People's Republic of China

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

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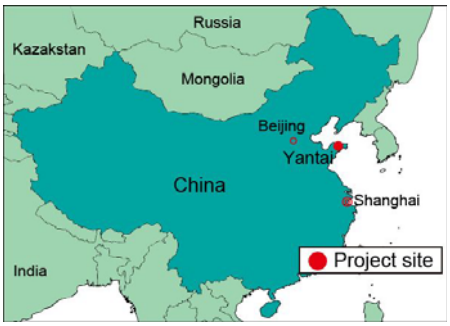
0. Summary

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.

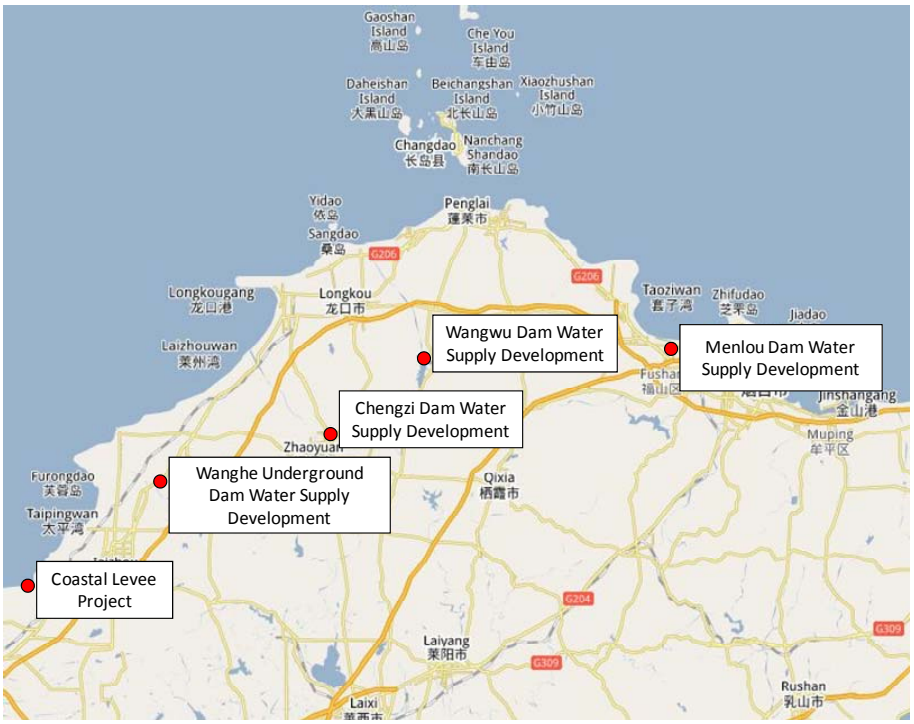


Figure 1 Location of the Project Site

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)