purification plant constructed by the local fund, was completed in 2010. This ex-post evaluation was carried out in the fiscal year 2010, only one year after the completion of the whole project, before it would become too late to obtain information on the yen-loan funded portion that was completed in 2004. From the evaluator’s point of view, the merit of the evaluation in this timing was that the cooperation from the executing agency has been easily available and the information necessary for the evaluation was ready. On the other hand, it was too early to grasp the economic impacts of the project as it would take some time to be reflected in statistical data. Since sufficient information on the effects and impacts of this project during the ex-post evaluation was not available, JICA is recommended to consider obtaining quantitative data (population in the target areas, population served, water demand, water supply capacity and GDP in the target areas) again in two to three years from present and to review the effects and impacts of the project.

4.3 Lessons learned

This project postponed the construction of the water purification plant in response to the changing trend of the increase in the water demand. JICA might want to consider establishing a modality of yen-loan projects that allows quick and flexible adjustment to respond to the changing demand.

Comparisons of the Planned and Actual Scope of the Project

Item	Planned	Actual
① Outputs		
Intake facility (not included in this project. Constructed in the project of Plant B)	・ Intake header 480,000m^3/day x 2 ・ Inlet pipes approx. 1.9km x 2	As planned. ・ Intake header 480,000m^3/day x 2 ・ Inlet pipes approx. 1.9km x 2
Connection pipes (local fund)	・ Connection pipes approx. 0.16km	As planned. ・ Connection pipes approx. 0.16km
Water purification plant (it was to be funded by the yen-loan, but was funded by the local fund)	・ Plant C 400,000m^3/day (coagulation-sedimentation-rapid filtration system) Flocculation basin, sedimentation basin, filtration basin	As Planned. ・ Plant C 400,000m^3/day (coagulation-sedimentation-rapid filtration system) Flocculation basin, sedimentation basin, filtration basin
Water transmission facility (yen-loan fund and local fund)	・ Water transmission pipelines approx. 25km	Mostly as planned ・ 26km Water transmission pipelines approx. 26km (20 km of which used yen-loan)
Water distribution facility (yen-loan fund and local fund)	・ Water distribution pipelines approx.140km ・ Pressure station 40,000m^3/day	The distribution pipelines were 54 km shorter than the plan. The pressure station was cancelled. ・ Water distribution pipelines approx. 86km (42km of which used yen-loan) ・ Pressure station was cancelled.
② Project Period	March 2000 (L/A) - December 2003 (start of operation) (46 months)	March 2000 (L/A) - May 2010 (start of operation) (123 months)
③ Project cost Foreign currency Local currency Total Yen loan portion Exchange rate	 7,293 million yen 10,665 million yen (711 million yuan) 17,958 million yen 7,293 million yen 1yuan＝15.00 yen (as of June 1999)	 4,244 million yen 10,694 million yen (763 million yuan) 14,938 million yen 4,244 million yen 1yuan＝14.01 yen (Average of 2000～2010)

People's Republic of China

Ex-Post Evaluation of Japanese ODA Loan Project
Yantai Water Supply and Water Induced Disaster Management Project

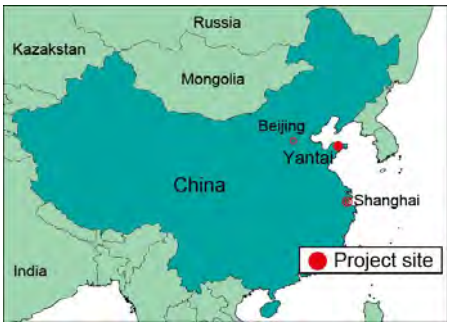
Yasuhiro Kawabata, Sanshu Engineering Consultant

0. Summary

The project objective was to contribute to achievement of the stable water supply and thus to the improvement of living conditions and sanitary environment, and enhancement of the regional economic development through coping with the insufficient water supply capacity and ever increasing water demand, improvement of lowering ground water level and prevention of the seawater intrusion by repairing dams (reservoirs), and constructing underground dams, water supply facilities and coastal levees in Yantai, Shandong Province. Regarding the relevance, the project has been highly relevant because of its substantial impact to the Chinese and provincial development plans and needs, as well as Japan's ODA policies. The actual project cost was within the plan, but the actual project period was substantially longer than planned. Therefore, the efficiency is considered moderate. Regarding its effectiveness, the project has largely achieved its development objectives (to contribute to achievement of the stable water supply and thus to the improvement of living conditions and sanitary environment, and enhancement of the regional economic development), and thus, its effectiveness is considered high. Since no major problems have been observed in the operation and maintenance system (organizational setup, technical capacity and financial status), sustainability of the project is also considered high.

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

1. Project Description



Location of Project Site

Yantai Economic &Technology Development Zone: No.2 Purification Plant

1.1 Background

China is divided into 9 main river basins. The southern region (south of the Changjiang River Basin) has about 55% of the country's total population and takes up about 81% of water resources in China. In contrast, the northern region (north of the Yellow River Basin) has about 43% of the total population and takes up only about 14% of water resources. Yantai City, Shandong Province, to which the project is targeted, is located in the south of the Yellow River. The amount of water resources supplied to the people in the southern region was 3,440m^3/person, compared to only 750m^3/person in the northern region, which is only 1/5 of the southern region. Provinces and cities, including parts of Shandong Province, Beijing, Hebei, Henan, and Shanxi, had been continuously suffering from poor water resources. Thus, the usage rate of ground water had been high ranging between 47% and 71% of the total amount of water supplied.

The Shandong Peninsula, where the project is located and which is surrounded by the Yellow Sea and Bohai Sea, has been strategically an important location for foreign trade, and has long flourished as a center for foreign trade. Although the Shandong Province has economically well-developed coastal cities, there are insufficient water resources because there is no major river. The surface water resource was only 418 m^3/person, compared to the national average of 2,288m^3/person; and the share of ground water usage among the total water supply was 46.6%, which was much higher than the national average of 29.1%. Since the ground water had been piped up as tap water, the damage including the settlement, lowering of the ground water level and seawater intrusion had come up in the region.

1.2 Project Outline

The project objective is to contribute to achievement of the stable water supply and thus to the improvement of living conditions and sanitary environment, and enhancement of the regional economic development through coping with the insufficient water supply capacity and ever increasing water demand, improvement of lowering ground water level and prevention of the seawater intrusion by repairing dams (reservoirs), and constructing underground dams, water supply facilities and coastal levees in Yantai, Shandong Province. The project plan is shown in Figure 1.

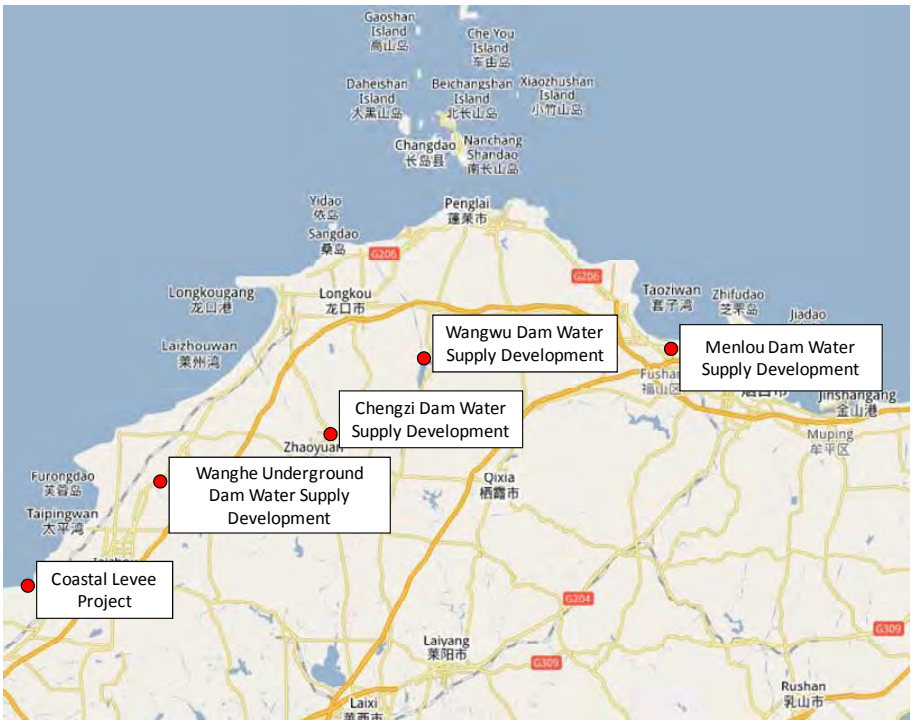


Figure 1 Location of the Project Site

Approved Amount/Disbursed Amount	6,008 million yen/ 5,991 million yen
Exchange of Notes Date/ Loan Agreement Signing Date	December 1998/December 1998
Terms and Conditions	Interest rate 1.30%; Repayment period 30 years (Grace period 10 years); Conditions of procurement: General Untied
Borrower/Executing Agency	Government of People's Republic of China/ Yantai Municipal Government
Final Disbursement Date	July 2004
Main Contractor (over 1 billion yen)	-
Main Consultant (over 100 million yen)	-
Relevant Studies (Feasibility Study and others)	Feasibility Study by Shandong Province Hydrology Survey and Design Institute (June 1997), JICA's Special Assistance for Project Formation (SAPROF) Study (May 1998)
Relevant Projects	

2. Outline of the Evaluation Study

2.1 External Evaluator

Yasuhiro Kawabata, Sanshu Engineering Consultant

2.2 Duration of Evaluation Study

The subject ex-post evaluation assignment was implemented as follows:

Duration of the Study : December 2010 to December 2011

Duration of the Field Study : February 20-March 5, 2011 and May 15-28, 2011

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

3.1 Relevance (Rating: ③[2])

3.1.1 Relevance with the Development Plan

The China's 9th Five-Year Development Plan (1996-2000) stated that the waterworks infrastructure in rural cities was the most essential agenda, with the following targets: i) increase of nationwide water supply by 40 million m^3/day; ii) raise accessibility ratio to portable water in urban areas to 96%; and iii) increase average water supply per person by 40ℓ/day. The facility capacity increased to 13.15 million m^3/day by 1998; consequently the target should be achieved by year 2000 taking into account the facilities under construction. The target for raising accessibility ratio to portable water in urban areas had been achieved ahead of schedule in 1998. The average water supply per person in 1998 was 214 ℓ/day, which has exceeded the targeted volume (210 ℓ/day).

However, since the lack of water still existed in the regions, the water supply development was one of the priority sectors in the urban development plan, as well as in the 10th Five-Year Plan that started in 2001. The China's 11th Five-Year Development Plan (2006-2010) included the strengthening of the wellhead protection in urban areas, and promoting the construction of water supply facilities. The wellhead protection is also considered a priority agenda in the 12th Five-Year Development Plan (2011-2015). The following measures were proposed: i) expansion and rehabilitation of the aging small reservoirs; ii) rehabilitation of large/medium scale irrigation facilities; iii) countermeasure works against drought; iv) protection work for small scale reservoirs in rural areas; and v) countermeasure works for water resources for arable lands.

The Shandong's 9th Five-Year Plan (1996-2000) stated that under the well-balanced development plan, the effective use of surface and ground water needed to be strengthened and at the same time projects including improvement of main rivers, rehabilitation medium -large

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

2 ③: High, ② : Fair, ① : Low

reservoirs and those for other water resource conservation would be promoted.

The Shandong's 11th Five-Year Plan (2006-2010) stated that in order to supply safer water, the following agenda would be addressed and promoted: (i) development of water supply network, (ii) construction of purification plants in urban areas, and transmission/distribution pipe lines, (iii) improvement of purification process, and (iv) monitoring of the water quality at reservoirs and tap water.

In the National Development Plan and development plans of Shandong Province and Yantai City at appraisal and post evaluation stages, the development/promotion of reservoirs and water supply facilities was a priority agenda. Thus, the project was in accordance with the National Development Plan and the development plans for the project target areas.

3.1.2 Relevance with the Development Needs

Shandong Province has coastal cities, which have been economically well developed. However, since there is no major river, the province is one of the regions that have suffered from lack of water resources. At appraisal time (1998), the surface water resource was only 418 m^3/person, and the share of ground water usage among the total water supply was 46.6%, which was much higher than the national average. Since the intake of water has long relied on ground water, the settlement, lowering of the ground water level and seawater intrusion had surfaced. The project's objective to address the water demand through rehabilitation of dams and underground dams, and construction of water supply facilities and coastal levees was in accordance with the development needs in the region.

The Yantai's 11th Five-Year Plan states that the following development agenda needs to be addressed and promoted with respect to the water sector: effective usage of water resources, management/purification of main rivers, construction of reservoirs in suitable locations, construction of dams and underground dams, construction of coastal levees in coastal cities to protect the tidal wave during the storm. It is expected that by 2010 the amount of water to be supplied would be increased by 210 million m^3/year so that the insufficient water issue could be resolved.

The water demand in the project target area is still increasing as population increases with the economic development; the development needs in the project area was/is high both at appraisal and at post evaluation.

3.1.3 Relevance with Japan's ODA Policy

According to the Overseas Economic Cooperation Implementation Policy (issued on December 1, 1999 and valid up to March 2002), the Japanese aid policy towards China focused on alleviation of disparity between regions, particularly giving priority to inland region and the development of the economic and social infrastructure which would promote self-motivating

economic development in order to advance the development of the private sector and democratic markets, as well as a well-balanced development to support the market-oriented economy. The project's objective is to develop the social infrastructure, and thus the project was in accordance with the priority agenda under the Japanese aid policies.

The project made significant impact to the Chinese development plan and needs, as well as Japan's ODA policies, and is therefore considered highly relevant.

3.2 Efficiency (Rating: ②)

3.2.1 Project Outputs

The project outputs (planned and actual) are summarized in Table 1.

Table 1 Comparison of Project Outputs (Planned and Actual)

Item	Planned	Actual
1) Menlou Dam Water Supply Development (Economic Development Zone (YEDZ))	・ Rehabilitation of Menlou Dam (not funded by JICA) ・ Intake pumps: 4 units ・ Conveyance pipes: 8.1kmx2 pipes ・ Purification plant: maximum capacity 126,000m^3/day ・ Transmission pipes: 5.8kmx2 pipes	(not funded by JICA) : 4 units, as planned : 7.76kmx2 pipes, almost as planned : capacity 126,000m^3/day, as planned : 5.1kmx2 pipes, almost as planned
2) Wangwu Dam Water Supply Development (Longkou)	・ Rehabilitation of Wangwu Dam ・ Intake facilities: 20,000m^3/day ・ Conveyance pipes: 4.84km ・ Purification plant: increase capacity 50,000m^3/day; new construction 20,000m^3/day ・ Transmission pipes: 17.78km ・ Distribution pond: 4000m^3x2 units ・ Distribution pipes: 72.11km	(not funded by JICA) : cancelled from the project : original 4.84km was cancelled, instead 7.52km installed. : increased as planned. new construction with 20,000m^3/day cancelled. : 17.2km, almost as planned : 4000m^3x2 units, as planned : extended to 83.16km
3) Chengzi Dam Water Supply Development (Zhaoyuan)	・ Rehabilitation of Chengzi Dam (not funded by JICA) ・ Pump station: 2 units ・ Conveyance pipes: 61.53km ・ Intake pumps: 3 units ・ Purification plant: capacity 20,000m^3/day	: (not funded by JICA) : 2 units: as planned : shortened to 41.5km : increased to 12 units : capacity increased to 60,000m^3/day
4) Wanghe Underground Dam Water Supply Development (Laizhou)	・ Underground dam: 14.5km ・ Rehabilitation/construction of check gates: 22 sections ・ Influent well: 1,300 units ・ Intake wells: 20 wells ・ Conveyance pipes: 6.77km ・ Purification plant: capacity 30,000m^3/day	: 14.0km: as planned : reduced to 16 sections : 1,210 wells, and changed to penetration ditch 65 sites : 12 wells : reduced to 1.59km : reduced to 15,000m^3/day
5) Coastal Levee Project (Laizhou)	・ Rehabilitation of coastal levee with a length of 40.2km ・ Construction of groin : 8 units ・ Bridge construction: one site ・ Rehabilitation of gates: 10 sites	: 40.2km, as planned : 8 units, as planned : constructed by own funds ahead of project : 10 units: as planned

Source: Response to the Questionnaire

Although the scope of the work has been partially revised, the actual outputs have been completed more or less as planned. The main revisions and their reasons are as follows.

Wangwu Dam Water Supply Development: 1) Since the management of the originally planned reservoir (Chijiagou) was entrusted to a private developer, the following works were cancelled from the project: construction of intake facilities (20,000m^3/day), conveyance pipes (4.84km), and a purification plant (20,000m^3/day). Instead, conveyance pipes from the Wangwu dam to the Lujia purification plant with a length of 7.52km were installed and the distribution pipe lines were extended according to the city planning of Longkou city.

Chengzi Dam Water Supply Development: 1) Since the factories, which consume a huge amount of water due to lack of water, were required to recycle the treated discharged water, the water demand decreased and the length of conveyance pipes was shortened; and 2) the Shandong Provincial Planning Committee approved the increase of purification capacity from 40,000 m^3/day to 60,000 m^3/day taking into account the rapidly increasing water demand in Zhaoyuan.

Wanghe Underground Dam Water Supply Development: 1) Since one of the originally planned wells was in the seawater intruded area, the water intake from the well was cancelled. Thus, the purification capacity was reduced; 2) since the intake location was changed, the length of conveyance pipes was also shortened; and 3) variations on construction volume on other items were due to design changes/variations made taking into account the actual condition of the site.

Coastal Levee Project: 1) Taking into account the necessity in the field, the Baisha Bridge was reconstructed ahead of the project by Laizhou Highway Bureau with their own fund.

The above mentioned changes of the output are considered appropriate taking the project's objective into consideration.

Wangwu Dam in Longkou
(Rehabilitation Work)

Coastal Levee in Laizhou
(Rehabilitation Work)

3.2.2 Project Inputs

3.2.2.1 Project Cost

The estimated total project cost at appraisal was 14.696 billion yen, of which the Japanese ODA loan was to be used only for the foreign currency portion amounting to 6.008 billion yen and the rest was to be financed by the Chinese government and four municipal governments (Yantai, Longkou, Zhaoyuan and Laizhou). However, the actual total project cost was 9.218 billion yen, of which the Japanese ODA loan amount was 5.991 billion yen and the rest was financed by the Chinese government and four municipal governments. Excluding the project components (repair of dams), not financed by the ODA loan, the actual project cost was within the plan, and was equivalent to 71% of the plan or 82% in Chinese yuan.

Table 2 Comparison of Project Costs (Planned/Actual)

Component	Planned					Actual				
	Foreign	Local		Total		Foreign	Local		Total	
	Million yen	Million yuan	Million yen	Million yuan	Million yen	Million yen	Million yuan	Million yen	Million yuan	Million yen
Menlou Dam Water Supply Development	1,644	110	1,755	212 (153)	3,399 (2,451)	1,645	60.93	857	177.93	2,502
Wangwu Dam Water Supply Development	1,557	83	1,332	181 (135)	2,889 (2,154)	1,557	13.27	187	124.02	1, 744
Chengzi Dam Water Supply Development	661	18	282	59 (52)	943 (835)	936	50.36	708	116.91	1,644
Wanghe Underground Dam Water Supply Development	916	60	963	117	1,879	1,110	53.62	754	132.55	1,864
Coastal Levee Project	743	30	481	77	1,224	743	30.02	422	82.85	1,165
Price Escalation	201	49	787	62	988					
Contingencies	286	16	263	34	549					
Land acquisition	0	22	357	22	357		21.26	299	21.26	299
Administration, Taxes	0	154	2,468	154	2,468					
Total	6,008	543	8,688	919 (804)	14,696 (12,905)	5,991	229.46	3,227	655.52	9,218

Note1: Figures in ( ) are the project costs excluding those for the components (rehabilitation of dams), not funded by JICA.

Note 2: Exchange rate at appraisal: Yuan = 16 yen, Exchange rate at post evaluation: Yuan = 14.062 yen (simple average rate during 2000 and 2004 checked by the evaluator.

Note 3: Administration costs and taxes at post evaluation are included in the project costs for each component.

Main reasons for the decrease/increase in costs are those mentioned in Section 3.2.1 Project Outputs.

Water Gate in Laizhou
(New Construction)

Underground Dam in Laizhou
(New Construction)

3.2.2.2 Project Period

The actual project period substantially exceeded the plan. The project period planned at appraisal was from December 1998 (Loan Agreement signing month) to December 2001 (commencement of the project operation), with a total period of 37 months. However, the actual project period was from December 1998 (Loan Agreement signing date) to October 2005 (completion of all the civil work in four cities), with a total period of 83 months, or equivalent to 224% of the plan. Three projects, including the Menlou Dam Water Supply Development, the Wangwu Dam Water Supply Development, and the Chengzi Dam Water Supply Development, were completed by end 2003. The main reasons for the delay of other projects/items were due to: 1) long delay in land acquisition/resettlement (four and half year delay from the original plan) of the Wangwu Dam Water Supply Development Project; since it was implemented simultaneously with other relevant projects, the project was carried out in accordance with the overall implementation schedule; 2)delay in implementation of the Wanghe Underground Dam Water Supply Development Project was due to i) extra time spent for negotiation on compensation for the land for transmission/distribution pipe facilities and the intake pump station since some residents nearby opposed to the construction, ii) long delay to undertake test run and calibrate the equipment installed at the purification plant; and 3) delay in implementation of coastal levees because additional work was recognized through the field inspection after the main part of the work was completed in 2002; the additional work was ultimately done, resulting in the delay of the overall implementation schedule.

The overall project period was longer than the planned.

The actual project cost was within the plan, but the project period was much longer than planned; therefore the efficiency is considered moderate.

3.3 Effectiveness (Rating: ③)

3.3.1 Quantitative Impacts

3.3.1.1 Results from Operation and Effected Indicators

(1) Response to Insufficient Water Supply Capacity and Increasing Demand

The balance of water demand and supply capacity in four cities under the project is shown in Tables 3 –6.

Table 3 Balance of Water Demand and Supply Capacity in YEDZ

Unit: 0,000m^3/day (daily average)

Year	2000	2004	2006	2008	2009	2010
Population water supplied (0,000 persons)	5.1	14.4	16.2	17.5	17.7	17.9
Water demand ①	1.7	2.9	3.6	4.4	4.9	5.6
Supply capacity ②	1.7	10	10	10	10	10
Balance between demand and capacity (② - ①)	0	+7.1	+6.4	+5.6	+5.1	+4.4

Source: Appraisal Documents and Response to the Questionnaire

Note 1: In August 2003, the supply capacity was increased by 100,000m^3/day (maximum 126,000 m^3/day) by the project.

Note 2: Upon completion of the project, the intake (17,000 m^3/day) from other plants was stopped.

Table 4 Balance of Water Demand and Supply Capacity in Longkou

Unit: 0,000m^3/day (daily average)

Year	2000	2004	2006	2008	2009	2010
Population water supplied (0,000 persons)	15	20.6	22.0	22.9	24.9	25.1
Water demand ①	5.1	6.71	7.69	8.82	9.45	10.12
Supply capacity ②	9	14	14	14	14	14
Balance between demand and capacity (② - ①)	+3.9	+7.29	+6.31	+5.18	+4.55	+3.88

Source: Appraisal Documents and Response to the Questionnaire

Note 1: In December 2003, the supply capacity was increased by 50,000m^3/day by the project.

Table 5 Balance of Water Demand and Supply Capacity in Zhaoyuan

Unit: 0,000m^3/day (daily average)

Year	2000	2004	2006	2008	2009	2010
Population water supplied (0,000 persons)	6.9	15.6	16.0	16.5	17.3	18.0
Water demand ①	4.2	8.9	9.4	10.2	11.5	12.6
Supply capacity ②	4.5	11.5	11.5	11.5	11.5	11.5
Balance between demand and capacity (② - ①)	-0.3	+2.6	+2.1	+1.3	0	-1.1

Source: Appraisal Documents and Response to the Questionnaire

Note 1: In 2001, the capacity of another plant was increased by 10,000 m^3/day. In May 2003, the capacity was increased by 20,000 m^3/day under the Phase 1 of the project and in end 2004 40,000 m^3/day under the Phase 2 of the project.

Note 2: Even though as of 2010, the supply capacity is insufficient, a planned new plant is to be completed during the 12th Five-Year Plan.

Purification Plant in Zhaoyuan
(Office Building)

Table 6 Balance of Water Demand and Supply Capacity in Laizhou

Unit: 0,000m^3/day (daily average)

Year	2000	2004	2006	2008	2009	2010
Population water supplied (0,000 persons)	28	35	45	50	55	65
Water demand ①	3.5	3.9	5.4	6.0	6.7	6.9
Supply capacity ②	3.0	5.0	7.5	10.5	10.5	10.5
Balance between demand and capacity (② - ①)	-0.5	+1.1	+2.1	+4.5	+3.8	+3.4

Source: Appraisal Documents and Response to the Questionnaire
Note 1: In October 2005, the supply capacity was increased by 15,000 m^3/day by the project.
Note 2: The supply capacity is the total capacity of 5 plants in Laizhou.

With respect to the operational status of plants in four cities in 5-6 years after the project was completed, those in three cities except that in Yantai (with an operational rate of 56%) have been effectively used with the following operational rates in each city (72% at Longkou, 100% at Zhaoyuan and 66% at Laizhou). The reason for the lower rate at Yantai is that the originally planned water supply area was reduced and thus the water demand decreased since a new purification plant was constructed in the neighboring district. However, since it is expected that moving of enterprises into the development zone would continue, it is anticipated that the growth of population to be water supplied and utilization rate would increase in future.

The project contributed to 1) increase of water supply capacity; and 2) respond to the water demand as planned.

(2) Improvement of lowering of the ground water level

At appraisal time, it was expected that the ground water level of minus 16m in the Wanghe Underground Dam area, and Laizhou would rise to minus 9m upon completion of

the project. However, the present actual ground water level is minus 2.65m, and thus the improvement is considered substantial.

(3) Prevention of seawater intrusion

It was expected that the seawater intruded area in Laizhou would be reduced from 80km^2 before the project to 50km^2 upon completion of the project. The current actual intruded area is 46km^2, and thus the improvement was made including partly the impact made under other related projects. The storm hit the Laizhou Bay in 2003 with the height of 3.14m, and in 2007 with a height of 3.2m. However, the protected area with coastal levees did not suffer any damages (life and properties).

(4) Quality of Tap Water

The quality of the tap water distributed from each purification plant meets all the requirements of the National Standards (pH, turbidity, bacteria count, coli form count, manganese, iron, zinc content, etc.), and it has been proven to be suitable as tap water. The results of the beneficiary surveys have confirmed that the water quality (particularly taste, smell, and color) has improved.

The project has achieved the originally planned objectives, including the response to insufficient water supply capacity and increasing demand, improvement of lowering of the ground water level, and prevention of seawater intrusion.

3.3.1.2 Results of Calculations on Internal Rates of Return (IRR)

(1) Financial Internal Rate of Return (FIRR)

FIRRs at appraisal and at post evaluation (only at purification plants) are shown in Table 7.

Table 7 FIRRs at Appraisal and at Post Evaluation

Project	FIRR at appraisal (%)	FIRR at post evaluation (%)
Menlou Dam Water Supply Development	5.34	6.1
Wangwu Dam Water Supply Development	5.72	5.26
Chengzi Dam Water Supply Development	8.63	6.99
Wanghe Underground Dam Water Supply Development	16.66	6.21

Benefits: Water charge revenue
Costs: Construction costs, and operation/maintenance costs, Tax
Project Life: 30 years

The reason for the higher FIRR for the Menlou Dam Water Supply Development Project at the evaluation stage is that the actual project cost was lower than planned. The reason for

the lower FIRR for the Wangwu Dam Water Supply Development Project at the evaluation stage is that despite the actual project cost was lower than planned, the water charge rates were not increased as much as planned. The reason for the lower FIRR for the Chengzi Dam Water Supply Development Project at the evaluation stage is that the actual project cost was doubled against the plan. The FIRR for the Wanghe Underground Dam Water Supply Project at appraisal was higher than those for other subprojects. The evaluation team checked with the executing agency on the reason of the higher FIRR. However, since the person in charge at appraisal has already retired and the reason was not clarified. (The FIRR at the preliminary design stage was 8.21%)

3.3.2 Qualitative Effects

As the qualitative effects, the following were considered: response to the ever increasing water demand; reduction in flood damages; improvement in living conditions due to increase in water supply; and contribution to the regional economy through increase of industrial production.

(1) Response to the still increasing water demand

According to the executing agency, since the improvement of the purification plant in the Yantai Economic Development Zone and upon completion of the project, the water shortage problem has been eliminated. With the improvement of water supply facilities in Zhaoyuan, in terms of the water supply amount and water quality, the water from the Chengzi Dam has been distributed mainly to the urban district of the city. The Wanghe Underground Dam development has contributed not only to the prevention of seawater intrusion and increase of water supply, but also to ecosystem conservation through rise of the ground water level. The beneficiary survey report also confirms that the water leakage ratio has substantially improved by replacing transmission and distribution pipes.

(2) Reduction of damages by flood

Since the design probability of flood for improvement of the Wangwu Dam was assumed to be once in 1,000 years, the life and assets of 50,000 residents along the downstream corridor would be well protected. With respect to improvement of the Chengzi Dam, the design probability of flood was also assumed to be once in 1,000 years and thus the life and assets of 35,000 residents along the downstream corridor would be also protected. Since the underground dam was constructed in Laizhou, the reservoir has a larger capacity allowance making it possible to control the water discharge volume to prevent flood in the rainy season. In addition, it is easier to secure the water quality along the downstream corridor for Wanghe River.

(3) Improvement of living condition by increase of supplied water

Because of the capacity increase of water supply and improvement of the water quality, the living condition in all the four cities has been improved. The vice mayor of Longkou informed the evaluation team that the increase of water supply has become a key factor for the city's economic development.

At the post evaluation stage, beneficiary surveys through interviews were conducted in the project targeted area. The total number of respondents was 250, distributing 50 respondents to each project. The classification of respondents by sex was 25% female and 75% male. From the surveys, it was confirmed that ninety-nine (99) % of respondents has admitted that the project has contributed to enhancement of the living standards. Main results of the beneficiary surveys are as follows:

Table 8 Results of Beneficiary Surveys

Questions	Menlou Dam Water Supply Development	Wangwu Dam Water Supply Development	Chengzi Dam Water Supply Development	Wanghe Underground Dam Water Supply Development
Contribution to stable supply of water	100	92	100	100
Sufficient amount of supplied water	100	92	100	100
Substantial improvement of water pressure	100	92	100	98
Improvement of water quality (turbidity, taste, smell)	100	92	100	96
Reduction of time spent for house work	100	94	100	100

Regarding the questions on the coastal levees (reduction of the seawater intruded area, improvement of living condition and business promotion), all the respondents admit the impact of the project.

Based on the above, the project has contributed to the improvement of living conditions and sanitary environment.

Therefore, the project has largely achieved its development objective, and its effectiveness is considered high.

3.4 Impact

3.4.1 Appearance of Intended Impacts

(1) Contribution to the regional economic development

The invested amount to YEDZ and the exported amount from YEDZ are shown in Table 9.

Table 9 Invested Amount to YEDZ and Exported Amount

	2006	2007	2008	2009	2010
Invested amount (domestic enterprises) in million yuan	1,801	372	231	675	813
Invested amount (foreign enterprises) in million dollars	340	363	326	330	338
Exported amount in million dollars	3,002	6,535	12,280	12,815	15,934

Source: Response to the Questionnaire

Upon completion of the project, the stable water supply became possible and other infrastructure has been developed. Consequently, the number of enterprises moving into YEDZ, including foreign enterprises, and the amount of investment and export has been increasing. About 40 companies out of the world top 500 ranking companies and Japanese enterprises, including Mitsui Corp, Nichirei, and Denso, have moved into the YEDZ. Because of increase of enterprises moved in and job opportunities, the employment rate has been risen. Since it became possible to distribute water to the newly developed industrial park and its surrounding areas by constructing the Wanghe Dam in Laizhou City, it has contributed to the rapid economic development in the city.

3.4.2 Other Impacts (Positive or negative impacts)

(1) Impacts on the surrounding environment

Treatment of sludge: Even though the amount of sludge produced in the purification process at the YEDZ plant, for which the Menlou Dam is the water resource, is minimal, the collected sludge is dried and used as fertilizer. Since the quality of raw water from Wangwu Dam and at the purification plant in Zhaoyuan, for which Chengzi Dam is the water resource, is fine and thus the amount of sludge is almost nothing, the sludge treatment process has not been undertaken with the permission of the respective Environment Protection Bureau of the municipal governments. The sludge treatment process has also not been undertaken at Wanghe Purification Plant for which the underground water is the water source.

Environment Protection at Dams: The navigation of a small fishing boat with an

engine and ships is prohibited in the dam. The guard fences and warning signs were installed around the upstream river basin and reservoir intake areas. These countermeasures have contributed to the water quality conservation.

(2) Land acquisition and Resettlement

The land area acquired, and costs for land acquisition and resettlement/compensation are shown in Table 10.

Table 10 Land Area Acquired, and Costs for Land Acquisition and Resettlement / Compensation

Project	Land Area acquired (ha)	Costs for Land Acquisition and Resettlement/Compensation (million yuan)
Menlou Dam Water Supply Development	100	12.05
Wangwu Dam Water Supply Development	76.09	7.08
Chengzi Dam Water Supply Development	39.56	0.98
Wanghe Underground Dam Water Supply Development	42.5	1.15
Total	258.15	21.26

Note: The land acquisition cost for the dam is not included under the Chengzi Dam Water Supply Development Project since the rehabilitation of the dam was not funded by JICA.

No resettlement occurred and only compensation for the land acquired, and temporarily used during the construction period, and the potential revenues to be earned from paddies, rice filed and orchards was paid. According to the executing agency, payment for compensation was made according to the standards and practice of the country, province and local governments, and no complaints have been reported.

(3) Other Impacts

Upon completion of the project, some local people have been employed in charge of operation and maintenance of purification plants. Furthermore, since the stable water supply became possible, the number of new enterprises in each city has increased and thus the project has contributed to the regional economic development.

Based on the above, the project has contributed to the improvement of living conditions and the regional economic development.

3.5 Sustainability (Rating: ③)

3.5.1 Structural Aspects of Operation and Maintenance

The following entities, which were identified at the appraisal stage, are currently responsible

for operation and maintenance of the completed facilities.

Dams for water supply : Water Resource Bureau (Yantai, Longkou, Zhaoyuan, Laizhou)
Purification Plants : Water Supply Company of each city
Coastal Levees : Laizhou Coastal Levee Management Bureau

The organizational setup of the purification plant in each city, which is responsible for operation and maintenance of the plant, is as follows:

Table 11 Number of Staff in charge of Operation and Maintenance of the Plant

	Number of Total Staff	Number of Staff in charge or operation and maintenance
YEDZ Water Supply Company:	130	35
Longkou Water Supply Company:	120	25
Zhaoyuan Water Supply Company:	110	26
Laizhou Water Supply Company:	90	20

3.5.2 Technical Aspects of Operation and Maintenance

The staff in charge of the plant operation and maintenance of each water company have technical qualification in the relevant fields and staffing at each company is considered appropriate. In order to enhance the technical capacity of staff, each company has prepared a set of manuals and texts on the operation/maintenance works, and staffs have regularly taken the training program on the subjects, including the following modules: national legislations/decrees/regulations on safety in production, quality control, and labor protection; regulations/institutions on each sector; and company's rules and professional knowledge on each work sector. Regarding the subject on the safety management, the person in charge has been sent to the seminar offered by the municipal government every year.

3.5.3 Financial Aspects of Operation and Maintenance

The revenue and expenditures of each water company is shown in Table 12 – 15. The water charge rates, which is the source for sales are shown in Table 16.

Table 12 The Revenue and Expenditures of YEDZ Water Supply Company

Unit: million yuan

Item	2006	2007	2008	2009
Annual sales (total revenue)	41.2	65.6	69.0	67.2
Expenditures	38.6	60.5	66.0	65.7
Sales and other expenses	10.9	11.4	9.6	7.1
Operation profit/loss	-8.3	-6.3	-6.6	-5.6

3rewater charge rates, which is the source for sales is shown in on period, teh s not team in the lump sum basis.

Table 13 The Revenue and Expenditures of Longkou Water Supply Company

Unit: million yuan

Item	2006	2007	2008	2009
Annual sales (total revenue)	17.1	18.3	22.3	24.0
Expenditures	11.9	13.8	16.2	16.3
Sales and other expenses	6.7	6.7	6.5	7.9
Operation profit/loss	-1.5	-2.2	-0.4	-0.2

Table 14 The Revenue and Expenditures of Zhaoyuan Water Supply Company

Unit: million yuan

Item	2006	2007	2008	2009
Annual sales (total revenue)	17	20	23	26
Expenditures	13	14	18	19
Sales and other expenses	3	5	5	6
Operation profit/loss	1	1	0	1

Table 15 The Revenue and Expenditures of Laizhou Water Supply Company

Unit: million yuan

Item	2006	2007	2008	2009
Annual sales (total revenue)	14	16	17	21
Expenditures	10	14	13	16
Sales and other expenses	4	4	4	5
Operation profit/loss	0	-2	0	.0

Table 16 Water Charge Rates in each City

Unit: yuan/m^3

Category	YEDZ	Longkou	Zhaoyuan	Laizhou	Chengdu (for reference)
Home use	2.8	1.8	1.5	1.8	1.95
Commercial	3.8	2.9	2.35	2.8	2.90
Industry	3.8	2.9	2.35	2.8	2.90
Others	3.8	5.0	3.0	2.8	6.60

The financial status of water companies in four local cities (Yantai, Longkou, Zhaoyuan and Laizhou) is either in deficit or slightly in surplus. Since the profitability of the water supply business is low, it has been run as public works. In fact, the water companies in four cities are 100% owned by the municipal government. The water charge rate, which is the most essential factor for the profitability of the water business, is determined by the city's Price Regulation Bureau, taking into account the financial status of the water company, the price escalation rates, and the level of other public utility charges. Thus, when the financial status of the water company deteriorates, the city government is supposed to provide subsidy. Since the financial

status of the company is considered to be stable, no major issues in the sustainability of the project are expected. The allocated budget for operation and maintenance of the plant in four cities is considered appropriate.

The maintenance of the dam in the reservoir is undertaken by the regular maintenance budget allocated to the city's Water Resources Bureau, and that of the coastal levees in Laizhou is undertaken by the normal maintenance budget allocated to the Laizhou Coastal Levee Management Bureau. Through the discussions with the staff in charge while inspecting the project site, it was confirmed that even though the budget for maintenance was not necessarily sufficient, no major financial issues for the routine maintenance work have been noted.

3.5.4 Current Status of Operation and Maintenance

All the equipment and facilities installed/constructed in four cities under the project have been functioning well and no major issues have been reported. The operation and maintenance methodology/method for the facilities in four cities is almost similar. The daily routine inspection is undertaken by four groups, including the operation team, technical maintenance staff, the safety equipment professional team, and management staff responsible for the assigned equipment and facilities. The periodic maintenance is undertaken in accordance with the frequency of usage/operation and the safety operational manuals. The preventive inspection and repairs of equipment/devices are implemented every year in the winter time when the demand for water supply is low.

Based on the above, since no major problems have been observed in the operation and maintenance system (organizational setup, technical capacity and financial status), sustainability of the project is considered high.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

The project objective was to contribute to achievement of the stable water supply and thus to the improvement of living conditions and sanitary environment, and enhancement of the regional economic development through coping with the insufficient water supply capacity and ever increasing water demand, improvement of lowering ground water level and prevention of the seawater intrusion by repairing dams (reservoirs), and constructing underground dams, water supply facilities and coastal levees in Yantai, Shandong Province. Regarding the relevance, the project has been highly relevant because of its substantial impact to the Chinese and provincial development plans and needs, as well as Japan's ODA policies. The actual project cost was within the plan, but the project period was substantially longer than planned. Therefore, the efficiency is considered moderate. Regarding its effectiveness, the project has largely achieved its development objectives (to contribute to achievement of the stable water supply

and thus to the improvement of living conditions and sanitary environment, and enhancement of the regional economic development through coping with the insufficient water supply capacity and still increasing water demand, improvement of lowering ground water level and prevention of the seawater intrusion). Hence, its effectiveness is considered high. Since no major problems have been observed in the operation and maintenance system (organizational setup, technical capacity and financial status), sustainability of the project is also considered high.

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

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

None.

4.2.2 Recommendations to JICA

None.

4.3 Lessons Learned

1. The loan closing date (final disbursement date) of the project was July 2004 and the project completion date (completion of all the civil works in four cities) for the project components financed by the ODA loan was October 2005. The reason why the post evaluation for the project is being made only now is because the inspection and acceptance of the whole project, including the locally-funded project components, was made by the Chinese authorities only in end 2010. Regarding the post evaluation of the project in 6 years after civil works were completed, it is extremely difficult to collect the relevant data and information, and arrange meetings with the staff involved in the project preparation and implementation. Consequently, it could affect the accuracy of the assessment and evaluation of the project. Thus, in order to raise its quality, it is recommended to conduct the ex-post evaluation in 2 years after its loan closing date, in the case that the main project components have been completed by that date.
2. The project is considered to be more or less a sector-loan type project since the project sites are dispersed into several cities (four cities under the project) and the subprojects in each city involves several components. This kind of project requires setting a few development objectives and corresponding monitoring indicators to easily assess to what extent the development objectives have been achieved. Consequently, since the assessment and evaluation of the project at the post evaluation stage becomes complex and difficult, the development objective and its corresponding indicators to be set at the appraisal stage should be as simple and precise as much as possible. For instance,

in case of this project, the development objective could be simply responding to the insufficient water supply capacity and still increasing water demand, and the monitoring indicator could be the balance between the water demand and supply capacity.

Comparison of the Planned and Actual Scope of the Project

Item	Planned	Actual
① Outputs		
1) Menlou Dam Water Supply Development (Economic &Technology Development Zone)	・ Rehabilitation of Menlou Dam (not funded by JICA)	(not funded by JICA)
	・ Intake pumps: 4 units	: 4 units , as planned
	・ Conveyance pipes: 8.1kmx2 pipes	: 7.76kmx2 pipes, almost as planned
	・ Purification plant: maximum capacity 126,000m^3/day	: capacity 126,000m^3/day, as planned
	・Transmission pipes: 5.8kmx2 pipes	: 5.1kmx2 pipes, almost as planned
2) Wangwu Dam Water Supply Development (Longkou)	・ Rehabilitation of Wangwu Dam	(not funded by JICA)
	・ Intake facilities: 20,000m^3/day	: cancelled from the project
	・ Conveyance pipes: 4.84km	: original 4.84km was cancelled, instead 7.52km installed.
	・ Purification plant: increase capacity 50,000m^3/day; new construction 20,000m^3/day	: increased as planned. New construction with 20,000m^3/day cancelled.
	・ Transmission pipes: 17.78km	: 17.2km almost as planned
	・ Distribution pond: 4000m^3x2 units	: 4000m^3x2 units, as planned
	・ Distribution pipes: 72.11km	: extended to 83.16km
3) Chengzi Dam Water Supply Development (Zhaoyuan)	・ Rehabilitation of Chengzi Dam (not funded by JICA)	: (not funded by JICA)
	・ Pump station: 2 units	: 2 units: as planned
	・ Conveyance pipes: 61.53km	: shortened to 41.5km
	・ Intake pumps: 3 units	: increased to 12 units
	・ Purification plant: capacity 20,000m^3/day	: capacity increased to 60,000m^3/day
4) Wanghe Underground Dam Water Supply Development (Laizhou)	・ Underground dam: 14.5km	: 14.0km: as planned
	・ Rehabilitation/construction of check gates: 22 sections	: reduced to 16 sections
	・ Influent well: 1,300 units	: 1,210 wells, and changed to penetration ditch 65 sites
	・ Intake wells: 20 wells	: 12 wells
	・ Conveyance pipes: 6.77km	: reduced to 1.59km
	・ Purification plant: capacity 30,000m^3/day	: reduced to 15,000m^3/day
5) Coastal Levee Project (Laizhou)	・ Rehabilitation of coastal levee with a length of 40.2km	: 40.2km, as planned
	・ Construction of groin : 8 units	: 8 units, as planned
	・ Bridge construction: one site	: constructed by own funds ahead of project
	・ Rehabilitation of gates: 10 sites	: 10 units: as planned
② Duration	December 1998 (L/A)~December 2001 (completion of the project) (37 months)	December 1998 (L/A)~October 2005 (completion of civil work in 4 cities) (83 months)
③ Project cost		
Foreign currency	6,008 million yen	5,991 million yen
Local currency	8,688 million yen	3,227 million yen
	543 million yuan	229 million yuan
Total	14,696 million yen	9,218 million yen
Yen Loan Portion	6,008 million yen	5,991 million yen
Exchange rate	1 yuan = 16 yen (as of May 1998)	1 yuan =14.062 yen (Average of September 2000 ~September 2004)

People's Republic of China

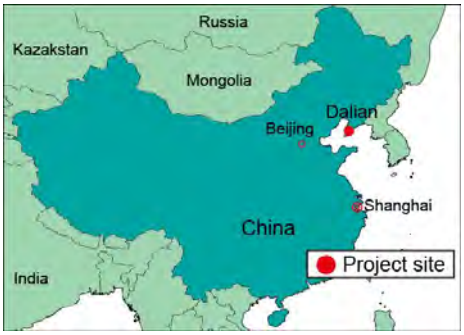
Ex-Post Evaluation of Japanese ODA Loan Project
Dalian Water Supply and Wastewater Treatment Project

Akemi Serizawa, Sanshu Engineering Consultant

0. Summary

The project, which improved the water supply facilities in Wafangdian and Zhuanghe and the wastewater treatment facilities in Wafangdian and Lushunkou in Dalian City, has been highly relevant with China's development plans, development needs, as well as Japan's ODA policy; therefore its relevance is high. The project cost was lower than planned, but the project period was substantially longer than planned because the completion of the Zhuanghe subproject was considerably delayed. Therefore, the efficiency is moderate. All subprojects have largely achieved their development objectives, which were to decrease the demand-supply gaps of water supply through the improvement of the water supply facilities or to improve the water quality of the rivers through the improvement of the wastewater treatment facilities, thus to improve the living conditions and the sanitary environment. Therefore, the effectiveness of the project is high. Since no major problems have been observed in the operation and maintenance systems such as organizational setup, technical capacity and financial status, the sustainability of the project is considered high.

1. Project Description



Location of Project Site

Lushunkou Wastewater Treatment Plant

1.1 Background

Water supply facilities in large cities of China have been improved since the 1980s. Since 1990s, suburban areas of large cities have faced to the demand-supply gap in water due to the increase of the water demand for the industrial and domestic purposes as a result of rapid industrialization and urbanization. Regional disparities of water supply services existed within a

city; while the central areas had almost achieved universal water supply, some suburban areas had only communal wells. The quantity of wastewater discharge also increased in cities due to rapid urbanization, and its average annual increase was 2.1% in China. Water pollution was also serious due to the increase of wastewater discharge.

The target areas of this project were Wafandian City, Zhuanghe City and Lushunkou District, all of which are municipalities of Dalian City. They have also experienced urbanization and thus faced insufficient water supply, increase in wastewater discharge and water pollution in the rivers.

1.2 Project Outline

The project objective is to contribute to the decrease of the demand-supply gap in water supply and to the improvement of the water quality of the rivers and thus to the improvement of the living conditions through the development of the water supply facilities in Wafangdian City and Zhuanghe City and of the wastewater treatment facilities in Wafangdian City and Lushunkou District in Dalian Metropolis. The project areas are shown in Figure 1.

Source: Wikipedia

Figure 1 Project areas (Dalian City)

Approved Amount/Disbursed Amount	3,309 million yen / 3,165 million yen
Exchange of Notes Date/Loan Agreement Date	March 2001 / March 2001
Terms and Conditions	Water supply projects: Interest rate 1.30%; Repayment period 30 years (Grace period 10 years) Conditions of procurement: General Untied Wastewater treatment projects: Interest rate: 0.75%, Repayment period 40 years (Grace period 10 years) Conditions of procurement: Bilateral-tied
Borrower/Executing Agency	Government of People's Republic of China / The People's Government of Dalian City
Final Disbursement Date	July 2006
Main Contractor (over 1 billion yen)	-
Main Consultant (over 100 million yen)	-
Relevant Studies (Feasibility Study and others)	Wafangdian Third-Phase Water Supply Project: China Northeast Design Institute (October 1998) Zhuanghe City Water Supply Project: China Huabei Design Institute (August 1998) Wafangdian Sewage Treatment Project: China Northeast Design Institute (October 1998) Lushunkou District Pollution Comprehensive Treatment Project: China Huabei Design Institute (September 1998)
Relevant Projects	JICA: Dalian Water Supply System Rehabilitation Project (L/A: September 1997) Norway and Netherland: Water supply project (Dalian Economic & Technological Development Zone) (1994) ADB : Dalian Water Supply Project (Dalian central districts) (1995) World Bank: Liaoning Environment Project (including Dalian wastewater) (1994)

2. Outline of the Evaluation Study

2.1 External Evaluator

Akemi Serizawa, Sanshu Engineering Consultant

2.2 Duration of Evaluation Study

The subject ex-post evaluation assignment was implemented as follows:

Duration of the Study : December 2010 – December 2011

Duration of the Field Study : February 20-March 5 and May 15-28, 2011

2.3 Limitation of evaluation

The subprojects are not related to each other except for the two Wafangdian projects. They are operated independently by each municipal government and its respective water supply company or wastewater treatment company, and the three target municipalities are distant from each other (100-200km in between). The government of Dalian City is not involved in the operation of the subprojects after it distributed the yen-loan funds to the three municipalities. The government of Dalian City was not able to provide the evaluator with the data of water supply and wastewater treatment of the whole Dalian City. Therefore, it was difficult to assess the synergistic effects of the subprojects and their impacts on the whole Dalian City. Considering the independent nature of each subproject, the evaluator rated them separately first and then rated the project on the whole.

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

3.1 Relevance (Rating[2]: ③)

3.1.1 Relevance with the Development Plan

The 9th Five-Year Development Plan of China (1996-2000) stated that the improvement of water supply facilities in the cities in the regions was one of the most essential agenda, and set up the following targets to be achieved during the Five-Year Plan period: i) increase of nationwide water supply by 40 million m^3/day; ii) raise the water supply coverage in urban areas to 96%; and iii) increase average water supply per person by 40ℓ/day. The water supply facility capacity increased by 13.15 million m^3/day by 1998, and thus the target should have been achieved by 2000 taking into account the facilities under construction. The target of water supply coverage in urban areas had been achieved by 1998, ahead of the schedule. The average water supply per person in 1998 was 214 ℓ/day, which has exceeded the target (210 ℓ/day).

Since many areas still suffered from shortage of water, however, the improvement of water supply facilities was among the priorities in the urban development plan also in the 10th Five-Year Plan (2001-2005).

Regarding wastewater, the government established regulations of the industrial wastewater discharge including introduction of the pollution charges, environmental assessment and the "three simultaneous system" which required companies to design, construct and operate pollution-prevention facilities at the same time as the construction of the main plants. The government also prioritized the improvement of wastewater treatment facilities in urban areas to respond to the rapid increase of domestic wastewater discharge.

The 11th Five-Year Development Plan (2006-2010) of China stated that the protection of

1 Overall rating: A: "very high", B: "high", C: "low in some aspects", D: "low"
2 Rating: ③: "high", ②: "moderate", ①: "low"

water sources for urban areas was to be strengthened, and construction of water supply facilities was to be further promoted. The ongoing 12th Five-Year Development Plan (2011-2015) also promotes the improvement of basic infrastructures including water supply and wastewater treatment facilities to ensure supply of safe water and to reduce water pollution.

This project was included as one of the priority projects in the 9th and 10th Development Plans of the three target municipalities. The priority areas of their 11th and 12th Development Plans include the improvement of water supply and wastewater treatment facilities in Wafangdian, the improvement of water supply facilities in Zhuanghe and the improvement of environment in Lushunkou.

The project was in line with the national policy of China and the development plans in the target municipalities because the improvement of water supply facilities and wastewater treatment facilities were among the priority areas, both at appraisal and ex-post evaluation.

3.1.2 Relevance with the development needs

At appraisal in 1999, the water supply capacity of Wafangdian City was only 50,000m^3/day which was just the same as its water supply demand. Wafandian City had a plan to increase its water supply capacity to 100,000m^3/day by 2003 by the construction of a new water plant of 65,000m^3/day by this project, in addition to another 35,000m^3/day capacity of the existing plant, which was to be reduced from 50,000 m^3/day to improve the quality of treated water. The water supply capacity of Zhuanghe City was only 47,000m^3/day, which was less than its water demand of 54,000 m^3/day. The plan of Zhuanghe City was to increase its water supply capacity to 100,000m^3/day by 2010 by the construction of a new water plant of 50,000m^3/day by this project, followed by another plant of 50,000m^3/day capacity after closing down the existing plant. Wafangdian City and Lushunkou District had no wastewater treatment facilities at the time of appraisal. Untreated wastewater discharged to the rivers caused stench and deprived citizens of healthy living conditions. This project to improve the water supply and wastewater treatment facilities was therefore relevant to the development needs of the target municipalities.

At the time of ex-post evaluation, the water supply capacity of Wafangdian City and Zhuanghe City and the wastewater treatment capacity of Lushunkou District cover their current demands, thanks to the contribution of the project. However, the demand might overtake the supply capacity sooner or later, as the further increase of the demand is anticipated. The wastewater treatment demand of Wafangdian City has already exceeded the capacity of the plant while it was sufficient to cover the demand when the plant started operation. The details of the demand and the supply capacity of each target municipalities are shown from Table 5 to Table 8

From the above, the needs to strengthen the water supply and wastewater treatment capacities existed in the target municipalities, both at appraisal and ex-post evaluation.

3.1.3 Relevance with Japan's ODA policies

According to the Overseas Economic Cooperation Implementation Policy (issued on December 1, 1999 and valid up to March 2002), the Japanese aid policy towards China focused on alleviation of disparity between regions, particularly giving priority to inland region and the development of the economic and social infrastructure which would promote self-motivating economic development in order to promote the development of the private sector and democratic markets, and to urge the well-balanced development to promote the market-oriented economy. This project to improve water supply and wastewater treatment facilities was in line with the Japanese aid policies.

The four subprojects and therefore the project on the whole have been highly relevant to the development policies in China, development needs, as well as Japan's ODA policies, and therefore the relevance of the project is high.

3.2 Efficiency (Rating:②)

3.2.1 Project Outputs

The project outputs (planned and actual) are summarized in Table 1.

Table 1. Comparison of Project Outputs (Planned and Actual)

Sub-project	Planned	Actual
A. Wafangdian water supply	・ Water intake pipes approx. 26km ・ Pumping facility 1 set ・ Water conveyance pipes between the pump station and the water treatment plant approx. 11km ・ Water treatment plant 65,000m^3/day (coagulation-sedimentation-rapid filtration system) ・ Water distribution pipes approx.14km	As planned. ・ Water intake pipes approx. 26km ・ Pumping facility 1 set ・ Water conveyance pipes between the pump station and the water treatment plant approx. 11km ・ Water treatment plant 65,000m^3/day (coagulation-sedimentation-rapid filtration system) ・ Water distribution pipes approx.14km
B. Zhuanghe water supply	・ Water intake pipes approx. 1 km ・ Water conveyance pipes approx. 16 km ・ Water treatment plant 50,000m^3/day (coagulation-sedimentation-rapid filtration system) ・ Water transmission pipes approx. 3 km ・ Water distribution pipes approx. 43 km	The water distribution pipes were 30km longer than the plan. Other items were as planned. ・ Water intake pipes approx. 1 km ・ Water conveyance pipes approx. 16 km ・ Water treatment plant 50,000m^3/day (coagulation-sedimentation-rapid filtration system) ・ Water transmission pipes approx. 3 km ・ Water distribution pipes approx. 73 km
C. Wafangdian wastewater	・ Wastewater treatment plant 60,000m^3/day (BIOFOR system) ・ River course treatment approx. 4.5 km ・ Water drainage pipes approx. 8 km	Another wastewater treatment system was selected. Other items were as planned. ・ Wastewater treatment plant 60,000m^3/day (ICEAS system) ・ River course treatment approx. 4.5 km ・ Water drainage pipes approx. 8 km

D. Lushunkou wastewater	・ Pump stations: 9 ・ Wastewater treatment plant 30,000m^3/day (Oxidation ditch system) ・ Water drainage pipes approx. 59km in total ➢ From Lushunkou to the plant approx. 51 km ➢ In the plant approx. 4 km ➢ From the plant to the discharge point to the sea approx. 3km ➢ Discharge into the sea approx. 1km	Another wastewater treatment system was selected. Pumps and drainage pipes were increased to respond to the needs of wastewater treatment in Lushunkou Development Zone. Other items were as planned. ・ Pump stations: 14 (5 pump stations were added for Lushun Development Zone) ・ Water treatment plant 30,000m^3/day (A2O system) ・ Water drainage pipes approx. 73km in total ➢ From Lushunkou to the plant approx. 53 km ➢ In the plant approx. 4 km ➢ From the plant to the discharge point to the sea approx. 3km ➢ Discharge into the sea approx. 1km ➢ In Lushun Development Zone approx. 12 km

Source: Appraisal documents, Questionnaire responses

The planned outputs have been completed almost as planned. Revised items and the reasons for the change are as follows:

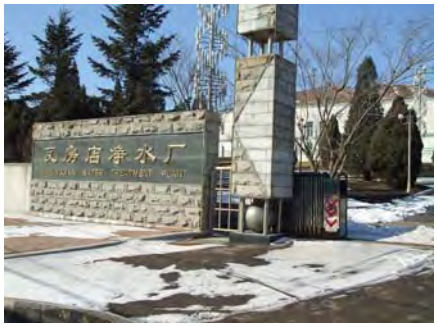
B. Zhuanghe water supply: The total extension of the distribution pipelines was about 30km longer than the plan. In order to avoid the risk of the fluctuation of the exchange rate at that time, local fund, instead of the yen-loan fund, was used to purchase the water inlet valves and chemical input facility. The surplus yen-loan fund was used to purchase the extra water distribution pipelines for the newly-added water supply areas after the appraisal.

C. Wafangdian wastewater: ICEAS[3] was selected instead of BIOFOR[4] as its wastewater treatment system. According to the executing agency, BIOFOR had become outdated and it became difficult to procure parts and materials as there were fewer manufacturers. After technical and financial comparisons between ICEAS and A2O[5], they selected ICEAS because it had advantages such as smaller operational cost.

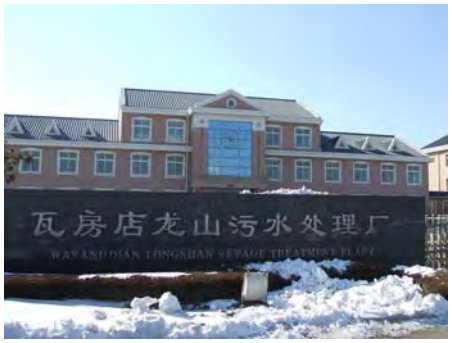
D. Lushunkou wastewater: A2O was selected instead of oxidation ditch system as its wastewater treatment system. According to the executing agency, A2O is the most popular wastewater treatment system in the Northeastern China with cold climate and

3 ICEAS (Intermittent Cycle Extended Aeration System) : One of the cyclic activated sludge technologies.
4 BIOFOR (Biological Aerated Filtration System): One of the cyclic activated sludge technologies.
5 A2O (Anaerobic-Anoxic-Oxic System): One of the cyclic activated sludge technologies.

it has various advantages such as that only one tank is needed for the three steps of wastewater treatment (adding oxygen, removing oxygen and chemical treatment), that the cost is smaller and that there is less stench. Another revision of the output was that extra pumps and water drainage pipes were procured in order to respond to the newly-developed needs of wastewater treatment in Lushunkou Development Zone.



Wafangdian Water Treatment Plant



Wafangdian Wastewater Treatment Plant

3.2.2 Project Inputs

3.2.2.1 Project Cost

The estimated project cost at appraisal was 9,235 million yen, of which the Japanese loan was to be used only for the foreign currency portion amounting to 3,309 million yen and the rest was to be financed by the Chinese government, Dalian City government and the governments of the three municipalities. The actual project cost was 9,225 million yen, of which the Japanese loan amount was 3,165million yen and the rest was financed by the Chinese government, Dalian City government and the governments of the three municipalities. The actual project cost was 100% of the plan in Japanese yen and 93% of the plan in Chinese currency. The difference between the plan and the actual cost in Chinese yuan is due to the change of the exchange rate, which was 1RMB=IJPY at appraisal and 1RMB=14JPY at ex-post evaluation. The project cost of each sub-project is summarized in Table 2.

Table 2. Project cost

	Planned	Actual	Reasons for difference	Rating
Wafangdian Water supply	1,917 million yen (FC* 985) (LC** 932)	1,851 million yen (FC 957) (LC 947)	While the outputs were same as the plan, the cost was smaller than the plan due to competitive bidding.	③ 97% of the plan
Zhuanghe water supply	1,625 million yen (FC 426) (LC 1,199)	1,157 million yen (FC 395) (LC 762)	Although the distribution pipes were 30km longer than the plan, the cost was smaller than the plan because the delivery was postponed until the exchange rate became stable and due to competitive bidding.	③ 71% of the plan
Wafangdian wastewater	1,933 million yen (FC 858) (LC 1,075)	2,588 million yen (FC 873) (LC 1,714)	The cost was larger than the plan because of the change of the wastewater treatment system that needed larger spaces for the plant.	② 134% of the plan
Lushunkou wastewater	3,192 million yen (FC 833) (LC 2,359)	3,631 million yen (FC 994) (LC 2,636)	The cost was larger the plan because the extra pumps and drainage pipes were purchased for the Lushun Development Zone. The difference of the local currency portion was due to the change of the exchange rate.	② 114% of the plan

Note: * Foreign currency, ** Local currency

Source: Appraisal documents, questionnaire responses

Zhuanghe Water Treatment Plant

Zhuwei reservoir, the source of Zhuanghe Water Purification Plant

3.2.2.2 Project Period

The actual project period substantially exceeded the planned period. The project period planned at appraisal was 31 months from March 2001 (signing of the Loan Agreement) to September 2003 (start of operation of the all sub-projects). The actual project period was from March 2001 (signing of Loan Agreement) to June 2006 (start of operation of the last subproject: Zhuanghe water supply) with a total of 64 months, which is 206% of the plan.

The delay of other three subprojects was relatively minor. Wafangdian water supply project started operation in September 2003, six months later than the plan (March 2003), Wafangdian wastewater treatment project started operation in March 2004, also six months later than the plan (September 2003), and Lushunkou wastewater treatment project started operation in January 2004, four months later than the plan (September 2003). According to the executing agencies, the reasons for the delay was the postponement of the bidding to avoid the risk of the fluctuation of exchange rate (Wafangdian water supply), the delay of the bidding for the equipment of the wastewater treatment plant following the change of the wastewater treatment method and the revision of equipment to procure (Wafangdian wastewater), and the prolonged testing process of the whole wastewater network of the district as it was their first wastewater treatment project (Lushunkou wastewater). Zhuanghe water supply project experienced significant delay: it started operation in June 2006, 33 months later than the plan (September 2003). While the water treatment plant was constructed in the planned period by the local fund as planned, the inlet pipes and distribution pipes were purchased by the Japanese loan fund about two years later than the plan, waiting for the right timing with stable exchange rate and the market prices of the steel pipes in China.

Table 3. Project period

	Planned	Actual	Project period since signing of Loan Agreement (March 2001)	Rating
Wafangdian water supply	October 2000 (start of Detailed Design) – March 2003 (start of operation)	April 2000 (start of Detailed Design) – September 2003 (start of operation)	Planned: 25 months Actual: 31 months	② 124% of the plan
Zhuanghe water supply	October 2000 (start of Detailed Design) – September 2003 (start of operation)	January 2000 (start of Detailed Design) – June 2006 (start of operation)	Planned: 31 months Actual: 64 months	① 206% of the plan
Wafangdian wastewater	October 2000 (start of Detailed Design) – September 2003 (start of operation)	January 2002 (start of Detailed Design) – March 2004 (start of operation)	Planned: 31 months Actual: 37 months	② 119% of the plan
Lushunkou wastewater	October 2000 (start of Detailed Design) – September 2003 (start of operation)	October 2000 (start of Detailed Design) – January 2004 (start of operation)	Planned: 31 months Actual: 35 months	② 113% of the plan

Source: Appraisal documents, questionnaire responses

The rating of the efficiency of the all subprojects is moderate as shown in Table 4.

Table 4. Efficiency of the sub-projects

	Efficiency (project cost and project period)
Wafangdian water supply	② (③+②)
Zhuanghe water supply	② (③+①)
Wafangdian wastewater	② (②+②)
Lushunkou wastewater	② (②+②)
Total	②

Regarding the project on the whole, the project cost was within the planned cost, but the project period was much longer than planned; therefore the efficiency is moderate.

3.3 Effectiveness (Rating: ③)

3.3.1 Quantitative effects

3.3.1.1 Results from Operation and Effect Indicators

(1) Enhancement of water supply capacity

Table 5 and 6 show the balance of water demand and supply capacity in Wafangdian and Zhuanghe respectively.

Table 5. Balance of water demand and supply capacity in Wafangdian

Year	1999	2005	2010
Population served (10,000 persons)	23.7	29.4	31.0
Water demand (10,000m^3/day)	5.0	5.0	6.7
Water supply capacity (10,000m^3/day)	5.0	10.0	10.0
Balance between demand and supply capacity (10,000m^3/day)	0	5.0	3.3

Source: Appraisal documents, questionnaire responses

Note: The current total water supply capacity of Wafangdian City is 100,000m^3/day, including the plant constructed by this project (65,000m^3/day, completed in September 2003) and the older plant, the capacity of which was decreased from 50,000m^3/day to 35,000 m^3/day to improve the quality of treated water.

Table 6. Balance of water demand and supply capacity in Zhuanghe

Year	1999	2005	2010
Population served (10,000 persons)	16.8	22.0	28.0
Water demand (10,000m^3/day)	5.4	7.8	10.0
Water supply capacity (10,000m^3/day)	4.7	4.7	10.0
Balance between demand and supply capacity (10,000m^3/day)	-0.7	-3.1	0

Source: Appraisal documents, questionnaire responses

Note: The current total water supply capacity of Zhuanghe City is 100,000m^3/day, including the plant constructed by this project (50,000m^3/day, completed in June 2006) and the new plant (50,000m^3/day, completed in April 2010 as the Phase II project of the same plant).

Wafangdian Water Treatment Plant

Water tariff of
Wafangdian Water Supply Company

Both cities have expanded the water supply capacity and the balance between the water demand and water supply capacity has been decreased. The Environment Bureaus of the two municipal governments certify that the quality of treated water satisfies the national standard of drinking water (pH, turbidity, coli form, etc.) and it is adequate as tap water. The result of the beneficiary surveys also confirmed that the water quality had been improved in taste, smell and turbidity.

(2) Enhancement of wastewater treatment capacity and decrease of pollutant discharge (decrease of water pollution)

Table 7 and 8 show the wastewater treatment capacity and the data of water quality in Wafangdian and Lushunkou.

Table 7. Wastewater treatment capacity and the data of water quality in Wafangdian

Year	1999	2005	2010
Population served (10,000 persons)	-	23.2	26.6
Wastewater treatment demand (10,000m^3/day)	5.0	6.1	10.0
Wastewater treatment capacity (10,000m^3/day)	0	6.0	6.0
Balance between demand and supply capacity (10,000m^3/day)	-5.0	0.1	-4.0
BOD of inlet wastewater (mg/L)	145	104	128
BOD of outlet treated water (mg/L)	-	10	6
BOD in the river (mg/L) Huitou River	127	2	4

Source: Appraisal documents, questionnaire responses

Note: The plant of 60,000 m^3/day capacity was the first wastewater treatment facility in Wafangdian City. At the time of appraisal, the city had a plan to increase the wastewater treatment capacity up to 100,000m^3/day by 2010, including this project, the second plant (20,000m^3/day, was to be completed in 2005) and third one (20,000m^3/day, was to be completed in 2010), which has yet been realized.

Table 8. Wastewater treatment capacity and the data of water quality in Lushunkou

Year	1999	2005	2010
Population served (10,000 persons)	-	No data	19.0
Wastewater treatment demand (10,000m^3/day)	2.9	2.0	2.9
Wastewater treatment capacity (10,000m^3/day)	0	3.0	4.0
Balance between demand and supply capacity (10,000m^3/day)	-2.9	1.0	1.1
BOD of inlet wastewater (mg/L)	170	290	151
BOD of outlet treated water (mg/L)	-	193	14
BOD in the river (mg/L) Long River	254	No data (Note 2)	No data (Note 2)

Source: Appraisal documents, questionnaire responses

Note 1: The current total wastewater treatment capacity of Lushunkou District is 40,000m^3/day, including the first plant constructed by this project (30,000m^3/day, completed in January 2004) and another plant (10,000m^3/day, completed in the end of 2010). At the time of appraisal, the District had a plan to increase the capacity up to 60,000 m^3/day by 2010, including 30,000m^3/day by this project and another 30,000m^3/day by the next plant. According to the executing agency, the District has changed the plan, and they are to add 50,000 m^3/day capacity in 2011 and 20,000m^3/day in 2012, which make 110,000 m^3/day capacity in total, as the Phase II project of the same plant.

Note 2: The water quality of the river is not measured as the treated water from this plant is discharged directly into the sea.

The wastewater treatment plants constructed by this project were the first of such facilities in the two municipalities. Before the project, non-treated wastewater was discharged directly to the rivers. As shown in the improved BOD of Huitou river in Wafangdian as well as supported by the opinions of the executing agencies and the beneficiaries, the water quality in the rivers and the sea has been improved as wastewater is properly treated. The result from the beneficiary surveys confirmed that the smells of the river and the sea had improved and the lives in the water had returned.

In Wafangdian City, the wastewater treatment capacity is not sufficient to cover the demand. According to the executing agency, the City still keeps a plan to increase the wastewater treatment capacity up to 100,000m^3/day, without detailed ideas such as the timeframe. The Lushunkou Wastewater Treatment Plant had applied the first grade wastewater treatment process since the start of operation until they upgraded the facility in 2008 by a private enterprise to conform to the second grade process, which is stricter than the first grade. It was a response to the revision of the national wastewater treatment water quality standard in 2008.

3.3.1.2. Internal Rate of Return

(1) Financial Internal Rate of Return (FIRR)

FIRRs at appraisal and at ex-post evaluation are shown in Table 9.

Table 9. FIRRs at appraisal and at ex-post evaluation

(%)

Sub-project	FIRRs at appraisal	FIRRs at ex-post evaluation
Wafangdian water supply	4.3	4.9
Zhuanghe water supply	9.8	4.4
Wafangdian wastewater	5.4	4.3
Lushunkou wastewater	2.4	2.9

Benefits: Water charge revenue
Costs: Construction costs, operation and maintenance costs, etc.
Project Life: 30 years for water supply projects; 40 years for wastewater treatment projects

The reasons for the differences between the FIRRS at appraisal and at ex-post evaluation are as follows:

A. Wafangdian water supply: FIRR at ex-post evaluation was higher than that at appraisal because the estimate of revenue in the future was based on the increase of revenue in the past, which was higher than the estimate at appraisal.
B. Zhuanghe water supply: FIRR at appraisal was based on the 50,000 m^3/day capacity of the plant constructed by the project. At ex-post evaluation, the calculation was based on the 100,000 m^3/day capacity in total, including 50,000 m^3/day of another plant that was completed in 2010. The Cost included the construction cost of the new plant and it reduced the cash flow during the period until 2010. Therefore, FIRR at ex-post evaluation was lower than that at appraisal.
C. Wafangdian wastewater treatment: FIRR at appraisal was calculated based on the assumption that the wastewater treatment capacity of the city would reach 80,000m^3/day. FIRR at ex-post evaluation was lower than that because it was based on the current capacity of 60,000m^3/day.
D. Lushunkou wastewater treatment: FIRR at ex-post evaluation was higher than that at appraisal because the actual tariff of wastewater treatment was higher than the estimate at appraisal.

3.3.2 Qualitative effects

As its qualitative effects, the project expected 1) response to the increasing water demand and 2) stable supply of safe water for the water supply projects. For the wastewater treatment projects, three effects were expected: which are 1) improvement of living conditions, 2) economy of water through the use of recycled water, and 3) recycle of sludge.

3.3.2.1 Water supply projects

(1) Response to the increasing water demand

The water supply capacity of Wafangdian is 100,000m^3/day and covers the current demand of 67,000m^3/day. The water supply capacity includes 65,000m^3/day of the plant constructed by the project, and 35,000m^3/day capacity of the older plant which was decreased from 50,000m^3/day to improve the quality of treated water. According to the executing agency, while the number of the clients has increased by about 2,000 households per year, suspension of water supply has been rare thanks to the enhanced water supply capacity.

The water supply capacity of Zhuanghe is 100,000m^3/day and is equal with the current demand of 100,000m^3/day. The capacity consists of 50,000m^3/day of the plant constructed by the project and another 50,000m^3/day of the new plant completed in April 2010. According to the executing agency, there is no plan to further increase the water supply capacity in Zhuanghe City while the supply is just the same as the demand.

(2) Stable supply of safe water

The treated water satisfies the national standard of drinking water both in Wafangdian and Zhuanghe. According to the executing agency in Zhuanghe, the water source before the completion of this project was contaminated rivers and chemical treatment was costly. After its completion, Zhuwei reservoir with excellent quality of water is used as the water source of the plant, and the cost of chemical treatment has been reduced and cleaning of tanks and pipes became less frequently needed as the water creates less sediment. Also, the level of groundwater has increased as its use has decreased, and its quality has been improved as it contains less seawater now. The improvement of water pressure through enhancement of water supply capacity allows residents of the upper floors of apartments to use tap water and toilet, while they had to often use public toilet before when the water pressure was not enough to pump up the water.

Beneficiary surveys were conducted through structured interviews in the project target areas. The number of the respondents was 200 in total, fifty for each subproject. The main findings from the surveys for the water supply projects are shown in Table 10.

Table 10. Results of beneficiary survey (water supply projects)

Changes experienced after the completion of the project	Wafangdian (Men 36, Women 14)	Zhuanghe (Men 37, Women 13)
Stable supply and safe water	96%	98%
Sufficient amount of supplied water	96%	98%
Improvement of water pressure	96%	94%
Improvement of water quality (turbidity, taste, smell)	92-94%	98%
Improvement of standard of living in sanitation	96%	98%
Reduction of time spent for housework	96%	98%
Economy of the city has been more active	96%	100%

From the above, it can be concluded that the project has been responding to the increasing water demand and contributing to the stable supply of safe water.

3.3.2.2. Wastewater treatment

(1) Improvement of living conditions

According to the executing agencies and the results of the beneficiary surveys, the living conditions along the rivers and the sea has been improved as the untreated wastewater no longer is discharged into the rivers and the sea and stench has been removed through the wastewater treatment facilities in the two municipalities. According to the executing agency of the Wafangdian wastewater treatment project, the riverside areas along Huitou River have been developed as prestigious residential areas and places for leisure, which led to the increase in the value of real property. They reported also that the fishery had been revived with return of water lives such as fish and shrimps. The executing agency of the Lushunkou wastewater treatment project also reported that the living conditions in the district had been improved by the improvement of water quality in the rivers and the sea.

(2) Economy of water through the use of recycled water

According to the executing agency of Wafangdian wastewater treatment project, the water quality of the dam of the downstream of the wastewater treatment plant has been improved, and then it is now used as a water source of tap water. In addition, 20,000m^3/day of 60,000m^3/day capacity of the plant goes through advanced treatment and is supplied as recycled wastewater (service water) that is not for human beings but for watering plants and other purposes. These facts are evidences of promotion of the effective use of the water resources.

(3) Recycle of sludge

At appraisal, sludge after wastewater treatment was to be recycled as fertilizer after

processed as determined in the national standard of sludge disposal. According to the executing agencies, however, sludge is disposed to the landfills without being recycled because the amount of sludge is small.

Table 11. Results of beneficiary survey (wastewater treatment projects)

Changes experienced after the completion of the project	Wafangdian (Men 34, Women 16)	Lushunkou (Men 39, Women 11)
Enhancement of wastewater treatment capacity	100%	100%
Wastewater treatment conditions are satisfactory.	92%	98%
Improvement of water quality in the rivers and the sea	100%	96%
Less stench of the rivers and the sea	100%	96%
Improvement of sanitary conditions	100%	98%

From the above, the wastewater treatment projects have contributed to the improvement of the living conditions and also to the economy of the water to a certain extent, while the recycle of sludge has not been in practice.

Therefore, the four subprojects, and then the project on the whole, have largely achieved the anticipated effects, and the effectiveness is high.

3.4 Impact

3.4.1 Appearance of intended impacts

(1) Contribution to the economic development in the target areas

The executing agencies reported that the project had contributed to the economic development in the target areas.

In Wafangdian City, the improvement of water supply facilities has contributed to attraction of investments. Since 2003 when the subproject was completed, two industrial zones were constructed and more than ten enterprises established offices in the city. GDP of the city has marked annual increase of more than 16%. The improvement of wastewater treatment facilities has contributed to the improvement of living conditions and to the development of the riverside as residential areas and spaces for leisure. Also, the fishery has been revived by the improvement of water quality.

Although no figures were available in Zhuanghe City, both the executing agency and the beneficiaries reported that the enhancement of the water supply capacity had contributed to the activation of the economy, as shown in Table 10 (results of the beneficiary surveys).

According to the executing agency of the Lushunkou wastewater treatment project, the plant has created employment of more than 100 people. As a result of the improvement of the living conditions, Lushunkou District has become more attractive as a tourist

destination and the value of real properties of the riverside has been increased. The fishery has been revived thanks to the return of the seashells and seaweed.

3.4.2 Other impacts (positive and negative impacts)

(1) Impacts on the natural environment

No negative impacts on the natural environment have been observed regarding the four subprojects.

A. Wafangdian water supply: The area between 1,000m upstream and 1,000m downstream of the intake spot is a reserve zone, in which no facilities or activities with a possibility of water pollution are allowed. The water quality control center (with nine staff members) conducts water quality inspections of the inlet and outlet spots of the plant. The wastewater from the plant is mainly domestic wastewater and is little polluted. After a simple treatment in the plant, it is discharged into the sewage network of the City. An automatic detection system for the chlorine leakage has been installed with an automatic absorption system. The monitoring is supervised by the Environmental Conservation Bureau of Wafangdian City and no negative environmental impacts have been observed so far.

B. Zhuanghe water supply: As the quality of the water source (Zhuwei reservoir) is good, little sludge is produced in the process of treatment. The wastewater from the plant is discharged directly to the river in the downstream. The Chemical Inspection Unit (with five staff members) conducts water quality inspections of the inlet and outlet spots of the plant. The monitoring is supervised by the Environmental Conservation Bureau of Zhuanghe City and no negative environmental impacts have been observed so far.

C. Wafangdian wastewater: It takes various measures to reduce stench. Sludge is not kept for a long time before transported to the landfill; the landfill to dispose sludge is distant from the residential areas; and the ICEAS system also is good to reduce the stench. The wastewater treatment plant itself is located in distance from the residential areas, and the site is with many greens and equipped with soundproof devices. Wastewater after treatment is checked every day by the inspection unit of the plant on the eight pollution indicators, and also receives monthly inspection by the Environmental Monitoring Station of Wafangdian City. No negative environmental impacts have been observed so far.

D. Lushunkou wastewater treatment: It takes similar measures as Wafangdian to reduce stench and the environment of the plant is also the same. Water quality inspection also follows a similar system to Wafangdian. Wastewater after treatment is checked every

day by the inspection unit (two staff members), and also receives monthly inspection by the Environmental Monitoring Station of Lushunkou District. No negative environmental impacts have been observed so far.

(2) Resettlement and Land Acquisition

The details of resettlement and land acquisition of each subproject are shown in table 12.

Table 12. Land area acquired, cost for land acquisition, resettlement and compensation

	Land area acquired	Number of resettled population	Cost for land acquisition	Compensation for resettlement
Wafangdian water supply	None	None	None	None
Zhuanghe water supply	3ha	6 people	None	RMB 320,000
Wafangdian wastewater	11ha	None	RMB 4,800,000	None
Lushunkou wastewater	5ha	None	RMB 25,570,000	None
Total	19ha	6 people	RMB 30,520,000	RMB 320,000

Source: Questionnaire responses

One household with six family members was resettled when the distribution pipes were laid out in the Zhuanghe water supply project. The executing agency reported that the compensation was made properly according to the compensation standards of the similar projects in the past in Dalian City. Regarding the wastewater treatment project in Wafandian and Lushunkou, the executing agencies reported that there had been no problems with the people affected as the land acquisition was implemented properly according to the land acquisition plans and the process of the explanation and obtaining consents was properly executed.

From the above, the project has contributed to the improvement of the living conditions and the economic development in the target areas.

3.5 Sustainability (Rating: ③)

3.5.1 Structural aspects of operation and maintenance

The following entities[6] which were identified at the appraisal stage are currently responsible for operation and maintenance of the facilities constructed by the project:

- Wafangdian Water Supply Company: 101 staff members are responsible for the operation and maintenance of the water treatment plant.
- Zhuanghe Water Supply Company: 52 staff members are responsible for the operation and maintenance of the water treatment plant.

6 The four entities are public corporations under the respective municipality government.

- ➢ Wafangdian Longshan Wastewater Treatment Plant: 28 staff members are responsible for the operation and maintenance of the wastewater treatment plant.
- ➢ Lushunkou Wastewater Treatment Plant: 28 staff members are responsible for the operation and maintenance of the wastewater treatment plant.

3.5.2 Technical aspects of operation and maintenance

The technical aspects of the four entities are as follows:

A. Wafangdian Water Supply Company: Among 101 staff members in the plant, 19 are graduates of technical colleges or above. All staff members participate in the annual technical training in quality management and process of operation and maintenance and take exams to measure achievements. According to the company, the staff members are technically capable enough to conduct standard operation and maintenance of water treatment plants. They have a management manual to ensure safety, which consist of a part for the regulations of safe productions and another for the regulations of safe operations. It includes regulations of operation and maintenance of every machine and facility.

B. Zhuanghe Water Supply Company: All of 52 operation and maintenance staff members are graduates of technical colleges or above, of which 12 are engineers or technicians. They receive annual training on procedures of operation and maintenance of equipment, among other subjects. The company has several manuals of patrol inspections and regulations for handling dangerous objects, as well as work manuals for each unit and equipment and standard of operations.

C. Wafangdian Longshan Wastewater Treatment Plant: According to the plant, the technical level of the staff members is sufficient. They participate in the monthly internal technical training. Staff members visit other wastewater treatment plants in the country once a year for technical exchanges and exchanges of views. When the plant started operation, staff members were sent to other plants in Kunming and Tsintao to be trained in ICEAS system. External experts were also invited to the plant as trainers.

D. Lushunkou Wastewater Treatment Plant: All of 23 staff members responsible for operation and maintenance have national qualifications and job experiences of at least three years, among which eight are university graduates. The plant provides technical training for newly recruited staff and all staff members participate in training in wastewater treatment technology and operation and maintenance of equipment, among other subjects. When the plant started operation, staff members were sent to other plants in Chanchung, etc. to be trained in A2O system.

3.5.3 Financial aspects of operation and maintenance

The revenue and expenditures of each entity are shown in the following tables.

Table 13. Revenue and expenditures of Wafangdian Water Supply Company

Unit: million yuan

Item	2007	2008	2009	2010
Annual sales (total revenue)	28.31	18.79	18.46	21.60
Expenditures	6.89	7.83	7.75	8.30
Cost for operation and maintenance	25.93	28.07	28.71	30.38
Operational profit/loss	-12.04	-12.61	-11.96	-8.76

Source: Executing agency

Table 14. Revenue and expenditures of Wafangdian Wastewater Treatment Plant

Unit: million yuan

Item	2007	2008	2009	2010
Annual sales (total revenue)	7.59	7.39	7.51	7.55
Cost of sales	12.13	11.82	12.10	11.56
Other expenses (including cost for operation and maintenance)	0.97	1.06	0.92	1.03
Operational profit/loss	-5.48	-5.47	-5.52	-5.04

Source: Executing agency

Table 15. Water tariff of Wafangdian City

Unit: yuan/m^3

Category	Water supply	Wastewater treatment	Total
Domestic use	1.5	0.6	2.1
Industry	3.2	0.9	4.1
Commercial	4.7	0.9	5.6
Public baths	6.0	1.1	7.1

Source: Executing agency

Table 16. Revenue and expenditures of Zhuanghe Water Supply Company

Unit: yuan/m^3

Item	2007	2008	2009	2010
Annual sales (total revenue)	34.63	35.67	37.44	45.67
Cost of sales	23.59	24.99	26.35	33.26
Other expenses	9.31	7.60	9.48	9.76
cost for operation and maintenance	8.31	6.07	8.23	8.78
Operational profit/loss	1.51	1.57	1.55	2.42

Source: Executing agency

Table 17. Water tariff of Zhuanghe City

Unit: yuan/m^3

Category	Water supply	Wastewater treatment	Total
Domestic use	1.6	0.6	2.2
Industry	3.2	0.9	4.1
Commercial	5.0	0.9	5.9
Special sector (public baths, etc.)	15.0	1.1	16.1

Source: Executing agency

Table 18. Revenue and expenditures of Lushunkou Wastewater Treatment Plant

Unit: yuan/m^3

Item	2007	2008	2009	2010
Annual sales (total revenue)	7.54	10.30	12.02	12.55
Cost of sales and other expenses (including cost for operation and maintenance)	8.64	10.10	10.14	12.57
Operational profit/loss	-1.10	0.20	1.88	-0.02

Source: Executing agency

Table 19. Water tariff of Lushunkou District

Unit: yuan/m^3

Category	Water supply	Wastewater treatment	Total
Domestic use	2.3	0.6	2.9
Industry	3.2	0.9	4.1
Commercial	5.0	0.9	5.9
Special sector (public baths, etc.)	5.0	0.9	5.9

Source: Executing agency

Among the four projects, only the financial status of Zhuanghe Water Supply Company is in surplus and others are in deficit. Since the profitability of water supply and wastewater treatment business is low, they have been run as public business. The four water supply/wastewater treatment companies are owned by the respective municipal government. The water tariff, which is the most essential factor for the profitability of the water business, is determined by the Price Regulation Bureaus of the municipal governments taking into account the financial status of the water companies, the price escalation rates and the level of the other public utility charges. When the financial status of the water companies is worsened, the municipal governments are supposed to provide the subsidy. Therefore, the financial status of the water companies are considered stable and no major issues exist in the financial sustainability of the project. The executing agencies consider that the budget for operation and maintenance of their water companies are appropriate.

3.5.4 Current status of operation and maintenance

All equipment and facilities installed or constructed by the project have been functioning well and no major issues have been reported. All water companies prepare annual plans for repair and operation and maintenance, and they operate daily inspections as well as periodic inspections every several months. Minor troubles are taken care in several days and major ones are treated according to the annual repair plan.

From the above, no major problems have been observed in the operation and maintenance of the four subprojects and therefore the project on the whole in the aspects of organizational setup, technical capacity and financial status. Therefore, the sustainability of the project is high.

4. Conclusions, Lessons Learned and Recommendations

4.1 Conclusions

Since the four subprojects are not related to each other as stated in "2.3 Limitation of Evaluation", each of them is rated first and then the project on the whole is rated. The results are shown in Table 20.

Table 20. Rating of the subprojects and the project on the whole

	Relevance	Effectiveness and Impact	Efficiency (Project Cost + Project Period)	Sustainability	Total
Wafangdian water supply	③	③	② (③+②)	③	A
Zhuanghe water supply	③	③	② (③+①)	③	A
Wafangdian wastewater	③	③	② (②+②)	③	A
Lushunkou wastewater	③	③	② (②+②)	③	A
Total	③	③	②	③	A

All subprojects and therefore the project on the whole have been highly relevant with China's development plans, development needs, as well as Japan's ODA policy; therefore its relevance is high. The total project cost was lower than planned, but the project period was substantially longer than planned because the completion of the Zhuanghe sub-project was considerably delayed. Therefore, the efficiency of the project is moderate. All sub-projects have largely achieved its development objectives, which were to decrease the demand-supply gaps of water supply through improvement of the water supply facilities or improve water quality of rivers through improvement of wastewater treatment facilities, thus to improve living conditions and sanitary environment. Therefore, the effectiveness of the project is high. Since no major problems have been observed in the operation and maintenance system of the four subprojects

such as organizational setup, technical capacity and financial status, the sustainability of the project is considered high.

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

4.2 Recommendations

4.2.1 Recommendations to the executing agencies

1) No financial problem is observed in the management of the executing agencies because the municipal governments of Dalian City determine water charges and they provide subsidies to the executing agencies when their financial status is in deficit. However, it is recommended to the municipal governments and the executing agencies to have regular discussions and consider possibilities of revision of water charges when necessary.
2) In Wafangdian City, the current wastewater treatment capacity is not sufficient to cover the demand. It is recommended to Wafangdian municipal government to prepare a concrete plan for enhancement of wastewater treatment capacity including the timeframes, while they have a plan with no determined target years or process.

4.2.2 Recommendations to JICA

None.

4.3 Lessons Learned

None.

Comparisons of the Planned and Actual Scope of the Project

Item	Planned	Actual
① Outputs		
A. Wafangdian water supply	・ Water intake pipes approx. 26km ・ Pumping facility 1 set ・ Water conveyance pipes between the pump station and the water treatment plant approx. 11km ・ Water treatment plant 65,000m^3/day (coagulation-sedimentation-rapid filtration system) ・ Water distribution pipes approx.14km	As planned. ・ Water intake pipes approx. 26km ・ Pumping facility 1 set ・ Water conveyance pipes between the pump station and the water treatment plant approx. 11km ・ Water treatment plant 65,000m^3/day (coagulation-sedimentation-rapid filtration system) ・ Water distribution pipes approx.14km
B. Zhuanghe water supply	・ Water intake pipes approx. 1 km ・ Water conveyance pipes approx. 16 km ・ Water treatment plant 50,000m^3/day (coagulation-sedimentation-rapid filtration system) ・ Water transmission pipes approx. 3 km ・ Water distribution pipes approx. 43 km	The water distribution pipes were 30km longer than the plan. Other items were as planned. ・ Water intake pipes approx. 1 km ・ Water conveyance pipes approx. 16 km ・ Water treatment plant 50,000m^3/day (coagulation-sedimentation-rapid filtration system) ・ Water transmission pipes approx. 3 km ・ Water distribution pipes approx. 73 km
C. Wafangdian wastewater treatment	・ Wastewater treatment plant 60,000m^3/day (BIOFOR system) ・ River course treatment approx. 4.5 km ・ Water drainage pipes approx. 8 km	ICEAS system was selected instead of BIOFOR. Other items were as planned. ・ Wastewater treatment plant 60,000m^3/day (ICEAS system) ・ River course treatment approx. 4.5 km ・ Water drainage pipes approx. 8 km
D. Lushunkou wastewater treatment	・ Pump stations: 9 ・ Wastewater treatment plant 30,000 m^3/day (Oxidation ditch system) ・ Water drainage pipes approx. 59km in total ➢ From Lushunkou to the plant approx. 51 km ➢ In the plant approx. 4 km ➢ From the plant to the discharge point to the sea approx. 3km ➢ Discharge into the sea approx. 1km	A2O system was selected instead of oxidation ditch system. Pumps and drainage pipes increased to respond to the needs of wastewater treatment in Lushunkou Development Zone. Other items were as planned. ・ Pump stations: 14 (5 pump stations were added for Lushun Development Zone) ・ Water treatment plant 30,000m^3/day (A2O system) ・ Water drainage pipes approx. 73km in total ➢ From Lushunkou to the plant approx. 53 km ➢ In the plant approx. 4 km ➢ From the plant to the discharge point to the sea approx. 3km ➢ Discharge into the sea approx. 1km ➢ In Lushun Development Zone approx. 12 km
② Project Period	March 2001 (L/A)- September 2003 (start of operation of all subprojects) (31 months)	March 2001 (L/A)- June 2006 (start of operation of all subprojects) (64 months)
③ Project Cost Foreign currency Local currency Total Yen loan portion Exchange rate	 3,309 million yen 5,925 million yen (456 million yuan) 9,235 million yen 3,309 million yen 1 yuan=13 yen (as of March 2001)	 3,165 million yen 6,060 million yen (433 million yuan) 9,225 million yen 3,165 million yen 1 yuan=14 yen (average of 2001-2006)