Ex-Post Project Evaluation 2010: Package II-4 (China)

November 2011

JAPAN INTERNATIONAL COOPERATION AGENCY

IC NET LIMITED

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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.

November 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.

Ex-Post Project Evaluation 2010:

Package II-4 (China)

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Ex-Post Evaluation of Japanese ODA Loan

Suzhou Water Environmental Improvement Project

External Evaluator: Kenji Momota, IC Net Limited

0. Summary

The improvement of water quality for Suzhou City, with its extensive network of waterways, had been a major public environmental issue requiring prompt attention. Since the completion of the project, the sewage treatment plant has been operating smoothly, achieving remarkable outcomes including a more than 50% improvement in the quality of water in the city's waterways. The objective of the project can generally be described as having been achieved, as evidenced by the opinion of many city residents who acknowledged the improvement in water quality, as well as by the healthy growth of the city's tourism industry. The Suzhou City government places a high political priority on water resources; hence, no problems are anticipated in terms of the technical and financial sustainability of the project. In the future, it will be necessary to convert the sludge treatment method from that of the currently employed landfill method to one of incineration or other more advanced technologies. In the light of the above, this project can be evaluated as highly satisfactory.

1. Project Description

Project Location

Fuxin Treatment Plant

1.1 Background

The Province of Jiangsu in southern China comprises Shanghai and other large cities, and as of 1997 ranked second in economic size. The city of Suzhou, located in the south of the province, has the status of a major city; it is enjoying growth as a tourist destination with its many World Heritage sites in addition to its importance as an industrial city. Suzhou is also known for its abundant water resources: it is surrounded by numerous lakes, large and small, as well as by the Beijing-Hangzhou Grand Canal, and within the city there is an extensive network of waterways. As much as 43% of the city's surface area is water.

The rapid growth in Suzhou's economy and population since the 1980s increased the amount of sewage and industrial effluent. However, the treatment facilities were poor in both coverage and efficiency. A large portion of the wastewater was discharged to the city's waterways without proper treatment to meet the national quality standards, thus aggravating the problem of water pollution. Furthermore, the 1992 diversion work of the Beijing-Hangzhou Grand Canal and other measures reduced the volume of water flowing into the city waterways. Accordingly, the natural purification capacity decreased and water pollution became more serious. The quality of water in the city's waterways failed to meet even the Classs V water quality level, which is the lowest rank in China's national water quality standards.

Fig. 1 A Waterway Before the Project

Fig. 2 A Highly Eutrophic[1] Waterway

[1] Eutrophication refers to the phenomenon of lakes and other closed water areas receiving an inflow of nitrogenous compounds, phosphates and other nutritious salts from the basin over a long period of time and transforming into nutrient-rich lakes with high rates of biological production. In an eutrophic lake, toxic substances such as algae and the like proliferate; they consume much of the oxygen in the water, leaving the lake poor in oxygen and killing aquatic life. The water quality deteriorates, the clarity decreases, bad odors are released, and the color turns green, brown, or red brown.

1.2 Project Outline

The objective of this project is to improve the water quality of rivers in the city of Suzhou, Jiangsu Province, by constructing a sewage treatment plant and sewer systems to increase the sewage treatment capacity, and thereby contribute to an improved living environment for citizens.

Loan Approved Amount/ Disbursed Amount	6,261 million yen / 6,261 million yen
Exchange of Notes Date/ Loan Agreement Signing Date	March 2000 / March 2000
Terms and Conditions	Interest Rate: 0.75% Repayment Period: 40 years (Grace Period of 10 years) Conditions for Procurement: Bilateral; tied
Borrower / Executing Agencies	People's Republic of China/Suzhou People's Government, Suzhou Qingyuan Construction & Development Company
Final Disbursement Date	July 2007
Main Contractor	Sainty International Group Jiangsu Machinery I/E Corp Ltd. (People's Republic of China)
Main Consultant	
Feasibility Studies, etc.	"Feasibility Study on Water Environment Comprehensive Improvement Project in the Urban Area of Suzhou" (Suzhou CIECC Engineering Consulting Co., Ltd. / Suzhou Qingyuan Construction & Development Company, 1998)
Related Projects (if any)	"China–Tai Basin Urban Environment Project" (World Bank, 2004)

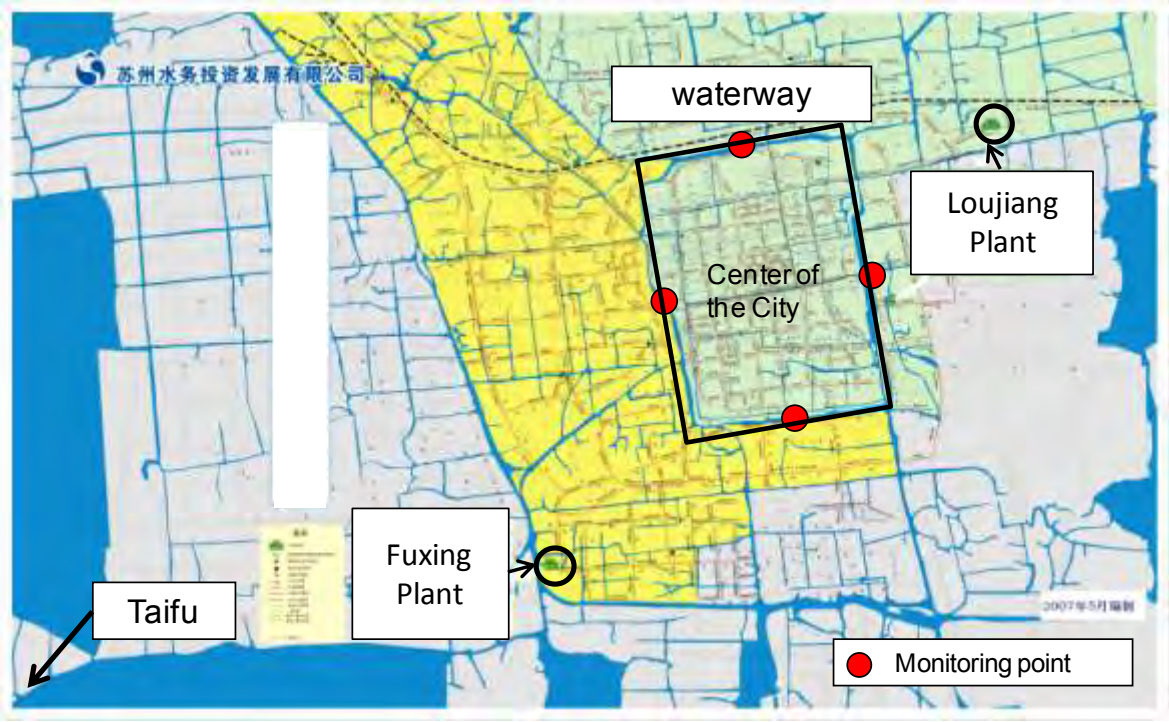

Figure 3 Suzhou City Zone and Project Sites

2. Outline of the Evaluation Study

2.1 External Evaluator

Kenji Momota, IC Net Limited

2.2 Duration of the Evaluation Study

For the purpose of this ex-post evaluation, studies were made in the following periods:

Duration of the Study: November 2010 – November 2011

Duration of the Field Study: February 26, 2011– March 9, 2011 and June 4, 2011–June 11, 2011

2.3 Constraints during the Evaluation Study

None of significance

3. Results of the Evaluation (Overall Rating: A[2])

3.1 Relevance (Rating: ③[3])

3.1.1 Relevance to the Development Policy of China

(1) Development policy at the time of project appraisal

Since the 1980s, China's rapid industrialization and urbanization have increased the urgent demand for potable and industrial water. This situation aggravated the problem of water quality deterioration. As a result, the Chinese government made the improvement of environmental water quality a high, long-term priority that became part of its basic policy. The national environmental standards, including those of water quality, have been tightened a number of times. With respect to lakes, in particular, the problem was serious in the Three Lakes (Lake Tai, Lake Chao, and Dian Chi). The most important policy item identified in the Ninth Five-Year Plan (1996–2000) was the improvements of urban sewer systems, along with the tightened control of industrial effluents, to control wastewater inflow into rivers and lakes in order to secure safe water sources.

Table 1 Water Quality Improvement Targets in Suzhou

Targets	By 2000	By 2010
Beijing-Hangzhou Grand Canal and waterways	Class IV - V	Class IV
Potable water source Class 1 protected zone	Class II	Class II
Lake Tai, Yangcheng Lake, other rivers and lakes	By district	n.a.

In pursuit of these targets, the Province of Jiangsu established the Jiangsu Province Lake Tai Water Pollution Control Ordinance in 1996, which provided for the formulation and implementation of a plan to improve sewer treatment facilities and for ordinances to protect waterways.

(2) Development policy at the time of ex-post evaluation

The Eleventh Five-Year Plan (2006–2010) set out a policy to strengthen environmental protection measures, calling for the implementation of ten major environmental protection projects. Of these, water quality improvements were given a high priority. Thus urban sewage treatment was considered crucial, hence, the specific target of treating 70% of sewers nationally.

The Suzhou Municipal City Government recognized that improvements to the water resource environment of the city were vitally important, because it is closely linked to the city's socioeconomic life. Accordingly, it promotes investment plans on a continual basis. The "City Total Development Plan (1996–2010)" of Suzhou City, which may be regarded as the city's urban planning master plan, cites improvements and conservation of the water environment as a major objective. Specific water resource environment improvement plans are implemented in accordance with the long-term plan, the "Suzhou Municipal City Urban Water Environment

[2] A: Highly satisfactory; B: Satisfactory; C: Partially satisfactory; D: Unsatisfactory

[3] ③: High; ②: Fair; ①: Low

Improvement Plan (2007–2020).” Capital investment projects, for which the total cumulative expenditure will amount to 836 million Yuna (approximately 10.8 billion yen), are planned for the modernization of existing facilities, the extension of the sewer network, and the improvement of river channels. Options for fund raising have been explored, including the BOT scheme[4] and other private investments.

In line with the above policy, the Suzhou Qingyuan Construction & Development General Company, which is the executing agency of this project, will be involved in the extension and upgrading of the treatment plant (Phase II Project), and in river improvement and conduit projects on a continual basis, even after the completion of the project. By way of background, an interview with the president[5] of the executing agency confirmed that the project under evaluation was critical in encouraging and facilitating investment in these subsequent projects. The project under evaluation has triggered the need for this series of sewage treatment projects up to the present.[6]

3.1.2 Relevance to the Development Needs of China

Suzhou, while important as a major industrial city in Jiangsu Province, is famous also as a tourist destination[7] with a 2,500-year history. The rivers and canals that run through the city have themselves been an important element of this scenic beauty. At the time of planning the project, Suzhou had insufficient wastewater treatment capacity to cover the increasing discharge of household sewerage and industrial effluents caused by rapid economic growth and population increase. Pollutant removal measures were inefficient and even the treated water often did not meet its standards. In addition, the canal diversion work carried out during the 1990s roughly halved the flow rate of waterways in the city; in particular, the volume of Lake Tai water that was of relatively good quality decreased, thus exacerbating the problem of poor water quality. As a result, the quality of water in the city’s waterways failed to reach even the lowest national standard (Grade V), requiring urgent attention in terms of both improvements to the living environment and protection of the scenic beauty.

Subsequent to the implementation of the project under evaluation, Suzhou has continued its economic and urban growth and there is greater need than ever for sound sewage treatment. The need for water quality improvement in the project location remains critical.

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[4] BOT (Build, Operate, Transfer) scheme: a scheme under which a private sector enterprise builds, operates, maintains, and manages, in most cases, a public facility with its own funds and transfers the ownership of the facility to the public sector at the end of the contracted period of operation.

[5] A position in a Chinese business enterprise, corresponding to the representative director in a Japanese business enterprise

[6] Projects that were implemented after the project under evaluation include (i) the Phase II expansion of the Loujiang and Fuxing Treatment Plants, (ii) upgrading of city center treatment plants, (iii) rainwater/sewerage separation and branch line/user connection, (iv) Xitang river channeling, (v) city center comprehensive river management, and (vi) city center flood control.

[7] Four gardens in the city were designated as World Heritage sites in 1997.

3.1.3 Relevance to Japan's ODA policy

The Country Assistance Program for China in effect at the time of this project appraisal cited environmental protection as one of its areas of focus, and laid out a policy of promoting assistance for sewage treatment and other water pollution control measures in line with the needs of China. Further, the Medium-Term Strategy for Overseas Economic Cooperation Operations then in effect for China[8] identified the environment, agriculture, and reduction of regional differences through inland development as three major areas of priority. This project under evaluation is an environmental protection project in the city of Suzhou where the water resource environment is very closely related to the living environment of residents. It was in line with the Country Assistance Program and the Medium-Term ODA Strategy for China, and it is adjudged to have played an important role in the development of the Program and Strategy.

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

3.2 Efficiency (Rating: ②)

3.2.1 Project Outputs

The table below summarizes the comparison between the planned and actual selected project output parameters. The project under evaluation was generally implemented as planned.

Output	Plan	Actual
1) Sewage treatment plants		
1. Loujiang Plant		As planned
Daily treatment volume	60,000 m^3/d	(expanded to 140,000 m^3/d by now)
2. Fuxing Plant		As planned
Daily treatment volume	80,000 m^3/d	(expanded to 180,000 m^3/d by now)
		*For both plants, deodorization units were procured in addition.
3. Sewer line		
Network improvement	Total 110 km	Total 108 km
Sewer system repair	19 connections	As planned
4. Pumping stations	20 locations	As planned
2) Waterway improvement and channeling		
1. Waterway improvement		
Dredging	65.3 km	As planned
Broadening	4.4 km	As planned
Bridge upgrading	21 locations	As planned
2. Channeling (Lake Tai)		
Intake volume	350,000 m^3/d	As planned
Conduits	29.1 km	As planned
Pumping station	1 location	As planned

[8] The Medium-Term Strategy for Overseas Economic Cooperation Operations was a document that was prepared by JICA every three years, on the basis of MFA's ODA Charter and the Medium-Term Policy on ODA.

Major changes from the original plan are as follows:

- The discharge outlet of the Loujiang Sewage Treatment Plant was originally designed to be situated upstream of Jinji Lake in the development zone. The outlet was installed downstream to avoid negative impact on water quality of Jinji Lake.
- Additional deodorization units were procured because increased housing development in the neighborhood of the construction sites meant the odor from the plants would become a potential problem[9].

To respond to the increased demand for sewage treatment after the completion of the project, a Phase II treatment capacity extension project was implemented with World Bank assistance. The current capacity is double that of the original (320,000 m^3/day). A Phase III project was then implemented in order to respond to the upgraded national standards for environmental and water quality[10]. The last project sought to raise the treatment capacity of pollutants that had not been included in the original design. It was completed at the end of 2010. In addition to the above-mentioned odor prevention measures, further deodorization/upgrading works are underway at the Fuxing Plant. Previously, the plant was located in a suburban area with few houses in the neighborhood and, therefore, no particular odor prevention measures were taken; however, subsequent economic growth stimulated housing development projects in the vicinity and deodorization became necessary to accommodate nearby residents.

Fig. 4 Biological Reaction Pond, Fuxing Plant

Fig. 5 Waterway Alongside Houses

[9] The additional procurement amounted to approximately 500 million yen, which was financed by the ODA project loan. Efforts at odor prevention continue; at the time of ex-post evaluation, additional work in covering the reaction pond was underway.

[10] The equipment that was renovated or added included graded frames, an aeration sand settling tank, an improved alternating biological reaction vessel, and a blower room and power distribution room for the secondary reaction vessel; their main purpose was to achieve the national discharge standard of Class 1-A/1-B.

3.2.2 Project Inputs

3.2.2.1 Project Cost

The total project cost amounted to 17,067 million yen (of which 6,261 million yen was ODA Loan), a slight increase over the planned cost of 16,578 million yen (of which 6,261 million yen was ODA Loan). The total cost includes approximately 510 million yen, accounting for the additional procurement of the deodorization unit. The actual cost of completing the original project was 16,558 million yen, which was lower than the planned cost (99.87%) due to exchange rate fluctuations and other factors, despite such factors as increases in land acquisition costs (approximately 275 million yen).

3.2.2.2 Project Period

The actual project period was 94 months from March 2000 through December 2007, as against the planned period of 46 months from March 2000 through December 2003. Therefore, the project ran significantly (204%) longer than planned. Major reasons included the following:

- Commencement and completion of the conduit installation work (about 1 km) had to be postponed until 2007 because of a government order to make it coincide with the renovation of the Suzhou railway station.
- Some of the conduit installation locations experienced heavy traffic and the permits from responsible authorities were not granted in a timely fashion.
- Land acquisition negotiations for the pumping stations took longer than anticipated at six locations, including the Baiyangwang and Qimen graded crossings, which led to a delay in starting work.

As described above, although the project cost was within the plan, the project period was exceeded, therefore the efficiency of the project is fair.

3.3 Effectiveness (Rating ③)

3.3.1 Quantitative Effects

3.3.1.1 Results from Operation and Effect Indicators

(1) Evaluation perspectives

The operation of the sewage treatment plants was evaluated mainly from the perspective of conformance (or non-conformance) with China's national environmental standards. Normally, evaluation criteria would be whether the performance of the treatment plant reaches the planned capacity and planned effects. However, China's wastewater discharge standards have become more stringent since the project was planned due to a national policy to tighten environmental standards. The sewage treatment plants under the present evaluation have implemented a series of plant extensions and upgrades to cope with the tightening of these standards. It is unrealistic to measure the plants' performance against the plan because the treatment capacity has

substantially exceeded that of the original plan. It is necessary to look at the overall effects of the project, including the measures subsequently added, if we are to make a true evaluation of the effectiveness of the project.

Table 2 National Standards for Treated Effluents

Indicator	When planned Class 1-B standard	Present Class 1-A standard
COD_{cr}[11]	60 mg/l max.	50mg/l max.
BOD_s[12]	20 mg/l max.	10 mg/l max.
SS[13]	20 mg/l max.	10 mg/l max.
NH_3-N[14]	8(15) mg/l max.	5 (8) mg/l max.
TP[15]	1 mg/l max.	0.5 mg/l max.

Source: Discharge standards for pollutants for municipal wastewater treatment plant (GB18918-2002)

(2) Operation of sewage treatment plants

1) Operation of Fuxing and Loujiang Treatment Plants

The two treatment plants can cover the treatment demand far beyond its original estimation, and operating at more than 100% of their rated capacity since they were commissioned. As was reviewed in Efficiency, both plants have been expanded to more than double their original capacities through the Phase II and Phase III projects. The city today has three plants including the Chengdong Treatment Plant that was already in service before the project. Their total treatment capacity has been increased to 320,000 tons/day, which is large enough for the time being to meet the treatment demands of the city.

[11] COD (Chemical Oxygen Demand) = the amount of oxygen consumed to oxidize organic compounds in water by means of an oxidizing agent; used like BOD to indicate the degree of water contamination

[12] BOD (Biochemical Oxygen Demand) = an indicator of water contamination; an especially important indicator for the control of industrial effluents. This is the amount of oxygen consumed by microorganisms to decompose organic compounds in water. The greater the BOD value, the dirtier the water.

[13] SS (suspended solid) = insoluble particle matter suspended in water. This includes minute particles derived from clay minerals, animal and plant plankton and their remnants, organic compounds and metal sediment derived from sewerage and industrial wastewater.

[14] NH_3-N=ammonic nitrogen. A substance generated by the decomposition of proteins, urea, uric acid, etc., and an indicator of nitric contamination. Together with phosphates, ammonic nitrogen accelerates eutrophication.

[15] TP = Total phosphor. The total amount of phosphates in water, expressed as a phosphor concentration. Phosphates are contained in urine, detergents, fertilizers, etc., and total phosphor is used as an indicator of eutrophication. In some closed water areas, it is regulated as a discharge standard.

Table 3 Operation of Fuxing Plant

	Indicator	Unit	Planned	2008	2009	2010	applicable national standard
1	Population coverage	ten thousand				25.4	
2	Treated water	(m^3/day)		79,500	113,000	125,200	
3	Rate of facility utilization	(%)		99.4%	62.8%	69.6%	
4	BOD density (mg/l)	in	180	145.1	139.8	117.4	
		out	30	7	5.1	2.81	Class A
		% of reduction	83.3%	95.2%	96.4%	97.6%	
		Quantity of reducition	4380	4007	5554	5237	
5	COD density(mg/l)	in	360	324.6	332	309	
		out	120	35.7	32	32	Class A
		% of reduction	66.7%	89%	90%	90%	
		Quantity of reducition	7008	8,383	12,374	12,658	
6	SS density(mg/l)	in	250	169	168	171	
		out	30	15	13	10	Class A
		% of reduction	88.0%	91.1%	92.3%	94.2%	
		Quantity of reducition	6,424	4,467	6,393	7,367	
7	NH3-N density(mg/l)	in	35	27.1	25.8	23.3	
		out	25	21	4.4	3.6	Class A
		% of reduction	28.6%	22.5%	82.9%	84.5%	
		Quantity of reducition	292	177	883	898	
8	TP density(mg/l)	in	4	3.7	4.19	3.72	
		out	1	1	0.95	0.51	Class B
		% of reduction	75.0%	73.0%	77.3%	86.3%	
		Quantity of reducition	88	78	134	147	
9	Quantity of treated sludge	t/year		23,599	28,684	44,032	
10	Rate of sludge recycle	(%)		100	100	100	

Source: Suzhou Qingyuan Construction & Development Company

The pollutant reduction rates at the plants had reached almost 90% by 2010 by most indicators. The design targets of post-treatment water quality and reduction rates have generally been met. The present level of treatment efficiency conforms to the original target for Class 1-B standards in all aspects. Conformance to the new target for Class 1-A standards is also considered fairly satisfactory, with all aspects being met with the exception of SS and TP.

Table 4 Operation of Loujiang Plant

	Indicator	Unit	Planned	2008	2009	2010	applicable national standard
1	Population coverage	ten thousand				20.2	
2	Treated water	(m^3/day)		61,200	124,000	123,900	
3	Rate of facility utilization	(%)		100%	89%	89%	
5	BOD density (mg/l)	in	180	95.3	102.7	111	
		out	20	6	4.01	2.99	Class A
		% of reduction	89%	94%	96%	97%	
		Quantity of reducition	3,504	1,995	4,467	4,885	
6	COD density(mg/l)	in	360	231.3	249	259	
		out	60	29.4	27.8	25.8	Class A
		% of reduction	83%	87%	89%	90%	
		Quantity of reducition	6,570	4,510	10,012	10,545	
7	SS density(mg/l)	in	250	119	124	124	
		out	20	13	12	11	Class B
		% of reduction	92%	89%	90%	91%	
		Quantity of reducition	5,037	2,368	5,069	5,110	
8	NH3-N density(mg/l)	in	35	24	23	23.3	
		out	15	4.6	2.52	3.64	Class A
		% of reduction	57%	81%	89%	84%	
		Quantity of reducition	438	433	927	889	
9	TP density(mg/l)	in	4	3.4	3.76	3.72	
		out	0.5	0.8	0.75	0.51	Class B
		% of reduction	88%	76%	80%	86%	
		Quantity of reducition	77	58	136	145	
10	Quantity of treated sludge	t/year		13,635	24,104	28,409	
11	Rate of sludge recycle	(%)		100%	100%	100%	

Source: Suzhou Qingyuan Construction & Development Company

(3) Channeling operation

The water intake operation from Lake Tai is operating as summarized below. Since the quality of the city's waterways has improved and integration with other water channeling operations has advanced, the emphasis of the project's channeling operation has shifted from stimulating water circulation so as to improve its quality to transmitting source water for the city's tap water system.

Table 5 Status of Channeling Operation

	Planned	2008	2009	2010
Intake (10,000 m^3/d)	35	31.9	23.8	18.8
Portion for tap water		9.9	9.8	9.8
Portion for circulation		22	14	9
Annual channeling days	300	365	365	365
Portion for tap water		365	365	365
Portion for circulation		22	16	10

Source: Suzhou Qingyuan Construction & Development Company

In 2010, channeling for waterway circulation purposes was performed during only ten days in the year, implicating that the water quality had improved significantly. The water transmission function operates throughout most of the year, proof that the ODA facilities are effectively utilized. In a parallel effort, Suzhou City implemented the Xitang River channeling project. This project is designed to introduce Yangtze River water into the city's waterways through the Xitang and Wangyu Rivers with a view to increasing the water volume and natural cleansing capacity of the river and water environment in the city. By now, its operation is coordinated with those of the Lake Tai channeling operations of the ODA project.

Fig.6 Water Intake at Lake Tai Shore

Fig.7 Intake Pumping Station

(4) Water quality improvement of city's waterways

The project was implemented to reduce the direct discharge of wastewater into the city's rivers and waterways by constructing and improving sewage treatment plants, sewer systems, and waterways; thereby contributing to improved water quality in the rivers and waterways. The table below summarizes the quality of water at key locations in the city's rivers and waterways (city center and inner moats). National standard IV, which represents the quality level required for scenic waters, is met at all locations.

As Table 6 shows, improvements of roughly 50% or more can be observed in terms of COD, BOD, and other indicators over pre-project levels. Remarkable improvements were seen in the quality of the waterways. A sampling survey that was carried out at five locations in the city

during the Field Evaluation Study confirmed sustained good water quality, with no apparent contamination or eutrophication. In addition, the effect of the sewage treatment project was confirmed through the positive responses (awareness of and appreciation for the improved water quality) of a number of respondents in the beneficiary survey, which will be detailed later in this report.

Table 6 Improvement of Water Quality in the City's Waterways

(Unit: mg/l)

		Pre-project		Present		
		1998	1999	2008	2009	Change from 1998
Xiangmen Bridge	COD[16]	38.9	39.1	22.23	20.21	-48%
	BOD	8.1	8.2	4.6	3.7	-54%
	NH_3-N	1.89	1.91	1.53	1.04	-45%
	TP	1.58	1.59	0.75	0.52	-67%
Pingmen Bridge	COD	39.3	39.2	23.4	21.32	-46%
	BOD	7.9	8.0	4.7	3.6	-54%
	NH_3-N	1.88	1.92	1.49	1.09	-42%
	TP	1.63	1.63	0.72	0.49	-70%
Guxu Bridge	COD	39.6	39.5	22.14	20.18	-49%
	BOD	8.3	8.1	4.9	3.8	-54%
	NH_3-N	1.91	1.9	1.44	1.16	-39%
	TP	1.59	1.63	0.67	0.46	-71%
Renmin Bridge	COD	39	39.3	21.98	20.01	-49%
	BOD	8.2	8.3	4.5	3.3	-60%
	NH_3-N	1.9	1.93	1.5	1.13	-41%
	TP	1.59	1.6	0.65	0.53	-67%

Source: Suzhou Environmental Protection Bureau

Fig. 8 A section of the City's Waterways

Fig. 9 Grand Canal in a City Suburb

[16] The documents for project appraisal used CODmr as the COD value. Since the value currently in use is CODcr, a comparison between the project appraisal and ex-post evaluation was made by collecting new corresponding data. There are two measurement methods for COD: the CODMn method that expresses oxygen consumption in potassium permanganate-based oxidation is widely used in Japan, while the CODcr method that employs the oxidation reaction by potassium dichromate is prevalent in China. Potassium permanganate is less potent as an oxidant. If an identical sample is analyzed by the two methods, CODMn gives a lower value (about one-third of the CODcr value).

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

The financial internal rate of return (FIRR) for the project was recalculated on the basis of the assumptions made at the time of project planning, incorporating the actual data. The recalculated FIRR is 1.86% against the original 6.2%. Major reasons for this deterioration include the increased cost of sewage treatment and the lower-than-anticipated sewage treatment fee. The sewage treatment cost (expenses) was estimated to be 0.6 Yuan/m^3 in the project plan, but the actual cost has risen to 0.65 Yuan/m^3. Moreover, the sewage treatment fee (benefit) was to start at 0.6 Yuan/m^3 and be raised every year to ultimately be 1.4 Yuan/m^3. In reality, the fee started at the level of 0.4–0.55 Yuan/m^3 and is now set at 1.15 Yuan/m^3. This narrower margin than that in the original plan has apparently resulted in the low FIRR. In an interview with the executing agency, it was explained that sewage treatment is by nature a public work and the current fee level is not intended to stress profitability but rather to recover the costs directly required for the sewage treatment operation.

Assumptions	Plan	Ex-post Evaluation (in 2011)
1.Expenses: initial capital investment, operating and maintenance costs 2. Benefit: sewage treatment fee income	**FIRR 6.2%**	**FIRR 1.86%**

3.3.2 Qualitative Effects

The project has brought about qualitative effects including better city scenery due to improved water quality and a better living environment. These will be discussed in detail in the Impact section.

As described above, this project has largely achieved its objectives, and therefore its effectiveness is high.

3.4 Impact

3.4.1 Intended Impacts

The project had the objective of contributing to the improved water quality of the city's rivers and waterways and the improved living environment of residents through improvements to sewage treatment facilities. In this section, we analyze the results of a survey that was conducted to assess the impact of the treated effluents on the quality of water in the rivers and waterways as well as to ascertain any changes in Suzhou citizens' awareness regarding their water environment.

3.4.1.1 Water quality of rivers and other water sources in the vicinity of the sewage treatment plants

As Table 7 shows, the quality of river water near the effluent discharge points[17] of the Loujiang and Fuxing treatment plants has been continually improving. At most of the monitoring points, the national standard for surface water Class IV has been met. The quality of river water is affected by the degree of contamination of water upstream and other factors, and it is not possible to clearly link water quality improvements with the project. However, the quality of effluents discharged into rivers from the project plants conforms to national standard Classes 1-A or 1-B, meaning that the quality has been improved to levels that do not leave an adverse impact on river quality. The discontinuation of discharges of untreated sewerage likely contributed to these improvements.

Table 7 River Water Quality near Loujiang and Fuxing Plant Discharge Points

1) Near discharge point of Loujiang Plant					
Monitoring point	Indicator	2003	2008	2009	National standard
Zhujiacun	COD_{mn} (mg/l)	6.2	5.0	4.7	50
	BOD (mg/l)	3.7	2.8	2.4	10
2) Near discharge point of Fuxing Plant					
Monitoring point	Indicator	2003	2008	2009	National standard
1.Qinghua warehouse	COD (mg/l)	35.8	25.8	20.2	50
	BOD (mg/l)	5	4.4	4.2	10
2.Changqiao	COD (mg/l)	30.7	20.4	20.2	50
	BOD (mg/l)	4.9	4.1	4.0	10

Source: Suzhou Environmental Protection Bureau

3.4.1.2 Overall water quality improvements in Suzhou

As discussed earlier, the quality of waterways in Suzhou has improved significantly, satisfying the water quality standard Class IV required for scenic waters. The overall sewage treatment coverage ratio is above the target, evidencing that this project and other initiatives of the city in support of water quality improvements have been effective. The president of the Suzhou Qingyuan Construction & Development Company stated in an interview during our

[17] The two treatment plants discharge effluents to the Loujiang River (Loujiang Plant) and Beijing-Hangzhou Grand Canal (Fuxing Plant), respectively.

field survey that the implementation of the project as planned and the smooth operation of the sewage treatment plants proved the high project implementation capacity of the executing agency and the effectiveness of sewage treatment in improving water quality, which in turn facilitated fund raising from donor organizations and accelerated the implementation of the Phase II Project and other water quality improvement initiatives. It can thus be said that the project played an important pump-priming role for a number of similar efforts that have ensued.

Table 8 Water Source Environment in Post-Project Suzhou

Indicator	2000	Plan	Actual
Water quality			
City waterways	Class V	Class V	Class IV
Drinking water sources	Class III	Class II	Class II
Sewage treatment			
Treatment ratio	50%	75%	Household 95% Industrial 100%
Sewer system coverage	85%	90%	n.a.

Source: Appraisal document

Note: No official data on sewer system coverage was available from the City Government. However, the executing agency stated that the coverage in the city area (urban area) was over 90%.

3.4.1.3 Improvement to the living environment of residents

One of the objectives of this project was to improve the living environment of residents through the improvement of the quality of the city's waterways. As part of the present ex-post evaluation study, a beneficiary survey was conducted with a view to understand the relationship between water quality improvement and the living environment. A questionnaire was distributed to a total of 100 individuals living or working near a waterway in Suzhou (Qili Shantang Scenic Area and Canglantin) and 98 valid responses were collected. The major results are described below.

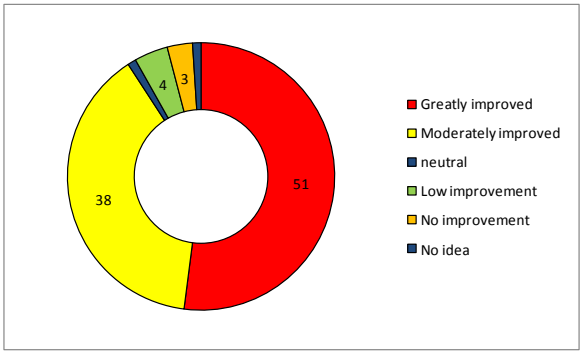


Fig. 10 Appreciation for Water Improvements

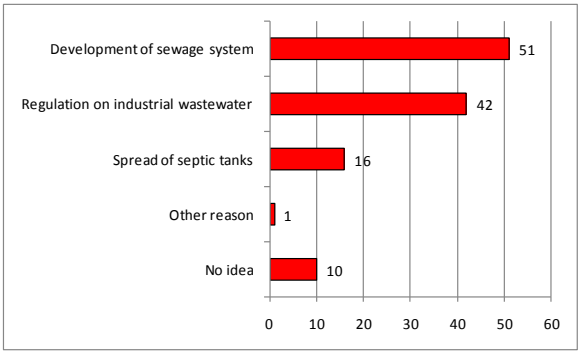


Fig.11 Causes of Water Improvements

Approximately 90% of respondents affirmed the quality improvements of the city's waterways in comparing these before and after the project, evidencing that the improving trend of water quality that we discussed in Section 2.3 was also recognized at the resident level. Further, approximately half of the respondents cited the installation of the sewage treatment

facilities as the cause of the improvement, showing that the project was well known by residents. The reasons for such a high awareness of the sewage treatment facilities are believed to include the presence of treatment plants not far from residential districts, and an environmental education campaign and other initiatives taken by the treatment plants.[18]

With respect to the link between water quality improvements and living environment improvements, approximately 85% of respondents gave positive answers. Specifically, they mentioned the reduction of strange or obnoxious odors from the waterway in front, the reduction of flies and other harmful insects, and better scenery through improved coloring of the water surface. In addition, the waterway improvements have led to wider leisure options in residents' daily lifestyle, such as strolling by the waterway. In this respect, too, the project can be said to have had some impact.

Meanwhile, there were complaints that some residents continues to discharge their household wastewater directly into the waterway. The executing agency has not taken any direct action to address this problem, because it does not have the authority. Continued environmental education is required to alter such behavior, in cooperation with the Environmental Protection Bureau and other organizations.

3.4.1.4 Improvement of scenery and growth of tourism industry in Suzhou

As many as approximately 85% of respondents to the beneficiary survey were aware that their living environment including scenic beauty had improved after the implementation of the project. A clear improvement trend was confirmed. Encouraged by such water quality improvement, the Suzhou City Government has taken a number of initiatives to promote river tourism including the Shantang–Shangtanghe circuit cruise and the Pingjiang Cultural Water Corridor. These and other efforts have resulted in steady growth in the number of tourists visiting Suzhou since the 2000s (See Fig.12).

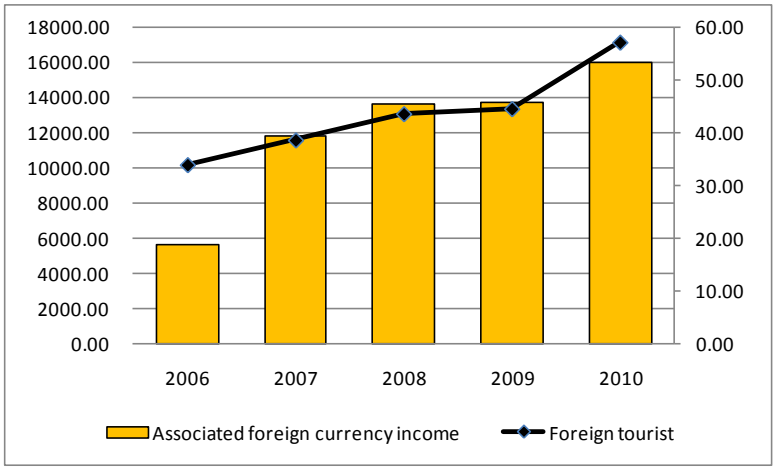


Figure 12 Number of Non-Chinese Tourists and Associated Foreign Currency Income to Suzhou

Source: Suzhou Tourism Bureau

[18] The executing agency makes public outreach and environmental education efforts by hosting, for example, plant tours for nearby residents several times a year.

An interview with the deputy director general of the Tourism Bureau of Suzhou City revealed the following:

- In the last ten years, the number of tourists has increased steadily, at an annual average rate of 14–17 %. It has more than quadrupled from its 2006 level. In terms of income from tourism, the foreign currency income is three times the 2006 level and the total income more than five times.
- The opinions of tourists as expressed in Tourist Bureau questionnaires include much fewer complaints about bad odors from the water compared to before. A visitor satisfaction survey of major tourist cities in China ranked Suzhou in sixth place.
- For Suzhou, which is known as the "Water Castle of the Orient," the sceneries of waterways and water resources are tourism assets. The recent improvements in water quality have had a very positive impact. The 2010 China National Tourism Administration survey on customer satisfaction with regard to tourist cities shows that Suzhou's ranking has moved from 11th to 7th to 3rd in the previous three years, which suggests the increasing attractiveness of Suzhou as a tourist destination.

While it is very difficult to measure quantitatively the contribution of the water quality improvement project to the growth of the tourism industry, the interviews described earlier in this report reaffirmed that waterways and water resources play a very important role in making Suzhou an attractive tourist destination. From this perspective, too, it can be concluded that the project under evaluation and other continued efforts to improve water quality have been contributing positively to the healthy development of the city's tourism industry up to this time.

3.4.2 Other impacts

(1) Sludge disposal: present situation and future challenges

The sludge generated in the process of sewerage treatment is disposed of under a contract with a private sector firm (engaged in farm technology and fertilizer production) located in Changshu in the north of Suzhou. There the sludge is mixed with organic waste to make compost. The firm treats 200 tons of sludge per day. However, a large portion of the compost thus produced is simply stored as stock, because there are not enough outlets for the product. While necessary storage space is said to be secured for the foreseeable future, the development of new sales channels is a challenge for the sustainable circulation of treated materials.[19] The firm making the compost argues that sludge-based compost is little known in the market and, hence, government assistance and other measures are needed to establish the healthy recycling process of sludge treatment–composting–and market distribution on a medium- to long-term basis. It is worth mentioning that, as the table below shows, a sampling test reportedly has shown that the quality of well water in the neighborhood of the sludge disposal site (four locations) met the national standards, posing no problems at this point in time.

Table 9 Quality of Well Water in Xuxingcun, Yuexizhen

(Unit: mg/l)

Indicator	Measurement	Standard
COD_{mn}	4.8	n.a.
NH_3-N	0.37	25.0
PH	7.4	6.0 - 9.0

Source: Suzhou Qingyuan Construction & Development Company

Fig. 13 Sludge Treatment in Changshu

Fig. 14 Product Compost

In a discussion with representatives of the executing agency's parent company (Water Affairs Investment Co., Ltd.), it was mentioned that upgrading the sludge treatment through the introduction of recycling, reuse, or other advanced technologies was under consideration but costs and other challenges would have to be properly addressed. The parent company intends to

[19] Of the compost produced, 20% is purchased by the government, another 20% is sold through independent channels, and about 60% is kept as inventory.

consider this course of action in its future long-term planning. In this discussion, interest was shown in possible technical studies or overseas cooperation regarding economical and efficient options for introducing new technology.

(Reference information) Sludge Treatment in China: Present Situation and Challenges

(1) Present situation of sludge treatment

The demand for sewerage treatment is increasing rapidly in step with nationwide economic growth and urbanization. Since the 1990s, the Chinese Government has focused on the construction and modernization of sewage plants using Japanese ODA and other means. While the infrastructure for sound sewerage treatment has been upgraded to a large extent, the disposal of the sludge that is generated in the process remains a big challenge. The national plan currently in force (the Twelfth Five-Year Plan) estimates 35–60 million tons of sludge is generated annually in the country, indicating an impending issue. Currently, sludge is disposed of mostly by landfill or simple piling. Secondary pollution from organics and heavy metals contained in the sludge poses a genuine risk. The introduction of advanced technologies such as sludge incineration and recycling is considered necessary, especially in coastal areas where landfill sites are increasingly difficult to secure.

(2) Efforts of the Chinese Government

The Chinese Government has put in place a variety of policies and regulations on sludge treatment/disposal; these include "Guidelines on Treatment/Disposal Technologies for Sludge from City Sewage Treatment Plants (2011)" and other measures that set out criteria for the selection of sludge treatment technologies and processes to promote sound management. In recent years, there have been strong initiatives to utilize private sector funds for the construction of sludge treatment plants through BOT and other schemes. Still, challenges remain with respect to such advanced technologies in terms of financing, treatment cost reduction, and the choice of optimum technologies and treatment methods suited to individual local conditions.

Selected list of leading or pilot projects for sludge treatment

Province	Project name	Treatment method and others
Dalian	Dialingdongtaixiajiahe Sludge Treatment Plant	Anaerobic digestion; BOT scheme; model project with German technology
Qingdao	Qingdaomaidao Sewerage Treatment Plant	Anaerobic digestion; generated methane gas used for power generation
Qinhuangdao	Qinhuangdaoivgang Sludge Treatment Plant	Automatically controlled biological composting
Xiamen	Advanced dehydration treatment, recycling disposal and utilization of Xiamen city sludge	Advance dehydration; recycling of dehydrated cake, etc.
Zhejiang	Zhejiang xiaoshan Sludge Drying and Incineration Project	Drying and incineration; incineration slag is used as a cement raw material, etc.

(3) Cooperation by Japan

The Japanese Government has extended indirect cooperation through, for example, seminars organized by JICA to present the sludge treatment technologies of Japanese companies. In addition to the continuation of such seminars, there is a need for support in the form of project feasibility studies at various locations in China, because sludge treatment technologies must be optimized to suit the stage of local development and other local peculiarities.

(2) Resettlement and Land Acquisition

Resettlement had been partly completed when the project was being planned. A representative of the executing agency responded that resettlement was carried out as planned, even though there was a delay due to prolonged negotiations about compensation. Qingyuan Company agreed to increase the compensation in an effort to avoid forcible expropriation and similar actions; it seems to have taken a rather long time before a final agreement was reached. The reason for the prolonged negotiation was that the national standard for the computation of compensation fees had been determined in 1996 and did not reflect any subsequent increases in the cost of living and land. People who were asked to resettle demanded a compensation fee above the official standard.

Table 10 Resettlements Made for the Project

	Planned (families)	Actual
Loujiang Treatment Plant	80	As planned
Fuxing Treatment Plant	None	None
Waterway improvement	600	As planned
Conduit installation	20	As planned

Source: Suzhou Qingyuan Construction & Development Company

As mentioned in the section on Efficiency, the prolonged negotiation resulted in a longer-than-planned duration for the project. However, this is deemed to have been a necessary and appropriate step to implement resettlement in an amicable manner.

As described above, this project's impact on the improvement of the living environment and the development of the tourism industry in Suzhou was confirmed to be real. It is a fair evaluation that the implemented project contributed to improving and upgrading the overall environment of the City of Suzhou. Future efforts to address the question of more sophisticated sludge treatment will be necessary as well as to tackle other medium- to long-term challenges.

3.5 Sustainability (Rating ③)

3.5.1 Structural Aspects of Operation and Maintenance

The facilities of this project are operated and maintained by the organizations listed in the table below. In the original project plan, Suzhou Qingyuan Construction & Development Company (a state company wholly owned by the Suzhou People's Government) was to act as the executing agency and would continue being responsible for operation and maintenance. At present, there have been some changes to the organizations and names responsible for operation and maintenance, even though there have been no substantive changes.

Table 11 List of Executing Agencies and Alterations

	Planned	Current
1.Sewage Treatment Plants	Suzhou Qingyuan Construction & Development Company	Suzhou Drainage Co., Ltd (newly created)
2. Sewer network	Public Service Bureau, Suzhou City	
3.Waterways		River Management Department, Water Management and Service Bureau, Suzhou City
4.Channeling facilities	Suzhou Qingyuan Construction & Development Company	Suzhou Waterworks Company

At the end of 2008, the city agencies for wastewater management in Suzhou were reorganized by separating the operating bodies from the policy agencies. The Suzhou Qingyuan Construction & Development Company, which was the executing agency at the time of project planning, was made into a company that specialized in the infrastructure development of the waterworks and sewer systems. On the other hand, the operation of the sewerage treatment plants became the responsibility of a newly created company, Suzhou Wastewater Company, Ltd. As an overarching body, the Suzhou Water Service Investment and Development Co., Ltd. supervises these companies and heads a group of companies involved in water resource management in Suzhou. All of these entities are state companies under the same umbrella and there seem to be no problems in their equity or cooperative relations.

3.5.2 Technical Aspects of Operation and Maintenance

Observations made during the Field Survey with respect to facility operation and staff work suggest that there is a good degree of expertise in terms of routine operation and maintenance and no problems seem to exist. Employees responsible for the operation carry “Special Work Operator Certificates” that are subject to periodic reexamination and retraining. Employee training and education programs are thus in place.

As discussed in Section 3.1 “Relevance,” Suzhou places a high priority on the improvement of water quality and is aggressively pursuing capital investment and technology introduction for new projects. It is believed that such initiatives have contributed to raising and maintaining high technical levels. The table below is a summary of the evolution of the number of employees engaged in operation and maintenance. Increased efficiency in the treatment process and the automation of certain equipment has made it possible to reduce the number of employees to about half of that originally planned. Responses of on-site technical staff members during our plant tour were accurate and to the point, suggesting that the technology has been successfully transferred to the shop floor level of the host country.

Table 11 Number of Employees at Major Facilities

Site	Plan	Actual
Loujiang Treatment Plant	50 (80*)	45
Fuxing Treatment Plant	70 (110*)	50
Sewer network	16	16

Source: Suzhou Qingyuan Construction & Development Company

* Numbers in parenthesis show manpower planned for post-Phase II Expansion

3.5.3 Financial Aspects of Operation and Maintenance

Suzhou Drainage Co., Ltd., which is responsible for the operation of the sewage treatment plants, is financed from the city government coffers into which all of the sewage treatment fees flow. Any shortfalls are made up for by the city government. The parent company, Suzhou Water Service Investment and Development Co., Ltd., invests constantly in water and is believed to have the necessary, stable budget allocated, given the importance of water quality in the city's waterways in terms of both its impact on citizens' lives and its value to tourism. Given the above, it is fair to say that the financial risk of the executing bodies involved in the project is low.

The sewage treatment fee was 0.55 Yuan/m^3 at the time of planning and was raised to 1.15 Yuan/m^3 in June 2002 and then to 1.33 Yuan/m^3 in April 2010. The current fee is set at a level just sufficient to cover the direct cost of sewage treatment (0.65 Yuan/m^3). The operating income is currently almost break-even.

Table 12 P/L Statement (Suzhou Drainage Co., Ltd 2010)

(Unit: RMB)

Item	Year 2010
Operating revenue	65,410,930
Operating cost	65,988,414
Operating income	-577,484
Non-operating income[20]	606,441
Income from ordinary operations	28,957
Net income	21,718

Source: Suzhou Drainage Co., Ltd

The current sewage treatment fee is set at a level that maintains a balance between the public service nature of the enterprise and the need for it to be a going concern. While no huge profit is expected, no real financial risks are anticipated.

[20] According to the executing agency, non-operating income accrues mostly when an operating income deficit is made up for by government expenditure.

3.5.4 Current Status of Operation and Maintenance

The operational data of major equipment is good and our observations during the plant tour uncovered no significant defects or deficiencies. The equipment is subject to periodic patrols and sample checks by the Construction Agency of the Provincial Government. A representative of the sewage treatment plants noted that equipment corrosion by acidic gases generated in the treatment process is a problem and corrosion prevention measures are taken on a periodic basis.

As described above, no major problems have been observed in the operation and maintenance system. Thus the sustainability of the project effect is high.

4. Conclusion, Lessons Learned, and Recommendations

4.1 Conclusion

Water quality improvement was a major potential issue for the living environment of citizens in the City of Suzhou. Since the completion of the project, the sewage treatment plants have been operating smoothly and have produced remarkable outputs including a more than 50% improvement in the quality of water in the city's waterways. Many residents have openly acknowledged the improved water quality, and the city's tourism industry has achieved steady growth. The objectives of the project can be said to have been accomplished for the most part. The Suzhou City Government continues to place a high priority on water resources and no problems are foreseen with respect to the technical and financial sustainability of the project. One challenge for the future is the needed shift from the present landfill disposal of sludge to incineration and other technologically advanced disposal methods.

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

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

(1) The currently employed sludge disposal method is problematic because the sales outlet of recycled compost is underdeveloped and the future prospects of stockyard availability are somewhat uncertain. To construct a more sustainable disposal process, the introduction of an advanced technology should be considered as a future course of action. From a medium- to long-term perspective, studies should be made to identify the disposal process that is most efficient and suited to the local conditions of Suzhou.

(2) While the infrastructure for the treatment of household sewage is evaluated to have been well developed, there appears to be room for improvement in the awareness and behavior of residents, as indicated by the continued direct discharge of sewage into the waterways. Environmental education and similar efforts should be promoted, not by the water service

agencies alone, but in cooperation with the Environmental Protection Bureau and other agencies.

4.2.2 Recommendation to JICA

While this project has produced an excellent outcome, the present sludge disposal process will eventually have to be replaced by a drying/incineration or other more advanced process. The executing agency has expressed its need for continued cooperation. Effective results can be expected if JICA considers continuing the currently offered technical exchange seminars and extending technical assistance in the form of optimum disposal technology selection and project feasibility study.

4.3 Lessons Learned

This project significantly improved the quality of the waterways in Suzhou City and had a strong socioeconomic impact in terms of an improved living environment and the promotion of the tourism industry. It is worth noting that the project was highly visible to residents of Suzhou because their homes are located close to the city's waterways and rivers and they easily recognized the changes brought about by the project. Further, the waterways and scenery by themselves constitute an asset to the city's tourism industry and the latter's improvement and prosperity was clearly understood. Such a high degree of understanding and acknowledgement of the development project creates a virtuous cycle leading to continual improvement of the climate for further development. Thus, the pioneer project and its objective and effects are rendered more sustainable. It is believed that public outreach activities by the executing agency have played a role in the creation of this virtuous cycle. Public relations activities should not simply be regarded as publicity but rather as an effective tool to sustain and reinforce the objectives and impacts of the project.

End

Comparison of Original State and Actual Scope of the Project

Item	Original	Actual
1. Project Output		
(1) Sewage treatment plants		
1) Loujiang Treatment Plant		
Daily treatment volume	60,000 m^3/d	As planned
2) Fuxing Treatment Plant		
Daily treatment volume	80,000 m^3/d	As planned
3) Sewer line		
Network improvement	Total 110 km	Total 108 km
Sewer system repair	19 connections	As planned
4) Pumping stations	20 locations	As planned
2. Waterway improvement & channeling		
(1) Waterway improvement		
Dredging	65.3 km	As planned
River broadening	4.4 km	As planned
Bridge upgrading	21 locations	As planned
(2) Channeling (Lake Tai)		
Intake volume	350,000 m^3/d	As planned
Conduit	29.1 km	As planned
Pumping station	1 location	As planned
2. Project Period	March 2000–December 2003 (46 months)	March 2000–December 2007 (94 months)
3. Project Cost		
Amount paid in Foreign currency	6,261 million yen	6,261 million yen
Amount paid in Local currency	10,317 million yen (688 million Yuna)	10,806 million yen (860 million Yuna)
Total	16,578 million yen	17,067 million yen
Japanese ODA loan portion	6,261 million yen	6,261 million yen
Exchange rate	1 Yuan = 15 yen (As of March 2000)	1 Yuan = 14 yen (Average between January 1996 –December 2010)

China

Ex-Post Evaluation of Japanese ODA Loan Project

Lanzhou Environmental Improvement Project

External Evaluator: Kenji Momota, IC Net Limited

0. Summary

In the city of Lanzhou, the capital of Gansu province, atmospheric pollution from the increased consumption of coal, and water pollution from the discharge of untreated sewage and industrial wastewater, were becoming increasingly serious. Improvement of the air and water environments was the most pressing issue for the residents and their living environment. In this project, a number of subprojects related to the improvement of the air and water environments were implemented, and are currently proceeding, achieving reductions in the amount of pollutants in the air and water mostly as planned. Since the implementation of this project, we have seen various effects, such as an improvement in air quality, improvement in the water quality of the Yellow River, and a more controlled use of groundwater. We can say that this project has indeed contributed to these trends to a certain extent. A point for future consideration is the need to change the treatment method of sludge generated at the sewage treatment plant; in order to prevent the risk of soil contamination and the like, more advanced methods such as incineration should be adopted in place of the currently used simple landfill method. Regarding the sustainability of this project, although the subprojects are not all without financial uncertainty, the operations of all the subprojects are stable in terms of structural and technical aspects, receiving support from the city government or the parent companies. Therefore, we do not foresee any problems. In light of the above, this project is evaluated to be highly satisfactory.

1. Project Description

Project location

Sewage treatment plant (final settling tank)

1.1 Background

Lanzhou City, the capital of Gansu province, is located in the most inland area of China and has continued to develop as a heavy industry city since the 1950s. Even during the project-planning stage, the chemical and oil-refining industries, among others, were developing in this central city of Gansu province. At the same time, the increase in population, the improvement in living standards, and the demand for coal due to economic development have escalated air pollution. During the winters, in particular, the consumption of coal for heating and the continued windless weather conditions in Lanzhou City led to an increase in the level of sulfur dioxide to around three times the national standard for atmospheric concentration.

There were also problems with water pollution in Lanzhou, where the sewage treatment rate was just 24% as of the end of 1995. The majority of the sewage was discharged untreated. The sewage was discharged into the Yellow River, one of the main sources of potable water for Lanzhou, where the water pollution far exceeded national standards. In addition, Lanzhou had depended on the Yellow River and groundwater sources for its water supply, but the increase in population and development of industry led to a capacity shortage for water supply facilities and the resulting overuse of groundwater supplies. This, in turn, led to some of the major issues of a declining groundwater level and the resulting subsidence.

1.2 Project Outline

The objective of this project is to reduce the air pollution caused by the burning of coal, to improve the water quality of the Yellow River, and to secure a safe supply of water by implementing air and water quality environment-improvement projects in Lanzhou, Gansu province, thereby contributing to the improvement of the lifestyles, sanitation, and health of the local residents.

Loan Approved Amount/ Disbursed Amount	7,700 million yen/7,690 million yen
Exchange of Notes Date/Loan Agreement Signing Date	December 1996/December 1996
Terms and Conditions	Interest Rate: 2.1% Repayment Period: 30 years (Including Grace Period: 10 years) General Untied
Borrower/Executing Agency	Government of the People's Republic of China/ Ministry of Environmental Protection (NEPA), Lanzhou City Gas, Lanzhou Thermal Power Company, Lanzhou City Construction Management, Lanzhou City Water Supply Corporation
Final Disbursement Date	January 2004
Main Contractor	None
Main Consultant	None
Feasibility Studies, Etc.	None
Related Projects	Gansu Province Lanzhou City Atmospheric Environmental Improvement Project (Yen loan/ 2007)

This project consists of four subprojects. The subprojects mainly fall into two categories: (1) projects whose objective is to improve the air quality and conditions, and (2) projects whose objective is to improve the water environment, such as water supply and sewage. This report is written using these two categories. The following are the implemented subprojects and their outlines.

Project Name		Outline
Type 1: Air Pollution Improvement Projects		
1-1	The Lanzhou Gas Supply Pipeline Network Project	Connect the existing gas plant in the suburbs of Lanzhou with the city using pipelines, increase provision of city gas, and reduce the consumption of coal for cooking
1-2	The Lanzhou Heating Supply Pipeline Network Project	Construct a thermal provision pipeline compatible with the existing thermoelectric plant, and reduce consumption of coal for heating by strengthening centralized the thermal provision ability for heating in the city
Type 2: Water Environment Improvement Projects		
2-1	Lanzhou Sewage Treatment Project	Construct a new sewage treatment plant in the Anning District of Lanzhou City, perform maintenance on the sewer network, and treat the sewage from the Anning District and the Qilihe District
2-2	Lanzhou Water Treatment and Supply Project	Expand the existing water treatment plants that use the Yellow River as their water source, and promote extension of the water supply pipeline network in Lanzhou City

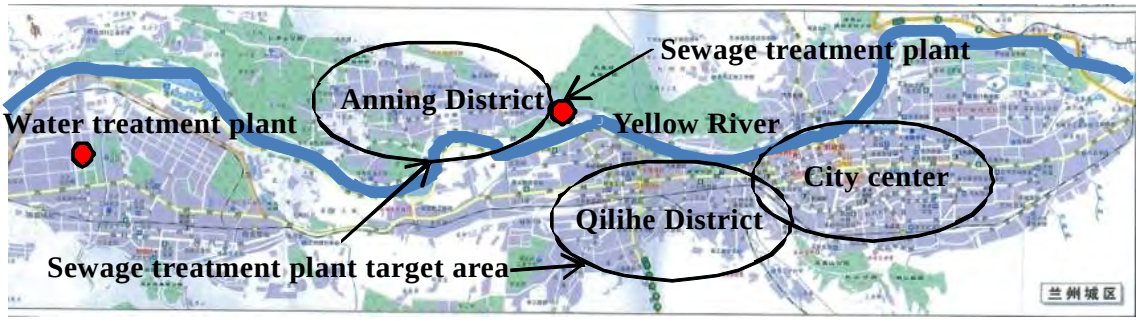


Figure 1: Lanzhou City and Project Sites

Note: Gas and thermal provision projects are not noted in the above map as there are numerous project facilities (pipeline network and thermal exchange locations) in the city.

2. Outline of the Evaluation Study

2.1 External Evaluator

Kenji Momota, IC Net Limited

2.2 Duration of Evaluation Study

Evaluations were conducted during the following periods for this ex-post evaluation:

Duration of the Study: November 2010–November 2011

Duration of the Field Study: March 10, 2011–March 20, 2011 and May 29, 2011–June 4, 2011

2.3 Constraints during the Evaluation Study

The objectives of the subprojects under this project were to improve the atmospheric environment of Lanzhou City and the water quality of the Yellow River, which runs through the city. In the ex-post evaluation, we attempted to obtain water quality data for the locations of sewage discharge because they would directly represent the objective of the subprojects. However, detailed data at the city level needed to confirm the clear relationship with these subprojects was not disclosed and could not be obtained. Because of this, national-level water quality data for the Yellow River was used in order to analyze the effectiveness of the subprojects. The Yellow River is an extremely large river and there are many factors within and outside Gansu Province that affect the water quality of the river both positively and negatively (for example, positive factors include other government environmental improvement projects, and negative factors include newly constructed factories that become sources of pollution). Therefore, it was difficult to accurately understand all these causes and factors. For these reasons, evaluations of the effectiveness and impact of these projects are concluded based on an analysis of the provided data and a certain amount of speculation. In addition, for subproject 1-1, The Lanzhou Gas Supply Pipeline Network Project, because not enough of the required data was provided by the implementing agency, parts of the evaluation were based on an analysis of information that was available, along with speculation.

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

3.1 Relevance (Rating: ③[2])

3.1.1 Relevance with the Development Plan of the People's Republic of China

(3) Development Plan at the Time of Appraisal

In China, while on one hand economic development was proceeding steadily, air and water pollution had become an increasingly serious issue, and measures to tackle environmental issues were a critical theme. In the ninth five-year plan (1996–2000), the most critical issue was taking measures against water and air pollution sources and an improvement in urban environments. To substantiate these state plans, the Council Decision Related to Issues Concerning Environmental Protection (August 1996) was announced. In an effort to achieve the objectives of the five-year plan, specific measures were decided upon, such as the clarification of environmental objectives, specifying of Priority Environmental Control Zones for major pollution sources (three large rivers, three large lakes, etc.) as well as control measures for new pollution sources.

(4) Development Plan at the Time of Ex-Post Evaluation

(1) Consistency with national policies (development plans)

The eleventh five-year plan (2006–2010) indicated policies to further strengthen measures related to environmental protection and noted the implementation of ten (10) major environmental protection projects. Water quality improvement projects were given the highest priority, and sewage treatment projects in the cities were one of these. The objective was to achieve a 70% rate of sewage treatment nationwide, and urban sewage treatment continued to be ranked as a critical issue item. In terms of the improvement of air quality, the same plan specified 113 environmental protection focal cities, of which Lanzhou City is one, and set air pollution measures that included the implementation of centralized heat and gas supply projects. The project under evaluation was implemented with these policies as a background and has been recognized as being relevant to the current development plan.

(2) Consistency with sector and regional measures

In the eleventh five-year plan (2006–2010) of Gansu Province, 10 major focal areas were specified, including the improvement of water and atmospheric environments. For water quality improvement the most critical issue was the improvement of sewage treatment plants, and for atmospheric environment improvement it was the introduction of clean energy (centralized heat provision and a shift of energy for public transportation systems).

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

[2] ③: High; ② Fair; ① Low

During the plan period, an investment of approximately 14.4 billion Yuan (approximately 187 billion yen) was planned. Of this amount, investments of 3.7 billion Yuan (48 billion yen) and 3.5 billion Yuan (45.5 billion yen) were planned for water and atmospheric environments, respectively. For the atmospheric environment, the plan raised the promotion of thermal energy provision, with its high energy efficiency, for the introduction of clean energy in the city. The measures for this project can be evaluated as being relevant to these intentions. In addition, the same plan set objectives for the improvement of air and water quality, which are listed below.

- Water quality: The objective was to improve the water quality of the major river, centered around the Yellow River, to Grade II or III of the national water standards.
- Atmospheric environment: The objective was to be below national class 2 standards for the daily average of sulfur dioxide and nitrogen dioxide in urban areas over the course of a full year. Another objective was for air quality to exceed class 2 standards for roughly 280 days per year.

This project is essential for the achievement of these objectives and has been recognized as being relevant to the sector and regional measures.

3.1.2 Relevance to the Development Needs of the People's Republic of China

3.1.2.1 Subproject Needs

Since the 1950s, Lanzhou City has continued to develop as a heavy industry city. Air pollution became increasingly serious as the chemical and oil refining industries developed, and the demand for coal rose as the population increased and living standards improved. In terms of water supply and sewage, in addition to pollution of the Yellow River, the main source of water, there was an absolute shortage in the supply capacity of then-existing water supply facilities, an overuse of groundwater supplies, and declining water levels and subsidence. There was an urgent need to maintain and improve water supplies that used surface stream water as their water source.

The sewage treatment rate in the city was 24% at the end of 1995. In the Anning and Qilihe districts in particular, only small-scale sewage treatment plants existed, where only primary treatment took place, and water quality continued to decline year after year.

From the above, we can see that there was a high need for this project in order to improve and solve the environmental issues in Lanzhou City, such as air pollution, declining water quality, and subsidence.

Even after implementing this project, the need for water and air pollution measures has continued to increase as urbanization and economic development continue. For example, the increase in sewage demand has led to work constructing additional sewage treatment plants. For the city gas provision projects, immediately following the completion of the

project, national policy[3] at the time led to a change in gas sources from the then-planned coal gasification plant to the transporting of natural gas from Qinghai Province. Although there was no change to the needs of the subproject itself, this resulted in a disposal or transfer of some facilities (refer to 3.2.1 Project Outputs).

3.1.3 Relevance of Project Objective Settings

The objective of the water quality improvement subprojects of this project was to "improve the water quality of the Yellow River." We believe that a more detailed objective needs to be set with attention to the scale of the project, and such a project objective should have been commonly shared with the Chinese side.

The Yellow River is a huge river, running 5,000 km in total length, and its water quality is affected by a variety of elements, such as those that take place in Qinghai Province in the upstream area of the river. In addition, in Lanzhou City in Gansu Province, there are discharge sources of pollutants, such as factories both upstream and downstream. Thus it is difficult to directly assess the effects of the measures taken by this project on the water quality of the Yellow River as a whole. In addition, when interviewing people associated with the implementing agencies, we could not confirm that specific objectives were considered or shared.

The setting of the objectives of this project should have considered the scale of implementation and the various causes that affect water quality and then aimed for a direct effect from the subprojects. Alternatively, the projects should have aimed for cross-section data from nearby water systems where direct effects could have been assumed and the project as a whole positioned to achieve higher water quality improvement of the rivers and water systems

3.1.4 Relevance with Japan's ODA Policy

The Country Assistance Policy (China) (at the time of appraisal), raised environmental measures as a major focal point and launched policies to proceed with assistance, while taking into consideration the needs of the Chinese side, regarding measures to prevent air pollution such as soot treatment and flue-gas desulfurization, as well as sewer improvements and other measures to prevent water pollution. This project is an environmental measures project targeted at Lanzhou City, where the worsening of atmospheric and water environments was becoming increasingly serious. This project also coincides with major focal areas in the Country Assistance Policy, and can also be

[3] The West-East Gas Pipeline Project: A national project in the tenth five-year plan to develop and promote the use of natural gas. It is a plan to transport natural gas produced in the Xinjiang Uyghur Autonomous Region to the eastern coastal regions of China via a pipeline.

evaluated as an important concrete step toward implementing it.

From this, although there were some issues regarding the relevancy of objective setting, this project has been highly relevant with the development plan and development needs of China and Lanzhou City, as well as Japan's ODA policy. Therefore, its relevance is high.

3.2 Efficiency (Rating: ①)

3.2.1 Project Outputs

The plan/actual project outputs are as follows; mostly implemented as planned.

Output	Planned	Actual
1) The Lanzhou Gas Supply Pipeline Network Project	12.37 km	**Mostly as planned** 34.87 km
1. Long-distance high-pressure pipe construction	167.8 km	As planned
2. Laying of provision pipes in the city		As planned
3. Acquisition of gas plant safety equipment		As planned
4. Pipeline maintenance management equipment		As planned
5. Construction of pressure adjustment stations		
2) The Lanzhou Heating Supply Pipeline Network Project	31.92 km	**Mostly as planned** As planned (currently 42 km)
1. Laying of heat provision pipes	69 stations	72 stations (currently 92 stations)
2. Construction of thermal conversion station	5,868 m^2	As planned
3. Construction of control building		
3) Lanzhou Sewage Treatment Project		**Partial changes**
1. Construction of sewage treatment plants	Daily processing volume 200,000/m^3	As planned (treatment method changed)
2. Construction of pumping station	3 locations	As planned
3. Laying of pneumatic sewage transport pipes	3,400 m	9,200 m
4. Construction of a cross-Yellow River sewage pipe bridge	350 m	350 m (changed to underground pipes)
4) Lanzhou Water Treatment and Supply Project		**Mostly as planned**
1. Expansion of water treatment plants nos. 1–4	450,000 m^3/day	As planned
2. Upgrade and expansion of pumping facilities	3 locations within the plant, 4 pumping stations	As planned
3. Construction of water distribution pipeline network	Approx. 90 km	Approx. 116 km (3 and 4 combined)
4. Connection pipes between	Approx. 7 km	

water treatment plants		

The main changes were as follows.

1) Regarding The Lanzhou Gas Supply Pipeline Network Project, as noted in "2.3 Constraints during the Evaluation Study" above, although detailed information was not provided by the implementing agencies, according to materials provided by the Japan International Cooperation Agency (JICA), we were able to confirm that the project was completed mostly as planned. Of the outputs, some of the safety and maintenance management equipment was used for a certain period of time but is currently not being used and has either been disposed of or assigned to other organizations[4]. This is because the CO measurement equipment and Supervisory Control And Data Acquisition (SCADA) system[5] that were installed for the initially planned gas plant were no longer required due to the switch in the gas source to transport natural gas from Qinghai Province after completion of the project. The main pipe network is still being used.

2) Regarding The Lanzhou Heating Supply Pipeline Network Project and Lanzhou Water Treatment and Supply Project, these were implemented mostly as planned. For the heat provision project, the Gansu Province Lanzhou City Atmospheric Environmental Improvement Project (2007) is currently being implemented as an additional yen loan project. This project is proceeding with the construction of central heat provision facilities and the expansion of the provision area.

3) In the sewage treatment project, there were changes in: (1) treatment method, (3) total pneumatic transport pipe length and (4) water transport pipe construction method. Regarding the treatment method, because the design was based on old environmental standards at the time of the feasibility study, the treatment method was changed in order to comply with the stricter environmental standards that were later enforced. Regarding the total pneumatic transport pipe length, the total length was changed due to a reconfiguration of the route based on detailed designs. For the water transport pipe construction method, although the initial plan was to construct a water pipe bridge over the Yellow River, the plan was changed to a water transport pipe underneath the Yellow River due to the possible effects on traffic congestion and waterfront scenery, as well as lack of land[6] (there were no changes in location or length).

[4] Facilities that were discarded or consigned to another organization accounted for approximately 6% of the total cost of the project and only account for a small fraction of the total.
[5] A centralized monitoring and control system for geographically distributed systems such as sewage treatment and gas pipeline systems.
[6] The methods used were technologies commonly used in China. There were not technical problems and we believe they were appropriate changes that also resulted in reducing costs.

Fig.2 Biological Treatment Basin at the Sewage Treatment Plant

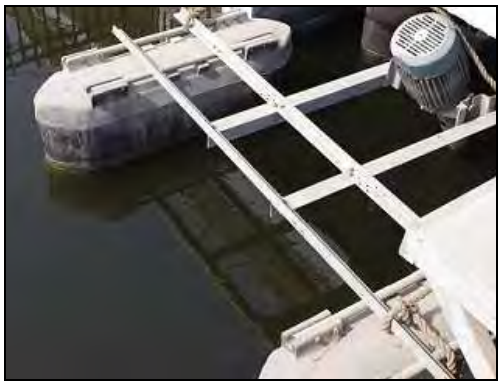


Fig.3 Water Discharged After Treatment

Currently, the sewage treatment demand of the city is 600,000 m^3/day and greatly exceeds the 460,000 m^3 treatment capacity of the plant. Because of this, the city government is currently constructing a sewage treatment plant with a treatment capacity of 150,000 m^3. With sewage treatment demand that far exceeds treatment capacity, the need for this subproject is becoming increasingly greater.

Fig.4 Water Supply Expansion Project Inside the Water Treatment Plant

Fig.5 Heat Provision Project Central Heat Provision Facility

3.2.2 Project Inputs

3.2.2.1 Project Cost

In comparison with the planned total project cost of 19.88 billion yen (of which 7.7 billion was a yen loan), actual cost was 25.41 billion yen (of which 7.69 billion yen was a yen loan), which was higher than planned. The main causes of the increased project cost were mainly due to the effects of the following:

1) Commodity prices increased (approximately 10% compared to the time of appraisal).
2) The length of pipes to be laid for the pipe network for the heat provision and sewage treatment projects increased.

3) Regarding the water supply project, the fact that the construction period was prolonged due to adjustments with operations of the conventional facilities had an effect on costs (explained in Project Period below).

3.2.2.2 Project Period

Taking into consideration that this project consists of multiple subprojects[7], the evaluation of the project period was made based on the total of the planned and actual periods (number of months) between start and completion for each subproject and averaging the plan ratio (refer to Attachment 1 for details). Therefore, the project period for this project is rated as ①.

Table 1 Planned/Actual Ratio for Subproject Project Periods

		Planned	Actual	Difference
1)	City gas	30	36	120%
2)	Heat provision	39	60	154%
3)	Sewage treatment	47	120	255%
4)	Water supply	46	83	180%
				177%

The main causes for the significant delay some subprojects included delays in the start of project implementation due to delays in the application approval procedures within the government as well as delays in the procurement of domestic financing. In terms of the city gas provision project, we were unable to receive a detailed response from the implementing agencies regarding the delays, but we believe there were no significant delays or problems.

(1) The Lanzhou Heating Supply Pipeline Network Project; reasons for delay

Delays were caused by delays in the start of construction due to delays in government application approval process regarding yen loan financing as well as application related delays due to an increase in domestic fund procurement amounts.

(2) Lanzhou Sewage treatment project; reasons for delay

1) As noted in the Project Outputs sections, the start of constructions was delayed until 2002 due to the feasibility study being re-implemented and re-approved (approximately

[7] For this project, which consists of multiple subprojects, the standard rating method that rates the entire project period from start to finish would mean that a substantial delay in one subproject would affect the rating of the entire project and might result in a rating that diverged from actual results.

four years leading up to 2000) as well as detailed designs based on the study.

2) Contracts were frequently rejected due to inexperience in international procurement procedures during the procurement stage.
3) Construction and procurement were halted for close to a year due to the outbreak of SARS in 2003.

(3) Lanzhou Water Treatment and Supply Project; reasons for delay

1) Delays due to design changes: Changes that were initially unpredicted were required during construction (this was due to the groundwater level at the planned installation site being higher than expected, leading to the need for construction to lower groundwater levels and stabilize the ground).
2) Application delays: Delays involved the approval of detailed designs, rebidding for some procurement, and delays in implementing applications for procurement (18 lots) due to inexperience in international competitive bidding.
3) Adjusting operations with conventional facilities: This subproject was an expansion of a previously existing water treatment plant and therefore construction had to take place while the water treatment plant was in operation. In addition, construction work to prevent disruptions in water supply when connecting the old and new pipes took time, leading to a prolonging of the construction work process.

The project cost slightly exceeded the plan, while the project period significantly exceeded the plan; therefore, efficiency of the project is low.

3.3 Effectiveness (Rating: ③)

3.3.1 Quantitative Effects

3.3.1.1 Results from Operation and Effect Indicators (Refer to Attachment 2 for indicator for each subproject)

(1) Achievement of the entire project

The types of subprojects are divided into Type 1: Atmospheric environment improvement and Type 2: Water environment improvement. In terms of evaluating the effectiveness, the effects of the subprojects were totaled by type and checked for whether the initially planned effect had appeared, and then an overall evaluation was implemented regarding achievement status for atmospheric and water improvement effects. The tables below show a summation of the effects of the water quality improvement and air quality improvement subprojects.

Table 2 Reduction in Air Pollutant Volume through Atmospheric Environment Improvement Projects (Type 1)

(Unit: Tons/year)

	Planned value	Actual	Plan ratio
SO_2[8] emissions reduction	9,360	6,749	72%
TSP[9] emissions reduction	34,851	25,992	75%
Coal consumption reduction	390,000	290,000	74%

Source: Edited based on responses from subproject implementing agencies and material provided by JICA

Table 3: Reduction in Water Pollutant Volume through Water Environment Improvement Projects (Type 2)

(Unit: Tons/year)

	Planned value	Actual	Plan ratio
BOD[10] emissions reduction	10,950	21,761	199%
COD[11] emissions reduction	29,200	46,794	160%
SS[12] emissions reduction	16,060	46,404	289%

Source: Edited based on responses from subproject implementing agencies

Regarding the reduction in air pollutants, the achievement rate is over 70% of the plan ratio. The reasons why it is only 70% of the initial plan ratio are thought to include the effect of a promotion of energy-saving measures, such as the construction of energy-efficient housing, and a restraining of heat provision volume[13] due to an improvement in the heat provision ratio of household heating, which was the target of the heat provision project. On the other hand, for reductions in water pollutants, a reduction of almost double the plan ratio was achieved. Although this can be considered to be the effect of increased reduction volume brought about by deterioration in the inflow water quality, it can be evaluated as achieving results that are above those planned. Overall, the operations status of each subproject is satisfactory and is achieving the initially planned functionality.

[8] SO_2 is a gas that is one of the major air pollutants resulting from the burning of fuels that contain sulfur, such as coal and heavy oil. It is a cause of acid rain.

[9] Total suspended particulates: A term used to refer to all particulate matter.

[10] Biochemical oxygen demand: Amount of dissolved oxygen required by aerobic biological organisms. Used as an indicator of water pollution, particularly important as one of the controlled items for factory wastewater and the like. This is the volume of oxygen consumed by microorganisms when they decompose organic matter in the water. The higher the number, the more the water is polluted.

[11] Chemical oxygen demand: Often used as a measurement of the amount of water pollution, it is a measure of the capacity of water to consume oxygen during the decomposition of organic matter.

[12] Suspended solid: Refers to insoluble particulate matter. This includes particles from clay minerals, phytoplankton, zooplankton and their carcasses, as well as organic and metallic sediment from sewage and factory water discharges.

[13] For example, at the time of planning, the heat provision volume per hour was 300 Gcal/h but the actual results for 2010 were only 206 Gcal/h. According to the implementing agency, this was not due to a shortage at the heat source, but instead due to the construction of housing with high heating efficiency, which led to a reduced heat provision volume per household.

(2) Subproject operations status (Details are noted in Attachment 2)

1) The Lanzhou Gas Supply Pipeline Network Project

Sufficient data was not provided for this subproject within the field study period and therefore for the effects of some portions of the subproject, the method used was to have a local specialist analyze the provided data, added to a confirmation of the effect on the reduction of pollutants that were presumed to be from this project.

The operations status of the gas provision project overall is satisfactory. At present, gas is being provided to 550,000 households, a substantial increase from the initially planned 160,000 households. This is due to the continued construction of pipelines by the implementing agencies even after the completion of the project. At present, gas is being provided to the northern and southern sections of Lanzhou City (on both sides of the Yellow River). The volume of gas provided is approximately 1.8 to 1.9 million m^3/day, of which 25% is for domestic use and the rest for commercial/industrial/public use. According to an interview with the implementing agencies, the provision of gas is stable, and there has been no stoppage in provision apart from those caused by accidents. Through these measures, it is presumed that SO_2 has been reduced by approximately 4,000 tons/year and the consumption of coal reduced by 170,000 tons,

2) The Lanzhou Heating Supply Pipeline Network Project

Through this project, the coverage rate for heat provision increased substantially. The conventional inefficient small-scale boiler was removed, and the project resulted in substantial achievements. With these achievements, since 2007, a yen loan project (Gansu Province Lanzhou City Atmospheric Environment Improvement Project)[14] has been underway, and a further expansion of the coverage rate is being planned. Even after the implementation of this project, the demand for heat provision is increasing as the city develops, and the total length of the heat provision pipes and the number of heat exchange stations is also increasing. At present, the provision area has already surpassed the planned 5.4 million m^2, and currently covers approximately 7 million m^2 of the central area of the city (Chengguan district) and 98,000 households (approximately 300,000 people). The implementing agencies are currently proceeding with the upgrading of facilities to higher efficiency facilities and the majority of exchange stations will be upgraded in the next three years, with seven to eight stations being upgraded a year.

[14] Once the second yen loan project (Xigu region provision project) is completed, the provision area is to become 18.2 million m^3 (the land area of Lanzhou City is approximately 90 million m^2)

Fig. 6 Interior of a Heat Exchange Station in the City

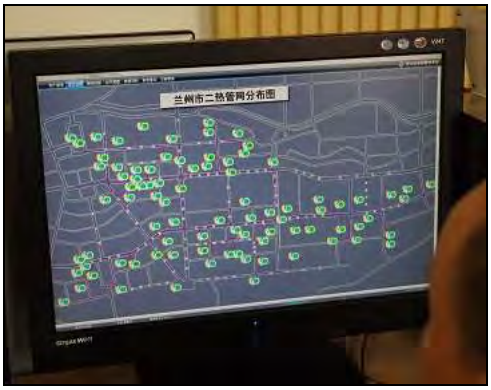


Fig.7 Map Showing the Location of Heat Exchange Stations in the City

Through this project, it is presumed that the effect was a reduction of approximately 2,800 tons per year in SO_2 emissions and a reduction of 120,000 tons in coal consumption per year.

3) Lanzhou Sewage treatment project

The current target areas for sewage treatment are the two locations of the Anning and Qihile districts in Lanzhou City. The volume of sewage processed in the first year (2007) was 60,000 m^3, which gradually increased to 160,000 m^3 in 2011. The reduction rate of pollutants is around 90% when NH_3-N[15][16] is excluded; the treated water has for the most part achieved Grade I in the national standards, and can be evaluated as having achieved results that exceed the project plans.

Table 4 Comparison of Water Quality at Inflow and Post-Treatment at the Sewage Treatment Plant

Indicator	Water quality (Jan.–Feb. 2011)		Reduction rate		National standard[17]
	Inflow water quality	Treated water quality	Planned	Actual	Class
BOD	368 mg/l	14.2 mg/l	-83%	-97%	Class I-B
COD	769 mg/l	48.1 mg/l	-80%	-95%	Class I-A
SS	697 mg/l	14.14 mg/l	-88%	-98%	Class I-B
NH_3-N	41.13 mg/l	18.13 mg/l	-40%	-40%	Not achieved

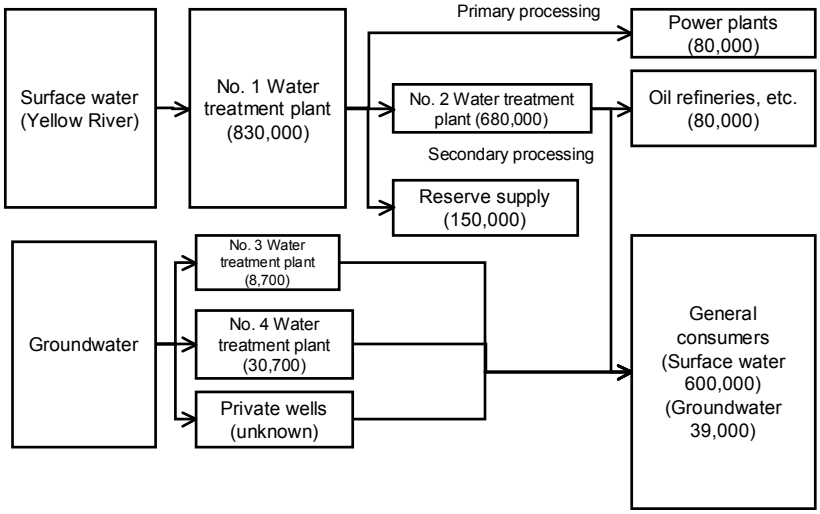
Source: Lanzhoucheng Environmental Protection and Water Service Co.

[15] Regarding NH_3-N, although the objective reduction rate of pollutants has been achieved, the effluent water quality itself has not quite achieved the objective 15 mg/L, due to quality deterioration of inflow water.
[16] NH_3-N is the abbreviation for ammoniac nitrogen, which is formed from urea and proteins contained in urine in sewage when they decompose. This is a measure of water pollution and is one of the causes of the eutrophication of lakes and oceans.
[17] In China, the water quality of treated sewage is ranked in grades, with the highest being Class I-A.

4) Water supply expansion project

By expanding the processing capacity of existing water treatment plants, the project aimed to control the subsidence of Lanzhou City by responding to the increased demand for water, transferring the water supply source from current groundwater sources (wells) to surface water (Yellow River) sources. At present, water is being supplied to approximately 2.07 million people and the water supply penetration rate is 93% in Lanzhou City. The current water supply system of Lanzhou City is as follows:

Table 5 Lanzhou City Water Supply System (numbers in parentheses are m^3/day)



The volume of water supplied per person is 270 l/day, which nearly achieves the objective of 275 l/day; the objective of a stable supply of water has been achieved. Although the current daily water supply volume is approximately only 60% of the project plan, this is largely due to the reduced industrial water demand from initial presumptions because of government policies such as Cleaner Production, which led to a promotion of water savings.

Regarding the objective of switching the water supply to surface water, the current use volume of groundwater (wells) sources is approximately 40,000 m^3/day and has been reduced to around 20% of the 220,000 m^3/day at the time of project appraisal, which greatly surpasses the planned value. The city government has established a policy to close all private wells by 2014, and this is currently being implemented.

3.3.1.2 Results of Calculations of Internal Rates of Return

The financial internal rate of return (FIRR) for this project was re-calculated using the actual results obtained, based on the prerequisites used at the time of planning as

summarized below. The results, as shown below, are all negative except for the sewage treatment project. This can be considered to be the effect of the continuing cost increases in general as well as increases in direct costs, for instance, the cost of raw materials (coal, etc.) for the heat provision project, while the fees and charges have not been raised accordingly due to the highly public nature of these subprojects.

Subproject	Prerequisites	Planned	Actual (2011)
The Lanzhou Heating Supply Pipeline Network Project	Project life: 20 years Benefits: Income from heat sales Costs: Project construction costs, operations, maintenance and management costs	6.29%	Negative
Lanzhou Sewage treatment project	Project life: 20 years Benefits: Income from sewage treatment fees Costs: Project construction costs, operations, maintenance and management costs	4.1%	2.7%
Lanzhou Water Treatment and Supply Project	Project life: 20 years Benefits: Income from water rates Costs: Project construction costs, operations, maintenance and management costs	8.18%	Negative

Note: For the city gas provision project, calculations were not conducted because the required minimum amount of data required for the calculations was not provided.

3.3.2 Qualitative Effects

In terms of the qualitative effects of this project, there are effects such as an improvement in living environment due to an improvement in air and water quality, but an analysis of these effects shall be noted in the Impact section.

From the above, it can be seen that this project has largely achieved its objectives. Therefore, its effectiveness is high.

3.4 Impact

3.4.1 Intended Impacts

This project aims to improve air quality in the city and the water quality of the Yellow River, and to ensure a safe supply of water through the implementation of atmospheric and water quality environment improvement projects. This section reviews the results of surveys that were conducted about changes in the atmospheric and water environments in the city, as well as changes in the attitudes of the residents of Lanzhou toward the environment, in order to analyze the impact of the project.

3.4.1.1 Improvement of the Atmospheric and Water Environments in Lanzhou City

(1) Improvement of the atmospheric environment

Below are figures illustrating the changes in major atmospheric pollutant concentrations before and after implementation of the project as well as the target values and the predicted pollutant concentration had the project not been implemented

Table 6 Changes in the Atmospheric Environment in Lanzhou City (2002–2009)

(Unit: Concentration is in mg/m^3; emissions volume is in tons)

	SO_2 Concentration	SO_2 Emissions volume	NO_2 Concentration	PM_{10} Concentration	No. of days clearing national standards (Class 1-2)
At time of survey (1993)	0.530	75,948			
Predicted value if the project had not been implemented	0.089	88,338			
Project target value	0.081	81,718			
City target value	0.060	n/a			
2002 Results	0.080	72,700	0.057	0.199	154
2005 Results	0.068	71,100	0.037	0.157	238
2006 Results	0.057	80,100	0.052	0.193	205
2007 Results	0.060	74,200	0.042	0.129	271
2008 Results	0.071	82,100	0.055	0.132	268
2009 Results	0.059	80,930	0.042	0.150	236

National Standard	SO_2 Concentration	NO_2 Concentration	PM_{10} Concentration
National Standard Class 1	0.02	0.04	0.04
National Standard Class 2	0.06	0.08	0.10
National Standard Class 3	0.10	0.12	0.15

Source: Lanzhou City Environmental Bulletin

The SO_2 concentration and emissions volume were both lower than the project target values and lower than the predicted values had the project not been implemented; as far as improvement in air quality is concerned, the project has, for the most part, achieved its initial objectives. Major standards such as NO_2 and PM_{10} have improved in comparison to past numbers (2002) and have cleared National Standards Classes 1 through 3. The number of days during the year on which air quality standards are met is increasing, and thus a certain degree of success has been achieved terms of improvement in the atmospheric environment[18]. There are other Lanzhou City Environmental Improvement Projects being implemented besides these, so it is difficult to determine the direct contribution of this project to the above achievements. However, in Lanzhou City, which is dependent on heat provision and gas as its main heating methods, it can be said that this project has a critical role in reducing the amount of coal consumed, so this project can be evaluated as having a major role in this achievement.

(2) Improvement of the water quality of surface water sources (Yellow River)

In interviews with persons associated with the implementing agencies, the water quality of the Yellow River was confirmed to have improved from National Standard Class IV at the time of planning to Class III. As of the 2010 Environmental Bulletin, the waters downstream of Lanzhou City had maintained a Class III National Standard, and the water quality is considered to have a trend toward improvement compared with the time of planning.

On the other hand, total volumes of sewage and COD discharge during the same period both show a drastic increase. This is believed to have been caused by an increase in domestic and industrial sewage resulting from urban development. From the perspective of maintaining a certain water quality level for the Yellow River despite these trends, this project can be seen as playing a certain role in "controlling the degradation of water quality."

Table 7 Changes in Sewage Discharge Volume of Lanzhou City

	2002	2009	Comparison with 2002
Generated volume of COD	23,796	47,897	201%
Total sewage volume (in 10,000 tons)	11,492	16,867	147%

Source: Lanzhou City Environmental Bulletin

[18] According to an announcement by the Gansu Province Environmental Protection Bureau, the total volume of SO_2 emissions in the province was 551,800 tons in 2010, an approximately 2% reduction in comparison with 2005. They announced that they have achieved the reduction target set for the eleventh five-year plan period.

Fig.8 Discharge Outlet for Treated Sewage

Fig.9 Yellow River (in Lanzhou City)

3.4.1.2 Improvement of the Living Environment of Residents

One of the objectives of this project was to improve the health and living environments of residents through the improvement of air and water quality in Lanzhou City. In order to understand the attitude of the residents as well as their evaluation of the effects of this project, a beneficiary survey was conducted among them. The survey was conducted in multiple locations in Lanzhou City, and samples from approximately 100 people were collected. The main questions and answers are as follows:

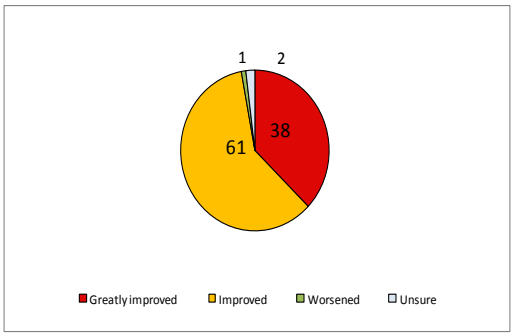


Fig.10 Evaluation of the Improvement in Air Quality in Lanzhou City

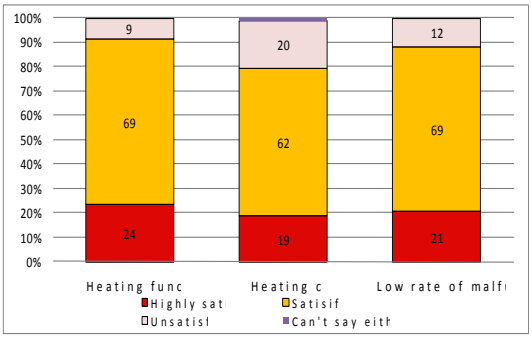


Fig.11 Degree of Satisfaction with Heat Provision Functions

According to the results of the beneficiary survey, over 90% agree that the atmospheric environment in Lanzhou City has improved in comparison to 1990, before the project was implemented. Almost 40% believe that air quality has greatly improved. In addition, 70–80% of the respondents agreed that the number of smoggy days and the occurrence of illnesses related to air pollution have also decreased. This has confirmed that the trend of improvement in air quality has reached a level that can actually be experienced and felt by the residents. In addition, some respondents also recognized an improvement in heating functions compared to previous small-scale boilers, thanks to the installation of a central heat provision network. In term of heating functions and cost, 80–90% of respondents for

each item said they were “satisfied” or “greatly satisfied,” both high ratings.

3.4.2 Other Impacts

(1) Current Situation and Issues Regarding Sewage Treatment

The sludge generated during the sewage treatment process is transported to a landfill in the suburbs of Lanzhou City and buried without being processed. The landfill is located tens of kilometers away from the center of Lanzhou City. Although we believe there is no direct effect on the city environment, a method of processing the sludge with as little effect on the environment as possible is desirable. At the implementing agencies, two egg-type anaerobic digestion tanks are planned to start operation from the end of 2011. After implementation, progress is expected in the dehydration and digestive processing of sludge. After processing, the sludge is planned to be used as fertilizer in the greenification of Lanzhou City.

Fig.12 Sludge Landfill in the City Suburbs

Fig. 13 Sludge Processing Facilities

Regarding the sludge processing system in Lanzhou City, discussions with the implementing agencies for this project and the Lanzhou City government construction bureau have confirmed the need for recycling and reuse as well as the implementation of advanced technologies in response to the increased demand that will come from future urban development. There were opinions expressed regarding the most economical and efficient types of technologies to choose, as well as opinions regarding technology surveys and foreign assistance.

(2) Resettlement of Residents/Acquisition of Land

There was no resettlement of residents in relation to this project. As the land acquisition was for the most part completed before implementation of the project, we have confirmed through the responses from the Lanzhou City government that there are no issues. There were few issues regarding land acquisition because, in general, this project mainly consisted of expansion and strengthening of existing projects, and because the laying of a pipeline network for transporting water, heat, and gas, the main part of this project, was underground.

(3) Impact on the Natural Environment

An environmental assessment for this project was conducted during the project formation stage, and project designs that took the environment into consideration were created. For example, low-sulfur coal was used in the heat provision project and electrostatic precipitators were installed at heat sources. These measures have been confirmed to be currently in service as planned, or upgraded to comply with the stricter environmental regulations that were later enforced.

From the above, we were able to confirm a certain degree of achievement in terms of the project's objective of improving the atmospheric and water environments of Lanzhou City. Therefore, the achievement status of the project objectives can be evaluated as good.

3.5 Sustainability (Rating: ③)

This project differs from regular yen loan projects, with the implementing agencies being defined as all of the implementing bodies for each subproject combined. In evaluating sustainability, the sustainability of each individual implementing body was evaluated and an overall evaluation made based on this[19]. As a whole, we did not see any major problems regarding the operations and maintenance management for the water quality improvement project, and it can be evaluated as having secured sustainability. While the atmospheric environment improvement project has faced financial issues, no problems have had a serious effect on operations. As a whole, the project effects can be viewed as being able to maintain high sustainability.

[19] However, because multiple organizations are evaluation targets, the evaluation process was simplified in comparison with regular ex-post evaluations, and the survey was conducted by focusing on the main points required for evaluating sustainability.

3.5.1 Structural Aspects of Operations and Maintenance

(1) Transitions in the Project Implementation Structure

The operations and maintenance management structure of the project implementation facilities is summarized below. Although there were no major changes in the implementing bodies, there were some changes in organizational form and capitalization, such as bureaus that were under the direct control of the city government becoming a government-owned company. At present, the Lanzhou city government finance bureau oversees the project.

	At time of planning	Current
Supervising agency	Lanzhou City Government	No change (City government finance bureau)
Subprojects		
1. The Lanzhou Gas Supply Pipeline Network Project	Lanzhou City Gas Bureau	CNPC Kunlun Gas
2. The Lanzhou Heating Supply Pipeline Network Project	Lanzhou Thermal Power Company	No change
3. Lanzhou Sewage Treatment Project	Lanzhou City Government Process Management Office	Lanzhoucheng Environmental Protection and Water Service Co. (Government-owned company)
4. Lanzhou Water Treatment and Supply Project	Lanzhou City Waterworks General Co.	Lanzhou Veolia Water

Of the above, private capital was invested in the projects (1) city gas provision, and (4) water supply expansion, and the operation structures of these two subprojects have become highly independent from the administrative branches.

The city gas provision project is being run by Kunlun Gas, a subsidiary of the major oil distributor PetroChina. Kunlun Gas provides gas in China's major cities and has achieved results in Harbin and Kunming. French capital has been invested[20] in the water supply expansion project, and project operations are being run as a joint venture with independent accounting. Both projects have personnel dispatched from the parent company to the subsidiaries, and there is a stable organizational structure under the umbrella of the major parent companies.

3.5.2 Technical Aspects of Operations and Maintenance

[20] It is a joint venture through capital participation from Veolia of France (the second-largest company in the world's water industry). It is the first case in China of foreign capital invested in a public works project (Lanzhou Model). Some management executives have been dispatched from the parent company in France.

The main target of this project is to expand and strengthen conventional operations, and because the technology used is mostly widespread and can be applied to general use, it is believed that no particular technical issues will affect project operations. In addition, there are subprojects in which globally widespread technologies have been adopted, such as The Lanzhou Gas Supply Pipeline Network Project, which can receive assistance from major national companies. Moreover, the water supply expansion project that has introduced international capital. Therefore, the evaluation is that a stable environment exists for maintaining and improving the technical standards.

By actually visiting each facility at the time of the field study and conducting interviews concerning the maintenance status of operations manuals and training implementation status, as well as interviews with the employees, it can be assumed that the operations structure is well maintained and a certain quality level for technical standards is being kept.

3.5.3 Financial Aspects of Operation and Maintenance

Apart from the heat provision project, we were unable to conduct a detailed financial analysis because no detailed financial statements were disclosed. However, based on the operating environment of the implementing agencies and their relationships with city government, evaluations were made as below. In terms of the heat provision project and the water supply expansion project, operating losses continue to accrue, and a slight concern is apparent. However, through negotiations with the implementing agencies, due to the highly public nature of the projects and the high possibility of assistance from the city government, we believe no serious financial problems will affect continued project effects.

1) The Lanzhou Gas Supply Pipeline Network Project: No Issues

In the two years immediately prior, stable profits were recorded, and finances are in a healthy state. It is believed that management and financial foundations are stable because the implementing agency is the Lanzhou branch of Kunlun Gas, a subsidiary of Petro China.

Table 8 Lanzhou City Kunlun Gas Operating Revenue and Expenses

(Unit: 10,000 Yuan)

	2008	2009	2010
Operating revenue		67,322	88,569
Operating expenses		61,679	83,512
Net profit		2,714	3,012

Source: Lanzhou City Kunlun Gas

2) The Lanzhou Heating Supply Pipeline Network Project: Slight Concerns Present

Operating revenues for the heat provision projects have been in the red for the three years immediately prior. This is due to increases in the costs to purchase from the thermal generation plants, the source of heat, as well as increased coal purchase costs.

Table 9 Lanzhou Thermal Power Company Operating Revenue and Expenses

(Unit: 10,000 Yuan)

	2008	2009	2010
Total revenue	14,448	15,154	15,927
Total expenses	15,101	15,722	16,653
Total profit	-653.2	-568	-726

Source: Lanzhou Thermal Power Company

The implementing agency has calculated the rate standards for cost recovery to be 21.2 Yuan/m^2, and rates were adjusted to this standard starting this term (2011). It is believed that operating revenue and expenses will improve.

3) Lanzhou Sewage Treatment Project: No Issues

Although detailed financial reports have not been disclosed, according to the implementing agency, the organization's financial spending is operated by the city government, so no link exists between the level of fee and the agency's budget. The maintenance management cost records show stable expenditures every year, and there are not believed to be any issues regarding daily operations.

4) Lanzhou Water Treatment and Supply Project: Slight Concerns Present

Although no detailed financial statements have been provided, interviews with the implementing agency confirmed that operating losses have been recorded for the past couple of years. Although the project was profitable at one point in 2009, operations costs and equipment capital investments continue to be a heavy burden and stable profitability has yet to be achieved. This is believed to be mainly due to the low water rates. On the

other hand, since the participation of Veolia began, reforms have been made, including reductions in overhead costs, and a degree of improvement can be seen.

3.5.4 Current Status of Operations and Maintenance

At the time of the field survey, after inspecting the main facilities and conducting interviews with personnel on site, we can conclude that facilities were for the most part in good condition. Note that we were not able to inspect the sites for the city gas provision project, and although we were not able to gain visual confirmation, personnel with the implementing agency have responded that there are no issues with facility conditions, and judging from the status of gas provision stated in the effectiveness section, we can assume that there are no major issues.

These subprojects make up the backbone of the infrastructure that supports the livelihood of Lanzhou City. Due to their importance, appropriate measures and assistance related to the operation and maintenance of the subprojects are being implemented and no major issues could be seen.

From the above, it is fair to say that no major problems have been observed in the operations and maintenance system. Therefore, the sustainability of the project effect is high.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

In the city of Lanzhou, the capital of Gansu province, atmospheric pollution from the increased consumption of coal and water pollution from the discharge of untreated sewage and industrial wastewater were becoming increasingly more serious. Improvement of the air and water environments was the most pressing issue for the residents and their living environment. In this project, a number of subprojects that relate to the improvement of the air and water environments were implemented, and they are currently proceeding, achieving reductions in the amount of pollutants in the air and water mostly as planned. Since the implementation of this project, we have seen various effects, such as an improvement in air quality, improvement in the water quality of the Yellow River, and more controlled use of groundwater. We can say that this project has indeed contributed to these trends to a certain extent. A point for future consideration is the need to change the treatment method of sludge generated at the sewage treatment plant; in order to prevent the risk of soil contamination and the like, more advanced methods such as incineration should be adopted in place of the currently used simple landfill method. Regarding the sustainability of this project, although the subprojects are not all without financial

uncertainty, the operations of all the subprojects are found to be stable in terms of structural and technical aspects, receiving support from the city government or the parent companies. Therefore, we do not see any problems. In light of the above, this project is evaluated to be satisfactory.

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

Analysis of environmental data from the city is required not only for the ex-post evaluation study, but also for monitoring the effects of this project. However, the city government finance bureau, which effectively oversees this project, has not provided adequate access to this data. An accurate understanding of the current situation is essential in forming future operations relating to environmental improvement. Therefore, cross-sectoral cooperation between organizations should be strengthened and a monitoring and supervising system should be established.

4.2.2 Recommendations to JICA

Although this project has achieved good results, immediate it is believed that advanced sewage treatment such as dehydration and incineration will be required in the future. We have confirmed with the implementing agencies their needs and requests for continued cooperation. It is believed that it would be effective for JICA to continue to conduct the technology interaction seminars that they have held up until now, as well as providing technical assistance such as selecting the optimal treatment technology and performing feasibility studies.

4.3 Lessons Learned

It is believed that the process of setting the objectives for this project could have been better. In terms of the objectives of improving the air quality in Lanzhou City and improving the water quality of the Yellow River, there were numerous external factors beyond the project itself. Not only was it difficult to measure the effects of this project on the improvement of the water quality, but through discussions with the local implementing agencies, it is believed that there was not enough sharing and understanding. In order to appropriately evaluate project achievements and to gain the cooperation of the host country, the setting and sharing of realistic objectives should be strengthened at the project-formulation stage while positioning objectives such as those pursued in this project as overarching objectives.

End

Comparison of the Original and Actual Scope of the Project

Item	Planned	Actual
(1) Project Outputs		
1) The Lanzhou Gas Supply Pipeline Network Project		
1. Long-distance high-pressure pipe construction	12.37 km	34.87 km
2. Laying of provision pipes in the city	167.8 km	As planned
3. Acquisition of gas plant safety equipment		As planned
4. Pipeline maintenance management equipment		As planned
5. Construction of pressure adjustment stations		As planned
2) The Lanzhou Heating Supply Pipeline Network Project		
1. Laying of heat provision pipes	31.92 km	As planned (currently 42 km)
2. Construction of thermal conversion station	69 stations	72 stations (currently 92 stations)
3. Construction of control building	5,868 m^2	As planned
3) Lanzhou Sewage Treatment Project		
1.Construction of sewage treatment plants	Daily processing volume 200,000/m^3	As planned (treatment method changed)
2. Construction of pumping station	3 locations	As planned
3. Laying of pneumatic sewage transport pipes	3,400 m	9,200 m
4. Construction of a cross-Yellow River sewage pipe bridge	350 m	350 m(changed to underground pipes)
4) Lanzhou Water Treatment and Supply Project		
1. Expansion of water treatment plants	450,000 m^3/day	As planned
2. Upgrade and expansion of pumping facilities	3 locations within the plant, 4 pumping stations	As planned
3. Construction of water distribution pipeline network	Approx. 90 km	Approx. 116 km (3 and 4 combined)
4. Connection pipes between water treatment plants	Approx. 7 km	

(2) Duration	October 1996– August 2000 (47 months)	December 1996– December 2006 (120 months)
(3) Project Costs Amount paid in foreign currency Amount paid in local currency Total Japanese ODA loan portion Exchange rate	 770 million yen 121.8 million yen (1.015 billion Yuan) 1.988 billion yen 770 million yen 1 Yuan = 12 yen (as of January 1996)	 769 million yen 1.772 billion yen (1.265 billion Yuan) 2.541 billion yen 769 million yen 1 Yuan = 14 yen (1997–2006 average)

Attachment 1 3.2.2.2 Project Duration Ratings Details (Planned and actual shown in number of months)

	Planned	Actual	Difference
1) City gas	30	36	120%
2) Heat provision	39	60	154%
3) Sewage treatment	47	120	255%
4) Water supply	46	83	180%
			177%

Ratings calculation method:

1. Ratings were calculated for each subproject by comparing planned and actual results (excludes cancellations and numbers that could not be confirmed)
2. The overall rating is the average of the above sub-ratings.

③: Less than 100%　②: 100% - 150% of plan　c①　150% or more of plan

For this project, the average value was 1.3 points. Therefore the overall rating was less than 50% or ③.

Attachment 2 3.3.1 Quantitative Effects Individual Operations and Effect Indicators Planned/Actual Table

(1) Type 1: Main operations and effect indicators for the atmospheric environment improvement project planned/actual list

1-1 The Lanzhou Gas Supply Pipeline Network Project

	Planned (Design) Value	Actual (2010)*
1. Operations indicators		
Provision volume	540,000 m^3/day	1.82 million m^3/day
Households supplied	160,000 households	550,000 households
Gas production volume	n/a	n/a
Gas production/transport stoppage times	n/a	0
2. Effect indicators		( )Plan ratio in parentheses
		n/a
Volume sold	n/a	n/a
Penetration rate	n/a	(2002 actual results)
		3,917 t/year (96%)
SO_2 reduction volume	4,080 t/year	15,192 t/year (100%)
TSP reduction volume	15,192 t/year	170,000 t/year
Coal consumption reduction	170,000 t/year	(100%)

*Actual results for operations indicators are the results for all implementing agencies including the main project.

1-2 The Lanzhou Heating Supply Pipeline Network Project

	Planned Value	Actual (2020)
1.Operations Indicators		( ) Plan ratio in parentheses
Area supplied	5.4 million m^3/day	6.7 million m^3/day
Households supplied	98,000 households	98,000
Volume of heat provided	300 Gcal/h	206 Gcal/h
SO_2 Reduction volume	n/a	n/a
TSP Reduction volume	n/a	n/a
2. Effect indicators		
SO_2 reduction volume	5,280 t/year	2,832 t/year (53%)
TSP reduction volume	19,659 t/year	10,800 t/year (55%)
Coal consumption reduction	220,000 t/year	120,000 t/year (60%)

(2) Type 2: Main operations and effect indicators for the water quality improvement project planned/actual list

2-1 Lanzhou Sewage Treatment Project

	Planned Value	Actual (2010)
1. Operations Indicators	(Whole of Lanzhou City)	
Sewage treatment population	n/a	
Secondary treatment volume		536,000 people
Total sewage volume	360,000 m^3/day	
Secondary treatment rate	882,000 m^3/day	360,000 m^3/day
Sewer penetration rate (%)	40.8%	550,000 m^3/day
Facility usage rate (%)	n/a	65.45%
	n/a	n/a
		80.15%
	Actual (2010*)	
2. Effect Indicators	Inflow water quality	Discharge water quality
BOD	368 mg/l	14.2 mg/l
COD	769 mg/l	48.1 mg/l
SS	697 mg/l	14.14 mg/l
NH_3-N concentration	41.13mg/l	18.13 mg/l
	(Planned values below)	( ) Plan ratio in parentheses
BOD reduction	10,950 t/year	21,761 t/year (198%)
COD reduction	29,200 t/year	46,794 t/year (160%)
SS reduction	16,060 t/year	46,404 t/year (288%)

*Of the effect indicators, pollutant densities are from data for January to February 2011.

2-2 Lanzhou Water Treatment and Supply Project

	Planned Value	Actual (up to 2010)
1.Operations Indicators	(Whole of Lanzhou City)	
	1.226 million people	
Water supply population		2.07 million people
Water supply rate (penetration rate)	97.0%	
		93%
Water supply capacity (or volume)	1.556 million m^3/day	
		1.28 million m^3/day
Average daily water supply volume	1.43 million m^3/day	
	n/a	830,000 m^3*
Non-revenue ratio (%)	n/a	n/a
Leakage ratio (%)	n/a	n/a
Facility usage rate (%)		59.95%
2.Effect indicators		
Water supply volume/person		
Groundwater usage volume	275 l/day	270 l/day
	126,000 m^3/day	39,000 m^3/day
	(43% reduction)	(83% reduction)

Attachment 3 3.5 Sustainability Rating Results By Subproject

(1) Evaluation Standards for Ratings

Supervising Agency	Evaluation Standards
Structure	- Are the structure and distribution of personnel appropriate for supervising the subprojects? - Is there an established relationship to constantly communicate with subproject-related organizations? - Is there a monitoring structure based on environment-related laws, regulations, and provisions?
Technology	- Do the allocations of personnel and technological skill of the environmental protection bureau exceed the standards to appropriately supervise the project?
Finance	- Have finances sufficient to perform the above activities been secured?
Subprojects	Evaluation Standards
Structure	- Is there an operations management organization (and those to make related decisions)? - Is there a possibility of privatization? If so, is there a possibility of this having an effect on the continuation of the project?
Technology	- Is there an appropriate number of personnel for sustained management? - Are there enough personnel allocated, such as specialists and professionals, to meet technical requirements for facility operations? - Is there a training system in place for operations management? What is the actual training implementation status? - Is there an operations manual, and is it actually being used? - Are inspections and maintenance procedures being appropriately recorded and managed?
Finance	- Are revenues and expenses balanced? - Is there a fee collection system that takes cost recovery into consideration? - If there are continued losses, are government subsidies being appropriately contributed, and are appropriate financial operations being practically secured?
Maintenance Management Status	- Are the conditions of the facilities being maintained so that they are able to function and operate as planned? - Is there a maintenance environment, including spare parts and the like, in place? - Do the regular maintenance activities cover the required activities? - In the event of any trouble, have the appropriate responses been taken?

(2) Ratings Results

	Structure	Finance	Technology	Rating
1) City gas	3	3	3	3
2) Heat provision	3	2	3	2.7
3) Sewage treatment	3	3	3	3
4) Water supply	3	2	3	2.7
			Total	**2.8**

Ratings calculation method:

1. Planned and actual values were compared for each subproject to come up with a sub-rating.
2. The average value of the above sub-ratings is the overall rating.
3. At this point, the numbers after the decimal point are rated using the following general rules.

③: 80% (2.4) or more ②: Over 50% and less than 80% (1.5 or more and less than 2.4)
①: 50% or less (less than 1.5)

China

Ex-Post Evaluation of Japanese ODA Loan Project

Yellow River Delta Agricultural Development Project

External Evaluator: Naoko Inada, IC Net Limited

0. Summary

The development of agriculture and rural communities is a priority area in China. Shandong Province occupies a prominent place in this regard with the third largest cultivated area and the second largest production of food in the country. However, the province has only limited water resources. Accordingly, the national and provincial governments are focusing on policies to promote effective utilization of water resources for agriculture and infrastructure development for that purpose. Therefore, this project has been highly relevant. Since all the outputs of this project have been implemented according to the plan in terms of both expenditure and period, the project has been highly efficient. With regard to the effects of this project, the agricultural profits have increased both throughout the project and in terms of household income. This is attributable to factors such as the enlargement of cultivated area, improvement of productivity, and transition to high value-added crops. Meanwhile, it was expected initially that the introduction of double cropping by irrigation would lead to an increase in the production of agricultural produce. However, due to the changes in the cropping pattern such as the expansion of more profitable cotton single copping, the gross production amount has not reached the planned value. Nevertheless, there have been no problems in the effective utilization of water resources, and thus the project can be regarded as highly effective. From the perspective of structure and technology, the operation and maintenance of the irrigation facilities have been executed properly in coordination and support of the project implementing entities and related organizations. With regard to the financial aspect, on account of the Chinese Government's policy of giving priority to agricultural affairs, the burden on the users of the irrigation facilities has been alleviated, and the financial resources have been secured in the government. In this context, there have been no problems in the operation, maintenance and expansion of the project and its effects. Therefore, the sustainability of the project has been high.

Consequently, this project is evaluated to be highly satisfactory.

1. Project Description

Project Location

Cultivated land in the Daluhu area (Moving clockwise from front of the picture, the crops are soybeans, winter wheat after harvest, maize after sowing, cotton, and paddy.)

1.1 Background

In China, nearly 70% of the entire population inhabits rural farming communities, and the development of agriculture and farming villages is still one of the highest priority issues, even as the country is experiencing rapid emergence of the market economy. Amid such circumstances, Shandong, a province blessed with ample water supply of the Yellow River, had come to be regarded as an important production base for agricultural produce, recording the country's second largest harvest in 1998. Since the 1990s, the Xiazhen area of Dongying City and Daluhu area of Zibo City have been proceeding with the modernization of agriculture and the reinforcement of implementing bodies, in response to the policy of the provincial government. Although the province ranked high in the country in terms of cultivated acreage, only a little more than 60% of its land had been irrigated. In addition, there was salt accumulation in the soil of the Xiazhen and Daluhu project areas, leading to low productivity.

1.2 Project Outline

The objective of this project is to cultivate a total of 34,000 hectares of land and improve low- and medium-yield fields in the Xiazhen area of Dongying City and Daluhu area of Zibo City with an eye toward the effective utilization of water resources and the stable production of agricultural produce, by developing agricultural infrastructures such as irrigation facilities and farmlands, thereby contributing to increased income of farmers.

Loan Approved Amount/ Disbursed Amount	8,904 million yen/ 8,882 million yen
Exchange of Notes Date/ Loan Agreement Signing Date	March, 2000/ March, 2000
Terms and Conditions	Interest Rate: 2.2%, Repayment Period: 30 years (Grace Period: 10 years), Conditions for Procurement: General Untied
Borrower/ Executing Agency	Government of the People's Republic of China/ Shandong Provincial Government
Final Disbursement Date	July, 2007
Main Contractor	Sinochem International Oil Company
Main Consultant	None
Feasibility Studies, etc.	Shandong Engineering Consulting Institute, 1998
Related Projects	None

Figure 1 Project Locations

2. Outline of the Evaluation Study

2.1 External Evaluator

Naoko Inada, IC Net Limited

2.2 Duration of Evaluation Study

This ex-post evaluation study was conducted as follows:

Duration of the Study: November, 2010 – October, 2011

Duration of the Field Study: March 3, 2011 – March 17, 2011; June 21, 2011 – June 27, 2011

2.3 Constraints during the Evaluation Study (if any)

None

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

3.1 Relevance (Rating[2]: ③)

3.1.1 Relevance with the Development Plan of China

According to the 9th Five-Year Plan (1996 - 2000), which was the development policy of China at the time of project screening, the three main objectives of the development were the increase of food production, improvement of farmers' incomes, and reduction of the indigent population. In addition, the Chinese Government declared in 1998 that as part of a middle- and long-term policy for agriculture and rural development, it would promote the following undertakings: (1) maintenance of food self-sufficiency and increased production of commercial crops; (2) implementation of environmentally - conscious farming practices including the effective utilization of water resources by means of water-saving irrigation; (3) reduction of poverty in rural areas; and (4) reform of the food distribution system.

Meanwhile, in the 12th Five-Year Plan (2011 - 2015), the most important objectives are the development of rural communities[3] and safe and stable procurement of food. In the field of rural and agricultural development, the plan places emphasis on the reinforcement of farming and rural infrastructures such as waterworks projects and farmland reclamation, as well as the enhancement of agriculture and the further enforcement of preferential policies for farmers[4].

The cultivated area of Shandong Province is 7,515,300 hectares, which is the third largest in the country (equivalent to 6.17% of the nation's total cultivated land). In 2006, the province

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

[2] ③: High; ②: Fair; ①: Low

[3] "Sannong" (Agriculture, farm villages, farmers) duties

[4] A financial expenditure of 988 billion 450 million Yuna is scheduled, marking a year-on-year increase of 130 billion 480 million Yuna. (Source: China's Central Committee's decision regarding the development and acceleration of water resources reforms by the State Council)

produced a total of approximately 40,490,000 tons of food crops, which was the second largest in the country in volume. Accordingly, the province is regarded as one of the most principal bases for agricultural production. The Shandong provincial government declared in its "Shandong Province 12th Five-Year Plan" (2011 - 2015) that the province's two main strategies for agricultural development would consist of improving agricultural productivity through modernization of farming technology and augmenting food production and farmers' income through reinforcement of the competitiveness of agricultural produce. Thereby, the province is committed to focusing on addressing agricultural issues.

Therefore, the objective of this project, which was to aim for increase in food production through the development of agricultural infrastructures, can be evaluated as relevant to the development policies of the Chinese Government at the time of both the screening and the ex-post evaluation.

3.1.2 Relevance with the Development Needs of China

(1) Development Needs of the Agricultural Sector in Shandong

Although the cultivated area in China's northern region, where Shandong Province is situated, accounted for 57% of the total cultivated area in the entire country, the region's reserves of water resources were only 18% of the total amount in the entire country. With the volume of water resources a person can use annually being 350 m^3 in Shandong, as opposed to the national average of 2,201 m^3 per year[5] the region was suffering from severe shortages of water.

[5] World Resources Institute, World Resources 2000-2001

Table 1 Annual water reserves per person in the northern and southern regions of China

Northern Region (m3)		Southern Region (m3)	
Province, Autonomous Area, Direct-controlled Municipality	Water Reserves per Person	Province, Autonomous Area, Direct-controlled Municipality	Water Reserves per Person
Ningxia Autonomous Region	149.8	Shanghai City	197.5
Tienchin City	159.8	Jiangsu Province	494.1
Beijing City	205.5	Anhui Province	1,141.4
Hebei Province	231.1	Zhejiang Province	1,680.2
Shanxi Province	256.9	Hubei Province	1,812.3
Shandong Province	**350.0**	Chongqing City	2,040.3
Henan Province	395.2	Guangdong Province	2,323.8
Liaoning Province	617.7	Hunan Province	2,512.8
Gansu Province	715.0	Fujian Province	2,886.3
Shaanxi Province	809.6	Guizhou Province	3,019.7
Heilongjiang Province	1,208.0	Sichuan Province	3,061.7
Jilin Province	1,215.2	Jiangxi Province	3,093.5
Inner Mongolia Autonomous Region	1,710.3	Guangxi Autonomous Region	4,763.1
Xinjiang Autonomous Region	3,859.9	Hainan Province	4,933.5
Qinghai Province	11,900.5	Yunnan Province	5,111.0
		Tibetan Autonomous Region	159,726.8

Source: "Production Capacity of Chinese Agriculture," Statistical Yearbook of China 2009 Edition, Ministry of Agriculture, Forestry and Fisheries

Furthermore, although the cultivated area in Shandong Province was one of the largest in the country, only a little more than 60% of the area was irrigated[6], with salts accumulated in the soils of the Xiazhen and Daluhu project areas. For this reason, the province was mired in low productivity. On the other hand, since the soils were relatively low in sodium and pH, many of these lands could be turned arable with proper irrigation and drainage. In the project areas, people called for the effective utilization of precious water resources and the improvement of soils. It was, therefore, prerequisite to construct irrigation facilities and artificial reservoirs in order to secure necessary agricultural water, thereby advancing irrigated agriculture free from the influence of the Yellow River's flow, and improving alkali soil through desalting irrigation.

(2) Additional Implementation of Embankment Maintenance

In September 2005, when the project was underway, additional pavement construction was conducted for the approximately 32 km section of the embankment across the Bohai Sea coast in the Xiazhen area.This construction work was carried out in order to deal with the inundation of the coastal area from the Bohai Sea, a problem that had been anticipated in the risk assessment at the time of the screening. That said, since the area subject to the risk of inundation had been undeveloped prior to the start of the project, where the inhabitants had been making

[6] "Production Capacity of Chinese Agriculture," Statistical Yearbook of China 2009 Edition, Ministry of Agriculture, Forestry and Fisheries

individual efforts to counter floods by constructing their own embankments, it was excluded from the project plan at the beginning. However, a devastating rainstorm[7] that occurred in 2003 when the project was in progress inundated the grassland in the project area with seawater, aggravating the alkalization of the soil. Consequently, the necessity of anti-flood measures was confirmed to be greater than initially anticipated, prompting the project contractors to implement pavement construction (Phase 2 Construction), aside from the embankment work (Phase 1 Construction) independently carried out by the city government. Thanks to the effects of the additional construction, typhoons in August 2007 were successfully prevented from causing inundation and associated salt damage.

As above, the additional implementation of embankment construction work was necessary to prevent the inundation of seawater, which could have significantly undermined the effectiveness of the project. Nevertheless, more meticulous risk analysis should have been conducted in the planning stage of the project to determine whether or not the initially conceived measures would be sufficient to avert flooding.

3.1.3 Relevance with Japan's ODA Policy

The Japanese Government in its "Country Assistance Strategy for Economic Cooperation with China" in 1992 placed emphasis on the development of economic infrastructure centering on loan assistance, agricultural/rural development, and development utilizing bountiful resources. Accordingly, agricultural sector support geared to securing food, development of agricultural infrastructure that can serve as a basis for sustainable growth, and development utilizing resources were all relevant to the Japanese Government's aid policy toward China and ODA policy at the time of the screening. Furthermore, the objectives of this project were also relevant to anti-poverty measures, development of economic/social infrastructure, and agricultural/rural development, i.e. the subjects prioritized in the implementation[8] policy of the yen loan program for China at the time of the screening.

As described above, this project has been fully consistent with the development policies and needs of China and Shandong Province, as well as Japan's ODA policy; therefore, its relevance is high.

3.2 Efficiency (Rating: ③)

3.2.1 Project Outputs

The plans and achievements of this project are listed in the table below. In general, the project proceeded in accordance with the plans with the exception of the following points:

(1) Changes in the number of reservoirs and the total distance of irrigation canals

(2) Additional reinforcement work for dykes

(3) Changes in the specifications and numbers of farming equipment

[7] The volume and level of sea water did not change significantly compared to before the project.

[8] This signifies the Strategy for Overseas Economic Cooperation created every three years based on the ODA framework and mid-term policy of the Ministry of Foreign Affairs.

Table 2 Output : Comparison between the plans at the time of screening and achievements

Items	Plans	Achievements
Xiazhen area		
Reservoirs	2 expansions, 1 new construction	1 repaired
Pump facilities	1 expansions, 14 repairs, 10 new constructions	As planned
Main irrigation canals	5 repairs, 81.93km	5 repaired, 100.53km
Secondary irrigation canals	111.9km	As planned
Transmission facilities	4 facilities, 185 km transmission line	As planned
Main drainage canals	5 canals, 155.3km	As planned
Secondary drainage canals	35 canals, 102.3km	As planned
Farmland consolidation	24,000 ha	As planned
Embankments	-	Second period construction, 30.2km
Other civil engineering works	13,010 ha	As planned
Construction machinery	32 types, 364 machines	As planned
Farming equipment	1,464 self-propelled machines, 1,285 accessories	As planned
Daluhu area		
Main irrigation canals	9 repairs	0 repaired, 1.2km newly constructed
Maintenance of irrigation wells	2,620 wells	As planned
Transmission facilities	6 facilities, 452 km transmission line	5 facilities
Secondary drainage canals	2 canals	As planned
Farmland consolidation	10,000 ha	As planned
Other civil engineering works	2,470 ha	As planned
Construction machinery	8 types, 56 machines	As planned
Farming equipment	95 self-propelled machines, 1,175 accessories	129 self-propelled machines, 2,942 accessories

Sources: Dongyingshi Cooperative Development Limited Liability Company and Yellow River Agriculture Development Corporation, Zibo City

(1) Changes in the number of reservoirs and the total distance of irrigation canals

The number of reservoirs in the Xiazhen area has decreased due to changing needs. In particular, flow of the Yellow River was interrupted for 200 days annually at the time of the screening on account of a decrease in the water volume. Accordingly, there was a need to secure a sufficient number of reservoirs to cope with this problem back then. However, the completion of the Xiaolangdi dam after the start of reservoir construction resolved the flow interruptions and thus lessened the demand for reservoirs. Consequently, the funds for reservoirs that had become no longer necessary was reallocated to the expansion of irrigation canals, which was the next highest priority task for more effective irrigation. As a result, the total distance of canal

repair became longer than initially planned.

The pavement work for the main irrigation canals in the Daluhu area was implemented at a site 1.2 km from a settling basin for new construction of waterways, down from the nine locations that had been initially planned. This was because the completion of the aforementioned Xiaolangdi dam enabled the adjustment of water flow in the Yellow River, thereby eliminating the need for concrete pavement that could withstand strong water pressure. Therefore, the irrigation canals were maintained as earth canals. Likewise, the irrigation wells in the Daluhu area were determined to be unsuitable for agricultural production, as groundwater testing at the time of detailed designing revealed that the salinity of the soil was too high at locations with high alkalic subterranean water. Accordingly, some of the drilling sites were changed, but the number remained unchanged from the plan.

Fig.4 Main irrigation canal and pump facility in the Xiazhen area

Fig.5 Embankment in the Xiazhen area

(2) Additional reinforcement work for dykes

Reinforcement work for more than 30 km of dyke across the Bohai Sea coast in the Xiazhen area was additionally implemented. (For details, refer to the "3.1 Relevance 3.1.2 Relevance with the Development Needs of China (2) Additional Implementation of Embankment Maintenance" section.) Since the funds for this additional implementation were secured in the physical contingency funds, the overall project cost and other outputs were unaffected.

(3) Changes in the specifications and numbers of farming equipment

In the Daluhu area, the numbers of farming equipment such as combines[9] and plows[10] were increased compared to the initial plans. This was in the context of the increase in the production of maize and wheat. Sometime after the start of this project, the profitability of soybeans

[9] Agricultural machines for harvesting and threshing crops
[10] Implements of tractors for plowing soil

dropped in relation to other crops owing to the fluctuation of market prices, thus prompting the shift from soybeans to other profitable crops. In particular, the cultivated area for maize and wheat expanded more than initially estimated. In the double cropping of maize and winter wheat, sowing of maize seeds preceded the harvest of wheat, thus necessitating mechanized operations. As a result, the numbers of farming equipment increased.

3.2.2 Project Inputs

3.2.2.1 Project Cost

In contrast with the total project cost of 19.663 billion yen (10.126 billion yen in foreign currency; 635 million yen in domestic currency), the actual project cost was within the plan at 19.197 billion yen (8.882 billion yen in foreign currency; 728 million Yuna in domestic currency) (98% of the planned figure). This total project cost was the sum of the planned value before the start of the project (16.704 billion yen, of which 8.904 billion yen were in foreign currency and 520 million Yuna) and the planned value for the additional implementation (2.959 billion yen, of which 1.222 billion yen were in foreign currency and 115 million Yuna were in domestic currency)[11].

The items that were subjected to major changes from the planned values are listed as below.

Table 3 Planned/actual project costs (Item-wise)

(Unit: million yen)

Item	Target Value	Achived Value	Target Ratio
Pumping stations, gates, and motors	729.5	186.1	26%
Transmission facilities	625.8	420.0	67%
Materials	3,703.7	5,376.2	145%
Civil engineering works and farmland consoli	5,847.0	9,861.4	169%
Maintenance fees	247.5	330.9	134%
Construction machinery	2,214.9	1,227.7	58%
Farm machinery	874.9	1,392.9	159%
Vehicles and office equipment	266.4	194.8	73%

Source: Created based on the information provided by Dongyingshi Cooperative Development Limited Liability Company and Yellow River Agriculture Development Corporation, Zibo City

The decreases in the items of construction machinery, pump facilities, gates/motors, transmission facilities, vehicles/office equipment were attributable to the reduction of the unit prices vis-à-vis the planned values as a result of competitive bidding, as well as the fluctuation of the exchange rate (from 1 Yuna = 15 yen to 13 yen[12]). Since the decrease in the number of reservoirs was offset by the increase in the maintenance and construction of irrigation canals,

[11] Although the expenses for this additional implementation were not anticipated at the beginning, their necessity was high as part of the project scope. Therefore, they should have been included in the initial plan. Consequently, they were included in the planned values for evaluation when comparing the planned values and achievement values of the total project costs.

[12] Rate in 2000.

the expenses for materials, civil engineering works and upkeep costs were not affected. However, the additional construction of embankments meant that the expenses for this item ended up higher than initially planned. The increase in the expenses for agricultural machinery was due to the increase in the number, changes in the specifications, and rise in prices.

3.2.2.2 Project Period

In comparison with the initially-planned project period between January 2000 and December 2004 (60 months), the project actually lasted from January 2000 to December 2006 (84 months; 140% compared to the plan). This was because it took 13 months to process the paperwork for the additional construction, and another 11 months to implement it. Therefore, the planned construction itself was finished within 60 months in accordance with the initial output, and according to the Shandong Water Resources Department, the additional construction was also completed within the project period. The delay in the construction schedule was derived from the increase in the unplanned output; therefore, the overall schedule for project implementation was reasonably appropriate.

As described above, this project was finished within the planned expenditure and period. This was largely attributable to the establishment of management practice in related organizations and the support system to make it functional. With regard to the procurement operations during the project period, the Shandong Water Resources Department took the initiative in establishing the management practice peculiar to the project. The department then proceeded to publicize the practice by making use of manuals and document formats, thereby significantly contributing to the project. Although there were numerous standards that needed to be observed such as Chinese laws and JICA's procurement guidelines, they were compiled into one manual so that the related organizations would find them easier to understand. In addition, the project implementing entities responsible for each project area were required to report to the project office of the provincial government every quarter, and an external audit was conducted annually.

As above, while the expenditure for this project was within the planned range, the project period exceeded the plan. This was due to the additional output that had not been planned at the beginning. Considering that the initially-scheduled output, as well as the additional one, was implemented as planned, both project cost and project period were as planned; therefore efficiency of the project is high.

3.3 Effectiveness (Rating:③)

3.3.1 Quantitative Effects

This project was aimed at stable production of agricultural produce and effective utilization of water resources. Although the total production of agricultural produce fell short of the targeted value after the project, it has continued to increase. Furthermore, thanks to the adoption

of crops with high added values, the farmers' income has far exceeded the expected level.

3.3.1.1 Results from Operation and Effect Indicators

(1) Status of Agricultural Production

The available arable land area in the project locations reached 34,667 hectares, or 101% of the plan, whereas production amounted to only approximately 60% of the planned level. This is because the production amount of the Xiazhen area was only a little less than 40% of the planned level on account of the changes in the cropping pattern.

At present, the single cropping of cotton[13] accounts for nearly 70% of total cultivated land in the Xiazhen area. Therefore, simple comparison indicates that the total production is smaller than the planned level. The underlying reason for the prevalence of cotton cultivation in this area is that the market price of cotton has risen since the start of the project, increasing the profitability. In addition, the salinity of the soil in this area is also a factor, as it makes the soil unsuitable for the production of other crops. On the other hand, although cotton requires the most water in spring when its cultivation starts, the water level of the Yellow River is low in the springtime. Therefore, without irrigation from the reservoirs constructed in this project, production expansion of this magnitude could never have been realized. In that sense, the transition to the present cropping pattern has been reasonable, given the current market and soil conditions, and it was this project that enabled this transition. In this area, the achieved value of the planting rate was 61% of the target level (see Table 5). This is because the actual project plan was changed to focus on single cropping of cotton, as opposed to the initial assumption of double cropping. The available arable land area was developed as planned, reaching 100%.

Meanwhile, the total production amount in the Daluhu area exceeded 90% of the planned level; thus the production condition is considered to have been satisfactory. In this area, in response to the decreasing profitability of soybeans, the transition to maize, a more profitable and highly-demanded crop, is in progress.

The trend that is common in both areas is the increase in the production of fruit and fishery products. Although the planted area for vegetables alone has not reached the target level, the overall area including that for fruit and fishery products has expanded. The factor behind this trend is the Government's support program promoting the branding of high-value added crops such as crabs and peaches as local specialties, in which subsidies are being doled out to the producers, and technologies are being transferred (refer to the "3.4.2 Other Positive/Negative Impacts" section).

[13] Since its cultivation period is from April to November, cotton is unsuitable for double cropping with other crops, thus yielding limited total harvest.

Table 4 Comparison between planned and achieved levels of planted area, unit crop and production amount

Total	Target value			Achieved value (2009)			Target Ratio
	Planted area	Unit crop	Production	Planted area	Unit crop	Production	
	ha	ton/ha	tons	ha	ton/ha	tons	
Paddy	7,400	7.2	53,300	2,569	7.7	19,719	37%
Wheat	21,400	5.1	109,100	7,311	5.9	43,176	40%
Maize	5,200	5.4	28,100	6,868	7.4	50,822	181%
Soybeans	15,400	2.2	33,900	849	2.1	1,743	5%
Peanuts	800	3.6	2,900	366	2.5	922	32%
Cotton	3,200	0.7	2,200	19,298	1.1	21,674	985%
Vegetables	4,100	74.1	303,800	2,277	45.3	103,187	34%
Fruit				1,178	57.6	67,868	-
Fishery				1,307	4.0	5,262	-
Forestry				2,000	1.1	2,150	-
Total planted area	57,500			44,023			77%
Cropping rate	167%			127%			
Cultivated area	34,380			34,667			101%
Irrigation area				34,467			
Irrigation rate				99%			
Total production			533,300			316,523	59%

Source: Created based on the information provided by Dongyingshi Cooperative Development Limited Liability Company and Yellow River Agriculture Development Corporation, Zibo City

Table 5 Comparison between planned and achieved levels of planted area, unit crop and production amount by area

Xiazhen Area	Target value		Achieved value (2009)		Target Ratio
	Planted area	Production	Planted area	Production	
	ha	tons	ha	tons	
Paddy	5,400	38,880	1,333	10,290	26%
Wheat	15,200	77,520	1,410	6,042	8%
Maize	2,100	11,340	796	4,042	36%
Soybeans	14,400	31,680	676	1,384	4%
Peanuts	800	2,880	226	428	15%
Cotton	1,200	840	18,152	20,367	2425%
Vegetables	2,100	155,610	973	24,532	16%
Fruit	-	-	667	45,023	-
Fishery	-	-	1,064	2,538	-
Forestry	-	-	0	0	-
Total planted area	41,200		25,298		61%
Cropping rate	170%		105%		61%
Cultivated area	24,200		24,200		100%
Irrigation area			24,000		
Irrigation rate			99%		
Total		318,750		114,646	36%

Daluhu Area	Target value		Achieved value (2009)		Target Ratio
	Planted area	Production	Planted area	Production	
	ha	tons	ha	tons	
Paddy	2,000	14,400	1,236	9,429	65%
Wheat	6,200	31,620	5,901	37,134	117%
Maize	3,100	16,740	6,072	46,780	279%
Soybeans	1,000	2,200	173	359	16%
Peanuts	0	0	140	494	-
Cotton	2,000	1,400	1,146	1,307	93%
Vegetables	2,000	148,200	1,304	78,655	53%
Fruit	-	-	511	22,845	-
Fishery	-	-	243	2,724	-
Forestry	-	-	2,000	2,150	-
Total planted area	16,300		18,726		115%
Cropping rate	160%		179%		112%
Cultivated area	10,180		10,467		103%
Irrigation area			10,467		
Irrigation rate			100%		
Total		214,560		201,877	94%

Source: Created based on the information provided by Dongyingshi Cooperative Development Limited Liability Company and Yellow River Agriculture Development Corporation, Zibo City

By contrast, the project has achieved more than expected in the plan in terms of profitability, with the gross profit of the produce in the project areas exceeding the target levels. The table below shows the calculated levels of the profits of the produce in each area (amounts of money after the production costs were subtracted from the sales revenues). Even in the Xiazhen area where the planted area and production volume did not reach the target levels, the profits surpassed the target levels, thus indicating an increase in the overall profitability. This was in context with the increase in the production amount per unit area (unit crop) and the conversion to/expansion of the production of high value-added crops. The reason why the achievement of the planted area fell short of the target is that the plan was changed to focus on single cropping of cotton, as opposed to the initial assumption of double cropping. The available arable land area was developed as planned, reaching 100%.

Table 6 Comparison between planned and achieved levels of production profits by area

	Target value			Achieved value (2009)	
	Land Area (ha)	Profit	Profit (inflation adjusted*)	Land Area (ha)	Profit
		(1000 yuan)	(1000 yuan)		(1000 yuan)
Xiazhen Area					
Low and middle production field development	13,300	145,310	174,372	13,300	211,715
Wasteland development	10,700	111,680	134,016	10,700	160,403
Grassland improvement	8,670	-		8,670	-
Food and fishery development	670	5,670	6,804	667	7,478
Fish breeding pond creation	670	4,390	5,268	667	18,583
Subtotal	34,010	267,050	320,460	34,004	398,179
Daluhu Area					
Low and middle production field development	10,000	138,530	166,236	10,000	137,758
Food and fishery development	470	5,820	6,984	467	9,167
Subtotal	10,470	144,350	173,220	10,467	146,925
Total	44,480	411,400	493,680	44,471	545,104
				Target Ratio	110%

Source: Created based on the information provided by Dongyingshi Cooperative Development Limited Liability Company and Yellow River Agriculture Development Corporation, Zibo City, as well as the results of a beneficiary survey.

* CPIs from 2000 to 2009 were used for inflation adjustment.

Table 7 compares the changes in the production volume and profit per unit area between before and after the implementation of the project. The crop yields have increased by nearly 140% to 230%, and the profits by 210% to 500% compared to before. Although the increase in cotton production has been relatively low, both the profitability and growth rate per unit have become the largest, owing to the stabilization of production as a result of irrigation from the reservoirs, and the rise in the prices accompanied by the increase in the demand in the domestic market.

Table 7 Changes in production and profitability per unit area

	Production per Unit Area (ton/hectare)			Profits per Unit Area (yuan/hectare)		
Product	Before Project	After Project	Grownth Rate	Before Project	After Project	Grownth Rate
Paddy	4.5	7.7	172%	7,335	19,958	272%
Wheat	3.5	5.3	153%	4,544	9,727	214%
Maize	2.9	6.7	231%	4,516	13,278	294%
Soybeans	1.0	2.1	207%	3,336	10,681	320%
Cotton	0.8	1.1	139%	5,702	28,826	506%

Source: Created based on the information provided by Dongyingshi Cooperative Development Limited Liability Company and Yellow River Agriculture Development Corporation, Zibo City, as well as the results of a beneficiary survey.

Fig.6 Cotton cultivation in the Xiazhen area

Fig.7 An aquaculture pond and winter wheat cultivation in the Daluhu area

Interviews with the related organizations have confirmed the following factors affecting production:

- There have so far been no particular problems related to natural conditions, disease/insect damage, and other factors, and a stable production environment has been maintained.
- Since reform of the government's agricultural policies in 2004, farmers have been provided with direct subsidies, leading to improvement in the quality of fertilizer and seeds and, consequently, increased productivity. This has been another factor in boosting production.
- In the Daluhu area, the county government's water resources department has taken the initiative in introducing piped irrigation[14] to 8,000 hectares, or about 80%, of the project area since 2010, thereby promoting more effective utilization of water resources.
- Within the project locations, the provincial government has designated model areas, which have been engaged in tasks such as providing information regarding excellent cultivars, imparting production technologies to interested parties, and promulgating the model to other regions.

(2) Indices Regarding Water Demand, Functions and Operation of Irrigation Facilities

With regard to the effective utilization of water resources, which is one of the objectives of this project, interviews with the project implementing entities and beneficiaries have revealed that they have been using only the necessary amount of water in a proper manner, and the annual volume of irrigation water sources, i.e. the Yellow River and subterranean water, has not changed significantly. In particular, with the construction of irrigation facilities in this project, farmers have become able to secure sufficient amount of water for soil preparation even during the springtime when the waterlevel of the Yellow River is the lowest. The interviewees explained that this water supply has contributed to the increase in agricultural production.

[14] Minimize the loss of water by using water supply piping instead of unpaved irrigation canals.

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

Economic Internal Rate of Return (EIRR)

The economic internal rate of return (EIRR) of this project has been recalculated based on the calculation method at the time of the screening. This has revealed that the EIRR has been improved to 24% from 18.5% at the time of the screening. This may be because the improvement of productivity and the rise in selling prices have been more significant than expected. The present improved productivity and the production pattern focusing on high value-added crops such as cotton have been achieved through the construction of irrigation facilities, thus demonstrating the effectiveness of the project.

Table 8 EIRR Recalculation Results

	At the time of the screening	Achievement
EIRR	18.5%	24%
・ Project Life: 50 years ・ Expenses: initial costs (direct construction costs, machinery purchase costs, environmental monitoring costs, project management costs, consulting services), facility maintenance costs, production costs ・ Benefits: agricultural produce, fishery, forestry and other products		

Note 1: Based on the beneficiary survey with farmers, prediction of future cultivation plans has been reflected in the calculation of agricultural produce.

Note 2: The production costs and prices have been calculated based on the results of the beneficiary survey and the information provided by the project implementing entities.

3.3.2 Qualitative Effects

With the aim of confirming how the direct beneficiaries, namely the farmers, have interpreted the effects of the project, a beneficiary survey[15] was conducted. According to the survey, the majority of the beneficiaries recognizes the improvement regarding the production status after the project and has expressed a high degree of satisfaction. In particular, they have praised the increased production through the utilization of irrigation facilities and improvement of production technology. With regard to the increase in production, it has been confirmed that not only the construction of irrigation facilities but also other efforts made through the project, specifically the technological transfer, lease of farming equipment, and sale of good seeds for farmers, have had good impact.

[15] The beneficiary survey covered randomly-selected 50 farmers in the Xiazhen project area and another 50 in the Daluhu project area.

Table 9 Changes in productivity, production technology and services after the project and evaluation by beneficiaries

	Xiazhen area	Daluhu area
1. Status of agricultural production after the project		
Significantly improved	98%	98%
2. Evaluation of current production status		
Very satisfied	88%	56%
Satisfied	12%	44%
3. Changes in production technology/methodology after the project		
	Introduction of advanced production technologies such as water-saving irrigation and excellent cultivars	Realization of water-saving irrigation, fertilizer blending, and mechanization; introduction of advanced production technologies such as excellent cultivars
4. Support services regarding production received after the project		
	Preferential pricing of fertilizers/agrichemicals, lease of farming equipment, guidance on farming, support for excellent cultivars	Preferential pricing of fertilizers/agrichemicals, lease of farming equipment, support for soil measurement/fertilizer blending technology and excellent cultivars

Source: Created based on results of the beneficiary survey

Fig.8 Beneficiary Survey (in Xiazhen)

Fig.9 Harvested Cotton (in Xiazhen)

As described above, the construction of irrigation facilities in this project has enabled the production of high value-added crops. In addition, the increase in productivity has significantly improved agricultural production and, consequently, agricultural profitability in the project areas. Therefore, the effectiveness of the project has been high.

3.4 Impact

3.4.1 Intended Impacts

Most of the farms in the project areas are managed by individual households. The majority of them are small hold farmers, with the cultivated area per household being around 1 hectare. The arable land in a village is shared almost equally by all the households.

(1) Farmers' Income

According to the beneficiary survey, farmers' household income has grown by three to four times as compared with prior to the start of the project. Although both the production costs and sales costs have risen since after the start of the project, the effects of the transition to high value-added crops and the increase in productivity have been great, thus resulting in the achievement of higher incomes to some extent.

Table 10 Changes in Farmers' Household Income (per year)[16]

	Before Project	Afrter Project	Growth Rate
Xiazhen Area	7,923.6	35,116.4	443%
Daluhu Area	2,436.3	8,727.7	358%

Source: Created based on the results of the beneficiary survey

In the beneficiary survey, in response to the questions about market and distribution (retailers, sales prices and production costs) that affect incomes, some of the respondents complained about high production costs. Nevertheless, they expressed generally high satisfaction over sales prices and the market and distribution conditions.

The gap of agricultural income between these two project areas stems from the difference in the profitability of the cultivated crops. Due to the difference in alkalinity in the soil between these two areas, the crops suitable for cultivation and the cropping patterns are different. Consequently, highly profitable cotton[17] is cultivated more readily in the Xiazhen area than in the Daluhu area, thus resulting in higher profits in the former. Another factor lies in the difference of the average cultivated area. As shown in Table 11, the average cultivated area in the Xiazhen area is 1.7 times larger than that in the Daluhu area.

[16] The amount of money where the annual production costs are subtracted from the annual earnings from agriculture, aquaculture and other production

[17] Alkali soil with high salinity is suitable for cotton cultivation.

Table 11 Average Farmland Area per Household

(Unit: ha/household)

	Target Value	Achieved Value	
		Before Project	After Project
Xiazhen Area	1.26	0.77	1.26
Daluhu Area	0.55	0.61	0.74

Source: Created based on the results of the beneficiary survey

(2) Effects of Higher Incomes

The results of the beneficiary survey have revealed that as a result of the project, some of the beneficiaries have seen a rise in their non-agriculture earnings in addition to the agricultural incomes. The increase in non-agriculture earnings may be because more farmers have become able to work away from home for longer periods as migrant laborers, thanks to the increased efficiency of farmwork as a result of mechanization brought about by higher incomes.

The increased incomes have also contributed to improvement of the living standard of the beneficiaries. According to the survey results, their expenditures for daily living and investments in movable and immovable properties have also increased. The asset investments included refurbishment/extension of houses and purchases of farming machinery, electric appliances, motorbikes, and automobiles. Almost all the households covered by the beneficiary survey have responded that their spending has increased. Although fees for compulsory education have become free, education-related spending has increased. This is because more people have started taking lessons outside of schools and more students are going on to higher-level schools.

Table 12 Asset Investment Items that have Increased after the Project

Properties Investment Item	Invested Household Ratio (%)
House Extensions	79
Motorcycles and bicycles	94
Consumer electronics	100
Cars	27
Farm machinery	67
Others	13

Source: Created based on the results of the beneficiary survey

Moreover, almost all the respondents to the beneficiary survey have expressed either a very high or reasonably high degree of satisfaction over their livelihoods after the project. The reasons for this included the increased production amounts, higher unit yields, higher sales prices, increased earnings and better quality of life.

3.4.2 Other Impacts

(1) Benefits to the Project Area and communities

The interviews with the parties concerned have revealed the following positive impacts of the project:

- Producers' associations specializing in particular products such as crabs, shrimps, fish and fruit have been established. They have been engaged in activities such as joint purchasing of feed and chemicals necessary for their production, sharing of equipment, and joint selling of their products. According to the beneficiary survey, 90% of the respondents in the Xiazhen area and all the respondents in the Daluhu area answered that they belong to some sort of newly-established producers' association. This indicates a trend toward the organization of associations related to production and distribution of products, especially those which require new technology and equipment, such as aquaculture and fruit products. For example, the government provides subsidies for the production of aquaculture crabs and peaches in the Xiazhen area so that they can be recognized as local specialties or brands, and this serves as an incentive for further promotion.
- This project has helped to cultivate large-size farmland, construct/repair irrigation facilities, and improve productivity. As a result, the project has had a positive influence on promoting the government's efforts to construct and improve infrastructures such as roads and irrigation facilities in the surrounding regions. The improved distribution as a result of road construction has contributed to making the transportation of agricultural produce more effective in a synergetic manner.
- Villages in the vicinity of the Daluhu area have taken interest in the effects of this project and have started maintaining irrigation facilities and practicing technologies for aquaculture and agriculture. At present, these technologies are being practiced on only about 200 hectares of cultivated land. In the future, they may further improve the productivity and the farmers' earnings in the regions around the project areas.

(2) Impacts on the Natural Environment

Since one of the project sites (Xiazhen area) adjoins the Yellow River estuary wetland, which is a national nature reserve, many voices raised concerns in the planning stage of the project about environmental impacts on hydrology, water quality and ecology such as the protection of bird habitats and water pollution by insecticides. In the environmental impact survey conducted at the time of the planning, it was confirmed that the implementation of the project would not have significant ramifications. Nevertheless, the project implementing entities have been monitoring water quality[18] and other factors.

For now, the index data for the surface water quality have largely been either improved or stabilized. However, the data in 2007 and 2009 showed that the water quality at certain

[18] Chemical oxygen demand (COD) and biochemical oxygen demand (BOD), indices for water contamination, were confirmed.

monitoring locations did not satisfy the government mass standard for surface water environment. The table below shows the results of water quality tests at the main monitoring points of this project.

Table 13 Monitoring Results of Surface Water Quality

(Unit:mg/m$^{3)}$

Index/Monitoring Points		Classification[19]	Standard Value	1998	2000	2003	2005	2007	2009
pH									
Xiazhen Area	Yihong	III	6.0-9.0	7.9	-	7.3	-	7.4	-
	Yongfeng	III	6.0-9.0	8.1	-	7.8	-	7.6	-
Daluhu Area	Zhimai	III	6.0-9.0	8.3	8.1	-	8.3	8.1	8.1
	Dalu lake	II	6.0-9.0	7.8	7.9	-	7.9	8.0	7.9
COD (Chemical Oxygen Demand)									
Xiazhen Area	Yihong	III	20	34.3	-	46.0	-	26.0	-
	Yongfeng	III	20	322.7	-	39.0	-	22.0	-
Daluhu Area	Zhimai	III	20	24.7	23.2	-	23.2	22.5	21.8
	Dalu lake	II	<15	25.0	22.6	-	20.6	19.5	19.0
BOD (Biochemical Oxygen Demand)									
Xiazhen Area	Yihong	III	4	4.2	-	14		6	-
	Yongfeng	III	4	9.3	-	10		4	-
Daluhu Area	Zhimai	III	4	2.2	3.7	-	2.8	2.4	2.3
	Dalu lake	II	3	2.8	3.0	-	2.5	2.3	2.2

Sources: Dongyingshi Cooperative Development Limited Liability Company and Yellow River Agriculture Development Corporation, Zibo City

This is probably due to the influence of domestic/industrial wastewater unrelated to the project contained in the drainage at the monitoring points in the Xiazhen area. However, with the construction of a sewage disposal plant in 2009, measures are being taken to some extent at present. In the Daluhu area, domestic wastewater was detected at the monitoring points. Therefore, it is difficult to confirm how much the drainage from agricultural production is influencing the water quality. Nevertheless, there must have been some improvement with the construction of a drainage facility worth 120 million Yuna by the county government in 2009.

According to each project implementing company and corporation, measures taken by them have been effective against the initially-anticipated issues such as the conservation of bird habitats, with no major environmental problems arising.

(3) Land Acquisition and Resettlement

The implementation of the project has not entailed any resettlement of residents or land acquisition.

As above, this project has made many impacts including the increase in farmers' household income, effective production through the organization of farmers, and regional development. Therefore, the project is considered to have been highly effective.

[19] The water area functions are classified into five categories in accordance with the purposes of use and protection for surface water areas.

3.5 Sustainability (Rating: ③)

3.5.1 Structural Aspects of Operation and Maintenance

(1) Agencies Responsible for Implementation

Basically, government agencies took charge of the operation and maintenance of this project, and beneficiary farmers were scarcely involved. The implementing agencies were "Dongyingshi Cooperative Development Limited Liability Company (Xiazhen area)" and "Yellow River Agriculture Development Corporation, Zibo City (Daluhu area)," both of which derive from the agricultural development departments of the county governments of the respective areas. Each company and corporation was responsible for supervising the overall project in the project area, as well as managing the main facilities. In addition, the company and corporation took charge of the coordination and supervision of personnel engaged in the operation and maintenance of the project. There have been no major changes in the organizational structure and role allocation of each company and corporation since the start of the project, nor will there be any likelihood of such changes in the future.

1) Xiazhen Area

During the project period, "Yellow River Delta Xiazhen Agriculture Comprehensive Development Group Corporation, Dongying" was renamed "Dongyingshi Cooperative Development Limited Liability Company." The company was in charge of the project as an implementing agency during the project and has continued to be in charge even after the end of the project. The operation and maintenance duties of the facilities have been shared as follows:

Table 14 Sharing of Operation and Maintenance Duties of Irrigation Facilities in the Xiazhen Area

Facility, Management Level, Content	Responsible Agencies	Content of Responsible Duties
Water Intake Facilities	County Yellow River Authority	Water resource management
Water Supply, Water Supply Planning	County water resources bureaus and the company	Formulation of water intake plans as necessary
Facility Management: County Level	Water system-based irrigation management offices and the company	Water supply, facilities maintenance, and water fee management
Facility Management: Management of Terminal Facilities at Township and Town Level[20]	Town irrigation stations	Water supply, equipment maintenance, and water fee collection
Facility Management: Village Level	Villager committees and unions	Adjustment of water supply for farmers

Source: Created based on the information provided by Dongyingshi Cooperative Development Limited Liability Company, the Kenli County Irrigation Management Office, and villager committees.

2) Daluhu Area

The "Yellow River Agriculture Development Corporation, Zibo City" was in charge during the project period and has continued to take responsibility even after the end of the project. According to the related institutions and organizations, the facility management duties are allocated as follows, and the role of this corporation is to coordinate and monitor the business of these related organizations.

[20] In general, Chinese administrative divisions have a three-tiered structure, with provinces, cities/counties, and townships/towns. Townships/towns are the smallest administrative divisions.

Table 15 Sharing of Operation and Maintenance Duties of Irrigation Facilities in the Daluhu Area

Facility, Management Level, Content	Responsible Agencies	Content of Responsible Duties
Water Intake Facilities	County Yellow River Authority	Prevention of flood and thaw damage and supervision by water supply laws, water supply in the Yellow River, management of civil engineering works
Water Supply, Water Supply Planning	County water resources bureaus	Formulation of water supply plans, water supply management, supervision of county-level water resource-related works
Facility Management: County Level	County water system-based irrigation management offices	Operation and maintenance of facilities, management of water fees
Facility Management: Management of Terminal Facilities at Township and Town Level	Township/town irrigation stations	Collection of water fees, operation and management of facilities, cooperation with upper organizations and villages, collection of water fees
Facility Management: Village Level	Villager committees	Coordination among village farmers

Source: Created based on the information provided by the "Yellow River Agriculture Development Corporation, Zibo City" and village committees

(2) Farmers' participation in operation, maintenance and management

With regard to the organization of farmers for the management of irrigation canals, the existing village committees have been in charge of coordination and management among the users of terminal irrigation canals under their organization structures. Interviews with the members of the village committees and the end users of the facilities have revealed that the facilities are functioning smoothly and without problems. Although it was the county water resources bureau that formulated water supply plans, the village committees were supposed to listen to the villagers' needs such as the volume and timing of water supply and report to the upper authorities.

In the reforms of agricultural support policies since 2004, measures have been taken to alleviate the burden on farmers through totally abolishing agricultural taxes and so on. This has also influenced the water fees for the irrigation facilities of this project, and the burden on farmers has been minimized.

The participation of the irrigation facility users - the beneficiaries of the project - in the maintenance and management duties of the facilities have been limited to the minimum tasks such as cleaning of the irrigation canals within their own land. This is because the institutional labor burdens on farmers were abolished after the agricultural reform in 2004, and as a result, the amount of labor assigned to the farmers has been drastically reduced. According to the

beneficiary survey, the payment rate of the water resources fees and the participation rate in the sludge disposal operations for the terminal irrigation canals were both 100%. The participation rate in committee meetings was 85% in the Xiazhen area and 60% in the Daluhu area. The users have largely abided by the water supply plans, causing no major problems. In the beneficiary survey, 50% each of the respondents were either “very satisfied” or “satisfied” with the utilization of the irrigation facilities. Therefore, the degree of satisfaction has been considerably high.

3.5.2 Technical Aspects of Operation and Maintenance

In both areas, there have been no incidents of technical problems in operation and maintenance. This is probably due to the effects of the technology transfer since the start of the project and the mechanisms to establish technologies (technical inspection and utilization of manuals and registries).

Each implementing company and corporation boasts years of experience in operation and management of irrigation facilities, having teams of technical experts. Training sessions regarding new technology and knowledge are held once every year for administration staff. Since each company and corporation has had hardly any personnel reshuffles since the project period, the effects of the technical transfers such as the maintenance and management of water resources facilities, inspection regulations, and safety control have become entrenched.

The irrigation stations in townships and towns are engaged in operation and maintenance duties under the tutelage of the county water resources bureau and the governments of their respective townships or town. Their personnel undergo an annual operation training and technical qualification examination in order to maintain the level of expertise necessary for water resources management.

Moreover, there is a compiled list of manuals and registries for the operation, maintenance and management of each facility, which is being used for monitoring the activities.

The farmers utilizing the irrigation facilities have expressed a high degree of satisfaction over the operating status of the irrigation facilities and the services provided by the responsible institutions and organizations. This is because the maintenance of the facilities has been conducted properly, and water supply has been guaranteed when it is necessary. Furthermore, the fact that the county water resources bureau has been formulating water supply plans taking into account the water demand of each village has also contributed to the satisfaction of the users.

The results of the interview survey concerning the degree of satisfaction of the beneficiary farmers over the facility operation are as follows:

Table 16 Evaluation of Facility Operation by Beneficiary Farmers

	Xiazhen Area	Daluhu Area
Evaluation of Operation Status of Irrigation Facilities		
Very Satisfied	80%	20%
Satisfied	20%	80%
Evaluation of Services by Villager Committees (village-level organizations responsible for facility operation)		
Very Satisfied	26%	26%
Satisfied	64%	74%
Evaluation of Services by Company or Corporation		
Very Satisfied	86%	52%
Satisfied	14%	48%

Source: Created based on the results of the beneficiary survey

3.5.3 Financial Aspects of Operation and Maintenance

With regard to the financial resources for the operation and maintenance of the project, the initial assumption at the planning stage was that the project would be managed in an independent manner on the basis of the water fees and the services provided by each company and corporation. However, at the time of the ex-post evaluation, it was the financial assistance by the government that formed the basis of the financial resources, with sufficient revenues guaranteed in the form of the budgets of the county and township/town governments, as well as the water fees collected in the urban areas. The water fee levied on the users of the irrigation facilities was 10 Yuna per person annually, which was significantly smaller than the initially-expected amount (2,410 Yuna/household annually in the Xiazhen area; 1,000 Yuna/household annually in the Daluhu area)[21]. This is attributable to the Central Government's policy since 2004, which was to drastically reduce the burdens on farmers, such as through the abolition of agricultural taxes by means of the reform of agriculture support policy. At the beginning of the project, each company and corporation had been collecting water fees as a responsible entity, but after this reform, the irrigation management office under the jurisdiction of the county government took over the responsibility.

In the case of the Xiazhen area, the county irrigation management office is in charge of collecting the water fees from the users of industrial and industrial and domestic water outside of the project locations. These revenues guarantee the financial resources for maintaining and managing the facilities in the project locations, and the company or corporation as the implementing entities are receiving their operating funds from these resources. The irrigation

[21] Prior to the project, it had been 320 Yuan/household annually in the Xiazhen area and 138 Yuan / household annually in the Daluhu area.

stations in the townships/town are under the jurisdiction of the township/town governments, and their operating funds are secured in the financial resources of the township/town governments.

In the Daluhu area, the water fees collected by the county irrigation management office and the general budget of the county government have been complementing the operating funds of the project. Meanwhile, the irrigation stations have been operated on the budgets of the township/town governments.

As for the future prospects, since the National People's Congress convened in March 2011 stressed the importance of continuing and reinforcing agriculture-related assistance programs, it is highly likely that the government will subsidize the operation and management of this project.

3.5.4 Current Status of Operation and Maintenance

On conducting a macroscopic observation of the status of the major facilities along with the agriculture experts in this on-site inspection, it has been confirmed that there to be no particular problem with the condition of the facilities.

Fig.10 Water Canal in Xiazhen Area

Fig. 11 Water Reservoir in Daluhu Area

As described above, no major problems have been observed in the operation and maintenance system, therefore sustainability of the project effect is high.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

The objective of this project was to make effective use of water resources and stabilize the production of agricultural produce by constructing agricultural infrastructures such as irrigation facilities and cultivated farmlands in the Yellow River Delta Region in Shandong Province, thereby contributing to the improvement of farmers' earnings.

The development of agriculture and rural communities is a priority area in China. Shandong Province occupies a prominent place in this regard with the third largest cultivated area and the second largest production of food in the country. However, the province has only limited water resources. Accordingly, the national and provincial governments are focusing on policies to promote effective utilization of water resources for agriculture and infrastructure development for that purpose. Therefore, this project has been highly relevant. Since all the outputs of this project have been implemented according to the plan in terms of both expenditure and period, the project has been highly efficient. With regard to the effects of this project, the agricultural profits have increased both throughout the project and in terms of household income. This is attributable to factors such as the enlargement of cultivated area, improvement of productivity, and transition to high value-added crops. Meanwhile, it was expected initially that the introduction of double cropping by irrigation would lead to an increase in the production of agricultural produce. However, due to the changes in the cropping pattern such as the expansion of more profitable cotton single copping, the gross production amount has not reached the planned value. Nevertheless, there have been no problems in the effective utilization of water resources, and thus the project can be regarded as highly effective. From the perspective of structure and technology, the operation and maintenance of the irrigation facilities have been executed properly in coordination and support of the project implementing entities and related organizations. With regard to the financial aspect, on account of the Chinese Government's policy of giving priority to agricultural affairs, the burden on the users of the irrigation facilities has been alleviated, and the financial resources have been secured in the government. In this context, there have been no problems in the operation, maintenance and expansion of the project and its effects. Therefore, the sustainability of the project has been high.

Consequently, this project is evaluated to be highly satisfactory.

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

In the Xiazhen area, it is expected that with the progress of soil improvement, the soil there will eventually become unsuitable for cotton cultivation. Currently, cotton cultivation accounts for 70% of the arable land, and thus it will be necessary to drastically change the cultivated crops in the future. Therefore, it will be important to revise the support policy for farmers as necessary and take measures such as providing excellent seeds of the crops recommended by the county government, so that the interests of the farmers are not compromised significantly.

4.2.2 Recommendations to JICA

None in particular

4.3 Lessons Learned

(1) Establishment of Project Operation and Maintenance Methodology

This project has been completed within the expenditure and period anticipated in the plan. The factors in this smooth implementation of the project are the establishment of management methodology for related organizations and the support system to make it function.

With regard to the project management such as procurement during the project period, the Shandong Water Management Agency has taken the initiative in establishing the management methodology peculiar to the project and notifying the executing agencies of that through the use of manuals and document formats, thereby contributing significantly to making the project operations effective. The reasons for this success lie in not only such thorough implementation of management, but also good communication among the concerned personnel from the JICA office, project offices, and executing agencies in each area. In addition, the establishment of the support and monitoring system to ensure that measures are always taken to prevent problems from occurring or spreading has also come into play. That said, this successful example should serve as a future reference.

(2) Formulation of Water Supply Schedules Based on Accurate Understanding of Needs on the Spot

In the usage management of irrigation facilities, disputes and dissatisfactions can arise among the facility users partly because the water supply is disproportionate to the water demand. In this project, however, the needs of the users are correctly grasped and that understanding is reflected in the water supply schedules, thereby resulting in an extremely high degree of satisfaction among the users. For the effective utilization of water resources, the villager committees and irrigation stations have been holding activities to listen to the demands of farmers in the project locations, so that the county's irrigation management office can formulate and comply with water supply schedules that accurately reflect needs on the ground. In general, when

implementing irrigation projects, coordinating interests of relevant parties is important in securing sustainability. By carrying out such interest adjustment frequently, and through some intervention by government authorities, appropriate management can be realized. Since it takes some time to realize independent operation and management by the users, entities such as government agencies should carry out a moderate level of intervention in securing sustainability. It is important for these agencies to arrange an environment conducive to effective management, while ensuring the continuous manifestation of the project effects.

(3) Clear Division of Operation and Maintenance Responsibilities and Pertinent Monitoring

Different organizations assume different responsibilities ranging from the water intake from the Yellow River to the maintenance of terminal water canals at township/town and village levels. In this project, the responsibilities of each organization have been clarified, and each company and corporation has monitored their performance as an implementing entity. Furthermore, all the relevant organizations have provided training with their staff, and the scarcity of personnel reshuffles has led to the consistency of skill/ability levels. These factors have contributed to the smooth implementation of operation and maintenance. In order to thoroughly maintain this kind of clear division of responsibilities and skill levels, it is important to design the structure and mechanism accordingly from the planning stage of a project, and continue paying attention to implementation during the project.

End

Comparison of the Original and Actual Scope of the Project

Item	Original	Actual
1. Project Outputs		
Xiazhen area		
Reservoirs	2 expansions, 1 new construction	1 repaired
Pump facilities	1 expansions, 14 repairs, 10 new constructions	As planned
Main irrigation canals	5 repairs, 81.93km	5 repaired, 100.53km
Secondary irrigation canals	111.9km	As planned
Transmission facilities	4 facilities, 185 km transmission line	As planned
Main drainage canals	5 canals, 155.3km	As planned
Secondary drainage canals	35 canals, 102.3km	As planned
Farmland consolidation	24,000 ha	As planned
Embankments		Second period construction, 30.2km
Other civil engineering works	13,010 ha	As planned
Construction machinery	32 types, 364 machines	As planned
Farming equipment	1,464 self-propelled machines, 1,285 accessories	As planned
Daluhu area		
Main irrigation canals	9 repairs	0 repaired, 1.2km newly constructed
Maintenance of irrigation wells	2,620 wells	As planned
Transmission facilities	6 facilities, 452 km transmission line	5 facilities
Secondary drainage canals	2 canals	As planned
Farmland consolidation	10,000 ha	As planned
Other civil engineering works	2,470 ha	As planned
Construction machinery	8 types, 56 machines	As planned
Farming equipment	95 self-propelled machines, 1,175 accessories	129 elf-propelled machines, 2,942 accessories
2. Period	January 2000 – December 2006 (60 months)	January 2000 – December 2006 (84 months)
3. Project Expenses		
Foreign currency	10,126 million yen	8,882 million yen
Domestic currency	9,536 million yen (635 million Yuna)	10,315 million yen (727.8 million Yuan)
Total	19,663 million yen	19,197 million yen
Yen loan	10,126 million yen	8,882 million yen
Exchange rate	1 Yuan = 15 yen (As of November, 1999)	1 Yuan = 14.1 yen (Average between March 2000 and December 2006)

China

Ex-Post Evaluation of Japanese ODA Loan Project

The Afforestation Project for Conservation of Middle Stream of Huanghe in the People's Republic of China (Phase II)

External Evaluator: Yuko Kishino, IC Net Limited

0. Summary

As part of the China's national afforestation plan that has as its aim increasing forest cover rate, this project was implemented as a tree planting model for the creation of shelter belts on the Loess Plateau with its desolate denuded land and unfavorable site location. Carefully considering local conditions, a basic design was drafted, and based on this work it was rigorously implemented, and this led to high survival rates[1]. Incorporating farmers from the planning phase and using the soft component and ensuring training of dissemination officials and farmers also contributed synergistically to the success of the project. The afforested area created successfully in this project was highly evaluated, which led to the raising of Shanxi unit planting value[2] and other improvements in policy as well as to the progress in afforestation over the entire area. Hereinafter in order to be maintained as a highly successful afforested area and to be used as a model for afforestation in the Loess Plateau entire region, it will be important to ensure appropriate forest nurturing and protection based on the state of tree growth.

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

1. Project Description

Project Locations

Daning (left) & Jixian (right) afforestation area

[1] Indicator representing the results (success) of afforestation efforts. Survival rate = no. of seedlings/number planted x 100

[2] The unit cost for planting 1 mu* , including costs related to capital wages and salaries, procurement of nursery stock, shipping, water supply, etc. *1 mu =0.0667 hectares

1.1 Background

Excess land clearing for food production and tree-clearing for timber production resulted in the reduction of forested areas to 13.9% of the Chinese national land area[3]. The water-retention function of forests had been lost and sediment runoff had increased. The Huanghe[4] and Yangtze basin areas had particularly high rates. In the Loess Plateau that extends through the Huanghe area, where easy to erode fine yellow sand grains piled high, heavy runoff occurred in the rainy season. At the time of the project planning, sediment production went from 5,700 tons/year to 9,400 tons/year per km^2 [5] and problems such as drought, flooding and reduced land productivity were apparent.

The Chinese government designated the forests of the Huanghe as the focus area for land and water maintenance and growth protection measures as well as measures to prevent landslides. Japan cooperated with China through Japan International Cooperation Agency (JICA)'s technical cooperation in terms of the "Loess Plateau afforestation training program project" (1990 to 1995) was and the "After-care cooperative program" (1999 to 2001) with a view to developing sediment runoff prevention techniques. The 1998 Yellow River flood disaster also gave impetus to Japan-China cooperation in terms of forest conservation and nurturing.

Amid such circumstances, the Chinese government requested from the Japanese government grant aid for efforts to improve the forest coverage rate in the Shanxi Xinshuihe basin area[6] (Midstream Huanghe).

1.2 Project Outline

The objective of this project is creating a model for dissemination of planting techniques and training of Shanxi Forestry department dissemination staff, thereby improving Shanxi Xinshuihe basin area (Jixian, Daning, Puxian and Xixian) forest coverage rate.

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[3] China's State Forestry Agency: The 4th forestry resources survey. (1989-1993)

[4] The source of the Huanghe is in Qinhai province and it flows into the Bohai bay and its total length is 5,464 km. The Huanghe river basin comprises Shanxi, Shaanxi, Henan, Gansu provinces and Ningxia, Neimenggu, with a total area of 750,000 km^2

[5] Shanxi Province Forestry Agency Shanxi Province Loess Plateau Xinshuihe Construction forest project (2001) p.2 It is said the Japanese yearly mountain area soil production volume per 1 km^2 is 250 tons. JICA's China Huanghe Loess Plateau conservation techniques training plan preliminary report (1988) p. 7

[6] Huanghe tributary is located at the southern end of Shanxi and Shaanxi; and this area strides Jixian, Daning, Puxian, and Xixian counties. It is said to be the area with the highest sediment runoff.

Grant Limit/ Actual Grant Amount	1,712 million yen (179 million yen, 519 million yen, 427 million yen, 369 million yen, 218 million yen)/ 1,649 million yen (176 million yen, 495 million yen, 412 million yen, 348 million yen, 218 million yen)
Exchange of Notes Date/ (Grant Agreement Signing Date)	1st term: March 2003, 2nd term: August 2003, 3rd term: July 2004, 4th term: June 2005, 5th term: June 2006
Implementing Agency	Shanxi Forestry Department
Project Completion Date	November 2007
Main Contractor	Techno Forest Co., Ltd./Oji Forest an Products Co., Ltd. Joint-venture 1st term); Ogawa Seiki Co., Ltd./ Fujigisou/ Taiki Co., Ltd. joint-venture (2nd term); Huanghe Afforestation joint-venture (Oji Forest and Products/Techno Forest Co. Ltd.) (3rd term); Ogawa Seiki Co., Ltd./OISCA joint-venture (4th and 5th terms)
Main Consultants	Japan Overseas Forestry Consultants/ Japan Forestry Engineering Consultants joint-venture
Basic Design	October/2001 - March 2002; May 2002 - January 2003
Related Projects	“The Loess Plateau Afforestation Techniques Training Project” “The Loess Plateau Afforestation Techniques Training Project Aftercare” “The Promotion of the Dissemination of New Technology for the Loess Plateau Forest in China Project” (All the three above: technical cooperation projects) “Loess Plateau Afforestation techniques promotion/dissemination project” (In-country training) “Shanxi afforestation project” (Yen loan)

	"Project for Afforestation for Conservation of Up and Middle Streams of Huang He in the Nignxia Hui Autonomous Region (Huanghe Middle Stream Shelter Belt Creation Plan)" (Grant aid) Others[7]

2. Outline of the Evaluation Study

2.1 External Evaluator

Yuko Kishino, IC Net Limited

2.2 Duration of Evaluation Study

The evaluation for this project is as follows:

Duration of the Study: November 2010 to October 2011

Duration of the Field Study: April 13, 2011 to April 30, 2011, June 6, 2011 to June 8, 2011

2.3 Constraints during the Evaluation Study

None

Fig. 1 Huanghe river, main stem (Jixian)

Fig. 2 Model stand based on JICA technical cooperation

[7] "Forest resources development protection plan", "poverty area forestry development plan" (these two with World Bank), "Northern Shanxi Construction Forest project" (with German KfW Bankengruppe)

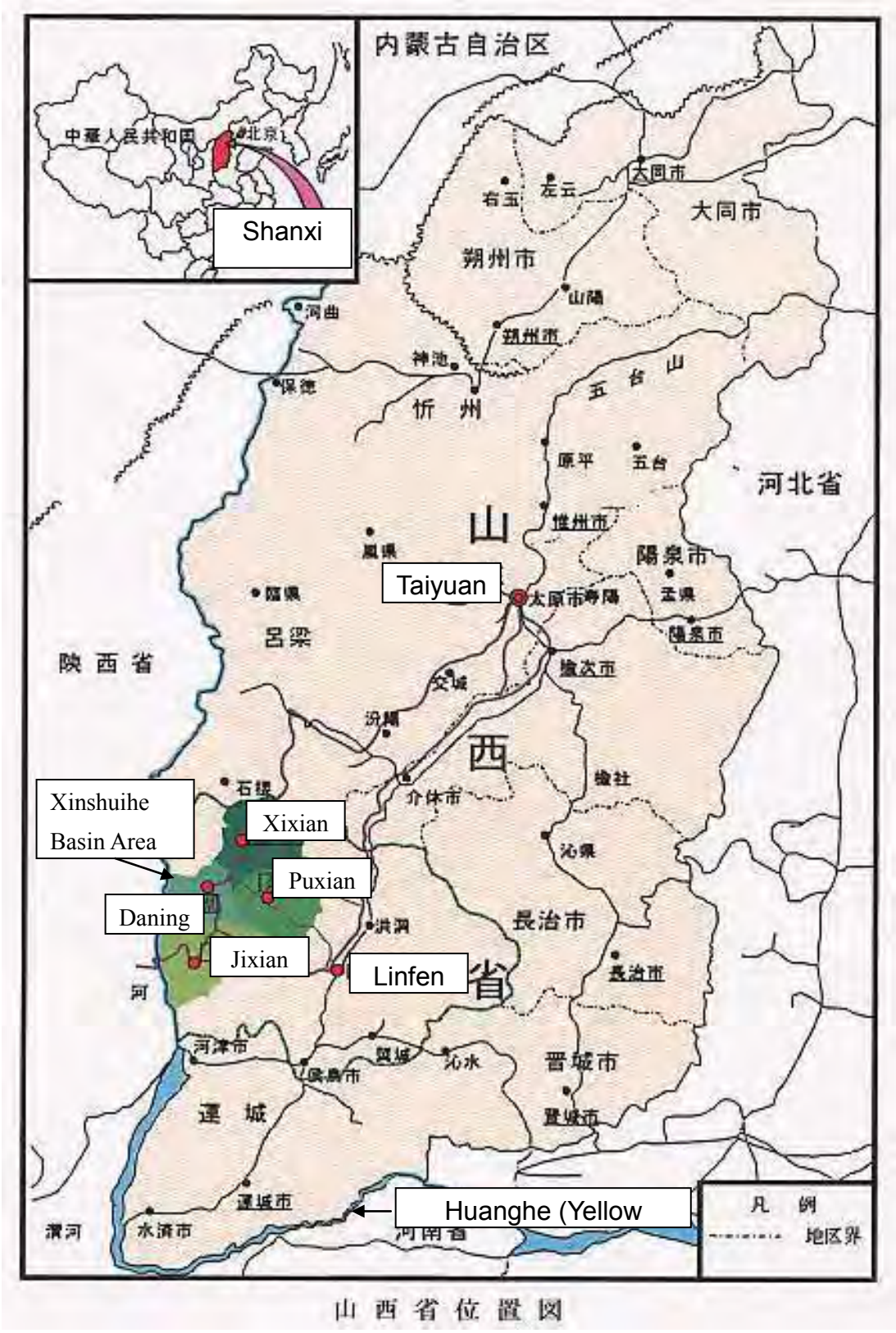

Figure 3 Project Implementation Site

3. Results of the Evaluation (Overall Rating: A[8])

3.1 Relevance (Rating: ③[9])

3.1.1 Relevance with the Development Plan of China

(1) Development policies at the planning stage.

In 1998, as part of the "National Ecological Environment Establishment Plan 1998-2050", the Chinese government designated the Huanghe river basin area as a critical area for sediment runoff, and promoted projects for the protection and nurturing of stands to improve forest cover. In Shanxi, this was a starting point, and the "Shanxi ecological environment plan" was implemented and a target of forest cover increase from 11.7% in 1998 to 45% in 2050 was set. To realize this goal, three of the six priority large-scale forestry projects,[10] namely the "Natural forest conservation"[11], "Three North Area and Yangtze river basin area forest reserve system construction"[12], and "Conversion of cultivation land to forest cover land"[13], were implemented, and international funds such as World Bank and German KfW Bankengruppen funds were proactively used to this end.

(2) Development policies at ex-post evaluation

In Shanxi province, the 11th 5-year plan (2006-2010) set out the "Green Shanxi" motto, and six large-scale projects such as roadside greening and afforestation of desolate mountain areas were implemented. The 12th 5-year plan (2011-2015) called for continuing afforestation efforts, and set targets of 3.77 million hectares by 2015, and 4.33 million hectares by 2020. In 2010, "Shanxi forestry development plan" replaced the "Shanxi ecological environment construction plan" and was implemented, and the targets of 23% forest coverage by 2015, and 26% by 2020 were set.

This project, like the afforestation plans with aims of forest cover rate improvements such as that mentioned above, was carried out as a model for conservation forest[14] along the Loess Plateau Xinshuihe area (with its severe environmental conditions), and relevance was designated as "high" at both the planning and ex post-facto evaluation stages.

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

[9] ③:High,②:Fair, ①:Low

[10] "Natural forest conservation", "Three North area and Yangtze river basin area reserve forest system construction", "Conversion of cultivation land to forest cover land", "Peking/Tianjin wind-blown sand control", "Wildlife protection and nature conservation area construction", "Priority area fast-growing high-yield timber production base construction".

[11] Regulate clipping of trees in natural forest for conservation purposes.

[12] Conservation forests constructed in Northeast, Huabei, and Xibei areas

[13] Stop farming inclined land areas and plant trees instead.

[14] Planting for this project in the target area was in land characterized by unfavorable afforestation conditions of thick Loess soil on inclined land, while the yen loan project "Shanxi afforestation project" (2001～2005) was directed to lands with relatively favorable afforestation conditions, though natural environment had deteriorated.

3.1.2 Relevance with the Development Needs of China

3.1.2.1 Relevance with needs

The Loess Plateau is a mountainous area characterized by high soil runoff and croplands and forested areas received significant damage due to erosion. The Xinshuihe area is characterized by the typical Loess plateau landform, and so soil runoff was at its worst here.

As mentioned before, after 1990, cooperation on afforestation techniques research and verification of planting techniques as well as the setting of afforestation standards took place. However, general planting operations did not achieve stand establishment in most cases due to lack of a plan or inadequate compliance. As the planting activities proceeded in the Loess Plateau, operation on land that is in good condition decreased, and planting in bad weather and denuded land conditions became necessary.[15]

In conditions such as those described above, there was a need for cooperation in terms of grant aid, and introduction of Japanese supervision of works methods in order to promote the success of planting initiatives and for such a model to be effectively disseminated.

3.1.2.2 Relevance of the plan

This project's aims are to promote farmers' afforestation activities, and a soft component of a scale and with content that are comparable to those of a technical cooperation was implemented. According to the soft component guideline (April 2004), involvement of Japanese consultants must be kept to a minimum in principle, to ensure the smooth start-up of the counterpart country's project and at least the minimal level of sustainability of cooperation effects. Even though there was a considerably greater involvement of Japanese consultants in this project than generally envisaged in the Guideline, it is commendable that that the project was planned, with out-of-the-box thinking, as an afforestation project integrated with technical support and achieved the intended synergistic effects.

One of the background factors is that the government started encouraging farmers and other individuals to engage in planting initiatives in 1998. As the government forestry sector had been directly involved in afforestation work up until then, the government had only limited experience of disseminating highly effective planting techniques to outside. There was however crucial need to disseminate planting techniques among farmers. To respond to this need, 1) dissemination agents were trained 2) farmers were trained, 3) tree planting apprenticeships established[16], 4) exhibitions of planting techniques were held, and 5) organizing of awareness seminars were all incorporated in the project plan. The result of the training program implementation is that planting programs developed in the correct order and this led to high survival rates. In addition, the result of farmers experiencing planting first hand was that they acquired planting techniques first hand, as well as the incentive to do so, and it can be said

[15] The area of denuded land exceeded 7.33 million hectares, accounting for about 20% of the total area.

[16] At the planning stage Japan side intended this apprenticeship program to be, in some sense, a way to reduce the project cost, but in actual fact, it contributed to enhance project effect.

that this project has succeeded in serving as a model to encourage afforestation activities by farmers.

3.1.3 Relevance with Japan's ODA Policy

In the "Economic Cooperation Program for China" (formulated in 2011) that represents a Country Assistance Program for China, "cooperation towards resolving environmental and other global issues" is listed as the number one priority area for economic cooperation, and the importance of afforestation and forest conservation, including the issue of the adverse effects on Japan of airborne sand particles, and cooperation on these areas are emphasized.

Afforestation activities from the year 2000 such as soil runoff prevention forest reserves construction were implemented in terms of funds of the Japan-China Greening Exchange Fund[17]. A total of 57.32 million yen has already been invested in Shanxi, and three projects are presently in the implementation phase[18]. Completion of the afforestation of 476 ha is foreseen for the year 2013.

As described above, this project has been highly relevant with the country's development plan, development needs, as well as Japan's ODA policy and afforestation activities; therefore its relevance is high.

3.2 Efficiency (Rating: ③)

3.2.1 Project Outputs

The outputs of this project have been realized mostly according to plan. Japanese output planning and results are outlined in Table 1. Because drawings were carefully made at the time of survey for basic design, there were no major changes at the detailed design stage, and each area showed only marginal increases or decreases in planting land area[19]. The change that was significant was for the "management simplification technical demonstration stand"[20], one of the programs in the "soft component". Surface area was decreased from 5 ha to 1.1 ha, and in the 4th term of the project, it was discontinued completely. This was a good decision because of the difficulty of seed germination due to dryness caused by low precipitation and due to weeds thriving due to simplified operations, which rendered growth difficult. As for Chinese outputs, construction and maintenance of access roads and conservation staff stations, training of such staff, dissemination activities, and nurturing after the effective term were all implemented effectively.

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[17] This Fund was set out when now deceased Prime Minister Obuchi visited China in 1999. Triggered by the 1998 great floods, the Fund grants aid to project for shelter forest creation and afforestation for, wildlife protection and desertification prevention.

[18] (i) The "Wutaishan greening project" designed to protect world heritage sites, (ii) "PRC Loess Plateau vegetation restoration Shanxi model forest construction project", (iii) "PRC Loess Plateau Shanxi desertification and land/water preparation model project" for dam conservation

[19] In Xi County, the planting land area is smaller than planned, because as a result of the torrential rains in the third year, shrubs grew in the originally treeless land and the need for planting disappeared. In exchange, the planted land area in Jixian was increased in view of the conditions there.

[20] Simple greening through direct-seeding method tried in the 2/5 term

Fig. 4 Thuja orientalis Planted in 2006 (Jixian)

Fig. 5 Mixed stand of Robinia pseudoacacia and Thuja orientalis (Daning)

Fig. 6 Forest road (Daning)

Fig. 7 Peach showcase grove (Jixian)

Table 1 Japanese outputs

Item	Details	Plan	Actual results
Construction of model afforestation	Planting surface area total	4,828.6 ha	4,827.8 ha
	(1) Jixian Tunli	1,104.3ha	1,196 ha no. planted 1.5 million
	(2) Puxian Jiejiahe	1,238.2ha	1,210.6 ha no. planted 1.5 million
	(3) Xixian Huangtu	1,344.2ha	1,196 ha no. planted 1.43 million
	(4) Daning Sandu	1,141.9ha	1,196 ha no. planted 1.37 million
Facilities construction	1) Civil construction		
	(1) woodland path new construction	79.5km	78.8km
	(2) small check dams	21 spots	21 spots
	(3) weather/soil measurement station/ observat	1 spot	1 spot
	2) Building construction		
	(1) lookout tower	8	8
	(2) conservation staff station	4	4
	(3) project introduction board	8	8
Equipment procurement	1)Maintenance management equipment	1 system	1 system (no change)
	2)Equipment for outreach	1 system	1 system (no change)
Soft component	1)training of outreach officials in the forestry department	2,420 people	2,501 people
	2)training of Daningxian agricultural workers	900 people	1,050 people
	3)Training students	400 people	567 people
	4)Practical training of Daningxian farmers in planting	900 people	900 people
	5)Exhibition of various tree varieties/products or techniques		
	Showcase forest (4 provinces, 4 areas)	28ha	28.2ha
	management simplification technical demonstration stand (Daningxian)	5ha	1.1ha
	6) Educational seminar	4 times	4 times

3.2.2 Project Inputs

3.2.2.1 Project Cost

This E/N budget limit of this project was 1,712 million yen, the Chinese contribution was 73 million yen and the total project cost was 1,785 million yen. The actual costs were 1,718 million yen, with the Japanese share being 1,649 million yen, and the Chinese share being 69 million yen, so the project was done within budget for both sides. Because it was divided into 5 terms, procurement of materials was carried out with attention to exchange rate movements and this was a big factor in staying within the budget. However, decreases in efficiency were seen as the construction consultants responsibilities increased with the revision of contracts related to execution deadline extensions etc., as term bidding fees accumulated each term, as construction workers turnover was high, and as nurturing, planting, support planting, land leveling operations for a particular stand proved ineffective.

Table 2 Project planned costs and actual costs

	Planned	Actual	Difference with plannned
Total amount	1,785 million yen	1,718 million	96%
Japanese portion	1,712 million yen	1,649 million	96%
Of which, soft component	325 million yen	293 million yen	90%
Chinese portion	73 million yen	69 million yen	95%

As described below, compared to similar projects, this project is considered to have been efficient in terms of cost-effectiveness.

The costs per one ha including construction consultant costs, soft component costs, facilities/equipment procurement costs is 350,000 yen, and aid assistance was comparable to the 390,000 yen (at the time of basic design) of the "Project for Afforestation for Conservation of Up and Middle Streams of Huang He in the Ningxia Hui Autonomous Region" (2001-2003). At a planting cost of approx. US$1,000 / ha, it is comparable to the $1,088/ha of the World Bank loan project "Forest resource development and protection project" (the 5th starting in 2010), and compared to the US$700 /ha of the yen loan project "Shanxi afforestation project", it is higher by 40%.

As will be mentioned in the section on effectiveness, forest results such as the survival rate and conservation rate are influenced by whether or not necessary amount of investment was made. In order to ensure good planting in semi-arid areas such as Loess Plateau, an amount such as that above would be necessary.

3.2.2.2 Project Period

In the basic design survey, the optimum project period was deemed approximately 60 months. The actual length was 57 months (95% of the plan), from March 2003 (E/N date) to November 2007. The project period of each term is outlined below, and for each the actual period was shorter.

Table 3 Project period of each term

	E/N	Project period (planned)	Completed (actual)	Project period (actual)
1st term	March-2003	13 months	March-2004	12 months
2nd term	August-2003	21 months	December-2004	17 months
3rd term	July-2004	21 months	November-2005	17 months
4th term	June-2005	21 months	November-2006	18 months
5th term	June-2006	21 months	November-2007	18 months

As described above, both project cost and project period were within the plan, and therefore efficiency of the project is high.

3.3 Effectiveness (Rating: ③)

3.3.1 Quantitative Effects

3.3.1.1 Results from Operation and Effect Indicators

(1) Forest cover rate improvement

Out of the 8,385.9 ha in 4 counties, four areas, 71.3% was denuded land, and only 8.3% or 697.8 ha was forest cover. At the time of evaluation, forest cover was 66.4%, almost reaching the target value of 66.8%. The reason for this slight dip below the target value was the below average results of the management simplification technical demonstration stand in Daning where the growing stage was not reached, and the survival rate of showcase stands except for Jixian falling below 80% of the target.

Table 4 Forest cover rate for areas covered by projects

(units: ha)

Project area	Before project implementation (2002)		At the time of evaluation (2011)	
	Forest	Forest cover	Forest	Forest cover
8,386	697.8	8.3%	5,572	66.4%

Sources: Prepared by the external evaluator, based on the basic design survey report, JICA documents, and information submitted by the Shanxi forestry department

Note 1: Forest cover rate=forest area/land area x 100

Note 2: The forest area after the implementation of the project includes the dimensions of the planted stands, the road next to the planted stands, the showcase stands, etc.

In terms of the success of planted stands, the main indicator, survival rate was 95%, well above the target rate of 85%. It was relatively high compared to the 2006 "Conversion of cultivation land to forest cover land project" survival rate of 85%[21] and the "Shanxi afforestation project" (yen loan project) survival rate of 85%[22]. Even Daning techniques dissemination model stand showed a remarkable 98% survival rate, higher than the 3 other counties' average.

The reason for the high survival rate can be summarized in 3 points: 1) The fact that such a thorough China/Japan plan was drawn up was due to past technical cooperation and proven conservation/afforestation techniques with planting methods appropriate to denuded land 2) at the implementation phase, the business units were adequately set and the necessary funds invested, 3) operations on site were according to plan and specifications/standards. The construction consultant in Daning advised the farmers directly as part of a practical training program, and the program was highly evaluated for following the correct procedures and being logical.

[21] Shanxi Publishing Organization/Shanxi Scientific Publisher "Process Afforestation theory and practice", (2007) p. 340

[22] Shanxi Province Forestry Department

(2) The growth conditions for tree varieties

To effectively grasp the actual growth of the type of trees planted, to the extent possible in the four target counties, sample surveys of tree height and survival rate were carried out. As shown in Table 5, the growth of each type of tree used was favorable. The average values calculations for the 4 provinces were as follows: Aburamatsu (Pinus tabulaeformis Carr.) at seedling height 14cm were 178 cm (5th year seedlings/ planted 2006), 189 cm (6th year seedlings/ planted 2005), and 202 cm (7th year seedlings/planted 2004); oriental arbor vitae were each 189 cm, 202 cm, 284 cm, and Robinia pseudocacia were 390 cm (5^{th} year seedlings), and 584 cm (7^{th} year seedlings). These excellent growths are apparent if compared to the oriental arbor vitae in the technical cooperation model stand in Jixian (130 cm for 5^{th} year seedlings, 150 cm for 6^{th} year seedlings and 180 cm for 8^{th} year seedlings)[23] and to the Robinia pseudocacia in the neighboring Suide County, Shaanxi province (290 cm for 5^{th} year seedlings, 300 cm for 6^{th} year seedlings and 370 cm for 7^{th} year seedlings).[24]

The basis of good growth is first of all, ground leveling work before planting. Construction consultants and contractors took into consideration terrain conditions, combined various land leveling methods and provided guidance and thoroughly checked that it was according to plan and the land was well balanced and level. The vitality of semi-arid land after planting was successfully achieved through guidance on checkpoints including: whether or not good quality nursery stock was secured, that the stock would not dry out, and a snug fit between roots and earth was done with care.

It was feared that the target recovery of vegetation according to the plan would be hampered by livestock overgrazing causing feed damage. Causeway damage and damage to sprouts by livestock overgrazing was indeed observed during the project implementation period. However, between 2007 and 2009 a ban was placed on livestock grazing in Shanxi, and it was strictly administered, and as a result, significant vegetation recovery was observed with livestock damage virtually eliminated. Some damage by field rats can still be seen, but the survival rate after planting three years of all tree varieties is over 92%, a rate much higher than the 78% survival rate after planting three years achieved by a Germany-assisted afforestation project implemented also before the ban. [25]

[23] Beijing Forestry University

[24] "Study on Relationship between Growth of Artificial Robinia pseudoacacia Plantation and Soil Desiccation in the Loess Plateau of Northern Shanxi Province", Li Wang (Institute of Soil and Water Conservation, Chinese Academy of Sciences et al in "Scientia Silvae Sinicaee" Vol. 40 (2004)

[25] Shanxi Publishing Cooperative Shanxi Scientific Techniques Publishing Co. "Process Afforestation Theory and Practice" (2007)

Table 5 Growth conditions by tree species for the project area

Year planted	Age of stand	Tree species	Seedling Height	Tree Height	Survival rate after planting three years
			(≧cm)	(cm)	(%)
2004	7 years	Aburamatsu	14	202	98.8
2005	6 years			189	100
2006	5 years			178	96.7
2004	7 years	Thuja Orientalis	45	284	100
2005	6 years			202	99.5
2006	5 years			189	99.5
2004	7 years	Robinia pseudoacacia	30(120)	584	98
2005	6 years			N/A	N/A
2006	5 years			390	92.3

Source: the evaluator based her work on the sample survey,

Note 1: the survey was done based on the kind of trees, year planted and the average was calculated for conifers' area of 120 m^2 and for broad-leafed trees' area of 160m^2

Note 2: Robinia pseudocacia seedling height was higher than 120cm but they were clipped to 30 cm and then planted.

(3) Condition of showcase stand

The showcase stand was created to stimulate farmers' incentive. According to JICA documents, regular growth was observed for 8 tree species, but according to field observation within this evaluation survey, with the exception of Jixian, the growth of most tree species was substandard. According to the County forestry bureau, there is always the possibility that new species do not match the soil. As for the survival rate after planting three years of the following trees: peach, amygdalus persica, Myrica Rubra, Prunus Armeniaca, jujube, Corylus Heterophylla, there is a variation by province of quadrapoid Robinia pseudocacia, there is variation from County to County and Jixian, where farmers are carrying out maintenance management, showed good results. As a result, it is too early to determine whether the land is appropriate for the new tree species. Hereinafter regarding planting of different tree species according to farmers' needs, it is desirable to stimulate the incentive to plant such forest land, which can then be used as a showcase stand.

3.3.2 Qualitative Effects

The expected effects of this project are 1) improvement of dissemination agents' technique dissemination techniques, and 2) thus contribute to development of farmers' afforestation initiatives 3) spread an effective dissemination model to similar sites which have proven viability and 4) the raising of the entire area's incentive for planting. To verify the effects of this initiative as part of the ex-post evaluation, 107 dissemination agents of the forestry department, the County forestry bureaus, ward forestry stations, and approximately 92 farmers in 4 counties were surveyed as beneficiaries using questionnaires. The target participants are broken down

into the groups indicated in the table below.

The results show that the dissemination agents' planting techniques dissemination abilities improved and that dissemination activities were stimulated by the project. The dissemination also greatly contributed to farmers' incentive to plant, their technique, as well as the progress of planting initiatives in general.

Table 6 Breakdown of beneficiaries for dissemination agents

(units: persons)

Affiliation	Forestry Department	Daning	Xixian	Puxian	Jixian	Ward	Total
Dissemination agents who received training	12	17	23	18	18	4	92
Dissemination agent who, as Instructor, implemented	3	8	2	0	2	0	15
Total	15	25	25	18	20	4	107

Note: the word instructor here means person who gave training and on-site instruction to dissemination officers after being trained to be an instructor by Japanese consultants. The training for this project during implementation phase was centered around the Japanese consultant, two individuals from the forestry department, and two persons from each County for a total of 10 people, and the forestry department dissemination agents also provided guidance on site.

Table 7 Breakdown of beneficiaries for dissemination for farmers

(units: persons)

Affiliation	Daning	Xixian	Puxian	Jixian	Total
Farmers who received	32	13	17	12	74
Farmers who weren't trained	4	9	5	0	18
Total	36	22	22	12	92

Note: Training means training/seminars conducted during implementation of the project

(1) Planting techniques dissemination improvements

Regarding transformations in planting techniques dissemination skills, 46.7% of dissemination agents replied "improved significantly", 53.3% replied "improved somewhat", and overall the self-evaluation in this respect was positive. Regarding becoming able to operate independently, 58.9% of the total credited "counseling onsite during supplementary planting", 53.3% credited "design of training plans". As for the instructors, 86.7%credited "counseling onsite during supplementary planning", "counseling during planting apprenticeships", and "nurturing of planting technique dissemination counselors". As for Daning instructors, 87.5% or more credited "design of training plans", "curriculum design", "design of teaching materials", "planting techniques dissemination agents nurturing", "implementation of classes", "counseling during ground leveling activities", "counseling during supplementary planting", and "planting counseling during apprenticeship training". Japanese stationed locally have confirmed significant increases of capacity in a variety of fields. Regarding "on-site ground leveling counseling" and "planting apprenticeship counseling", namely, capacities required of

dissemination agents charged with the responsibility to spread techniques to farmers, only 5.9% and 18.5% of all respondents gave positive answers respectively; continued training appears to be in order.

Less than 10% of respondents indicated becoming able to provide counseling at awareness seminars and showcase stands independently, a rather low success rate. That significant skill improvement was not observed for items for which there was no training component is proof that targets recognized training as useful for improving dissemination techniques.

(2) Progress in farmers' planting activities through technique dissemination

Dissemination activities increased after implementation of the project, which is demonstrated by the fact that all dissemination agents responded “showed significant increase” or “increased somewhat”. 72.9% of dissemination agents responded that farmers' planting activities “progressed significantly” and 26.2% responded “increased somewhat” and together these two groups make up 99.1 %. As for the reason for progress in farmers' planting activities encouraged by dissemination agents’ activities, farmers indicated incentive increases due to the desire to see a rise in income and to see prevention of soil runoff.

As for the survey of farmers, 65.2% indicated that planting activities “progressed significantly” while 29.3% responded “progressed somewhat”, adding up to a total of 94.5%. In terms of the effects on 1) increased interest in planting 2) planting technique, and 3) the difference in the number of people with experience and those without, a difference was observed when comparing farmers who participated and those who didn't. For the first item above, 66.2% of farmers who participated said “increased significantly” compared with 38.9% of non-participants.

For the second item, 66.2% of participants indicated “increased significantly” or “increased somewhat” compared to 16.7% of non-participants. 3) 86.5% of participants indicated having experience compared to 61.1% of non participants. So 25-50% difference was seen in terms of training levels. It can therefore be considered that the training as part of the project increased interest in planting and technical ability.

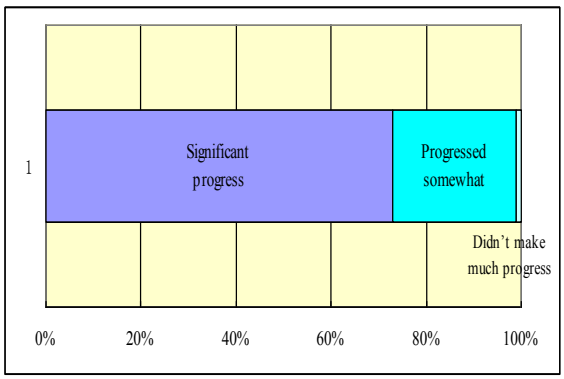


Fig. 8 Progress in planting due to farmers (dissemination agents)

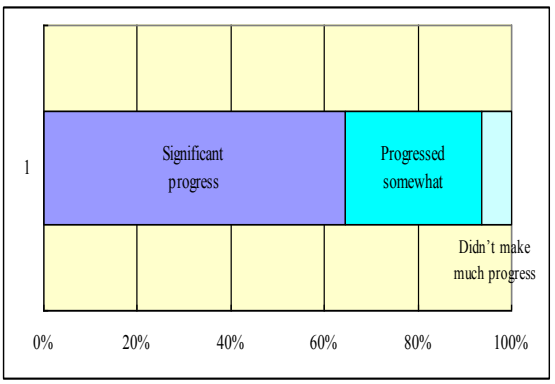


Fig. 9 Progress in planting due to farmers (farmers)

(3) Influence of effective dissemination model on similar regions

As Figure 8 shows, there is a significant difference over previous projects in terms of "planting operations/supervision of works." As stated previously, this difference translated into a difference in planting results. The survey results show that the model had influence inside and outside Shanxi Province and there was a disparity in the degree of influence

According to the survey sheets submitted by dissemination agents, 41.1% indicated that the effect of the dissemination model on related areas was "significant", 57.9% responded "somewhat", for a total of 99%, and this influence was not only for the target 4 counties, but for Shanxi as a whole.

According to the interview with Shanxi Forestry Department officials, this project was highly evaluated, and served as a model of planting /supervision of works/dissemination for the Three North forest reserves construction project within the province, the denuded mountain greening project by the Shanxi Government itself (one of the 6 large-scale planting forest projects), County-level roadside greening projects and ring road greening projects. In terms of general afforestation, general planting supervision was introduced as a model, and in addition to supervision for denuded land, planting techniques and planting labor were also adopted. The span of application of the latter is of approximately 110,000 ha per year[26]. The model dissemination started in 2010 with the JICA technical cooperation project "Promotion of the Dissemination of New Technology for the Loess Plateau Forest in China" encompassing seven provinces on the Loess Plain, and hereinafter it is expected to have a larger impact on the yen loan project locations in and out of Shanxi Province.

(4) Increased incentive in the entire area

The plan was drawn out to involve farmers by applying planting techniques they could use so that the local people could understand and cooperate. The plan was carried out steadily by those who had highly motivated townships selected for the trainees. These two points contributed greatly to the result.

It should be noted that the number of respondents indicating a desire to be involved in planting activities was 95.9% for those who participated in training and 83.3% for those who didn't, both quite high. "Forest land group ownership system[27] reform" was implemented in 2008, and in the target areas, factors such as group-owned forests being split up and conceded to individual farmers, with they themselves becoming capable of managing and operating them, and with support such as government seedling distribution / technical support being enabled,

[26] Approx. 270,000 ha are planted in Shanxi Province every year. Expressed in terms of 2010, out of planted land area of 29,000 ha, 170,000 ha are in the national budget, 120,000 ha are in the provincial governmental budget. Within the provincial government budget, the land area of the model ecological forest that was adopted was estimated at 110,000 ha, or 94%. (Shanxi ForestryDept)

[27] Forest land group ownership refers to possession of planted land and denuded land (to be planted) and use of these latter. These rights of use are transferred to local residents and the latter develop a sense of responsibility for managing the lands, and the result is that their incomes increase. The maximum ownership period is 70 years.

influenced the improvement of the area for which planting took place. Farmers understood that commercial forests would be conducive to higher incomes and this could be considered a contributing factor.

In Lingtou Township, Daning it was demonstrated in interview format surveys that commitment to planting and maintenance of nurturing of stands is spreading throughout the entire township. With the township leader's cooperation, trust was built up between all interested parties including experts and counterparts. On this basis, training was implemented, and local farmers were able to engage in planting activities independently. In addition, through awareness seminars targeting elementary and junior high school students, the importance of forests was thoroughly communicated throughout the entire area. Even upon termination of the project, approximately half of dissemination agents continued awareness seminars. From the long-term perspective, passing this on to the future generation that is charged with maintaining the forests will contribute greatly to afforestation efforts.

This project has largely achieved its objectives; therefore its effectiveness is high.

Table 8 main differences between prior methods and this project model

Item	Sub-Item		Before project implementation	During Project implementation
afforestation program *	ground leveling (Providing for a process to ensure percolation of rainwater into the soil as preparation for planting)		small ditch ** flat ditch*** etc. Features: 1. Constructing ridges with topsoil 2. soil remains in ditch 3. ridges are not firm enough 4. there are many shallow and narrow areas	Using flat ditch mainly, but choosing small ditch) if matching the shape of the land Features: 1. filling in ditch with upslope soil 2. Making ridges with soil 3. tamping for making strong ridges 4. implementing ground leveling as planned
	nursery stock	selection	Coniferous tree: Two to three year-old first or second class bare root seedlings and one year-old pot seedlings Broadleaf tree: One year-old first or second class bare root seedlings	Coniferous tree: Two year-old first class pot seedlings Broadleaf tree : One year-old first class bare root seedlings
		transportation method	Transport without bags	Transport with bags
	nurturing	weeding	No implementation	Implementation up until the third year
		tilling ditch soil	No implementation	Implementation up until the third year
		mulching	No implementation	Partial implementation
		branch selections	No implementation	Implementation
construction supervision	plan		Rough planting plan only, so small groups not set in detailed fashion. No forest road, observation tower or staff room	Detailed planting plan with small group units set. Existence of forest road, observation tower or staff room.
	quality control		Forestry department carries out planning, implementation, inspection. No supervisors	Change in implementation staff → new bidding at each planning, implementation, inspection stage. In this project Plan – drafted by construction consultant and China side Planting – implemented under supervision by construction consultant and construction staff Inspection – implemented under supervision of construction consultant and Shanxi Forestry Department
	Inspection		Desk checking is the base. Take rough samples. Has onsite inspection experiencem	Implement on-site inspection of 20% of small groups
Dissemination agents	Training method		Indoor classroom only	Combination of Indoor class (detailed planting techniques / soil preparation / planting / nurturing) and site visits, practical training

Source: Prepared by the external evaluator, based on interview survey and basic design report.

Note: *planting work carried out by farmers. This project model is implemented by famers that meet the standards of a specialty team.

** Small ditch– this method allows for small diameter ditches to be set up where long ones are not possible because the land is sharply inclined and has shrub coverage. In China, it is called fish scales pit. In an area with thin top soil, a hole with a diameter of 40-8cm is dug, and soil is piled into the hole and then rocks on top of that. This helps store water.

*** Horizontal ditch – this method involves setting up a ditch along the direction of the slope and following its contours. An embankment is disposed, and rainwater collected flows along the contour of the declination

3.4 Impact

3.4.1. Intended Impacts (Xinshuihe area forest cover rate improvement)

Xinshuihe basin forest area and forest cover rate improved to the extent that it reached 38% compared to the 44.65% target set out in the plan. This was possible due to the unit value increase, budget increases, adopting models and increasing survival rates after planting three years.

Table 9 Xinshuihe basin area forest area and forest cover rate

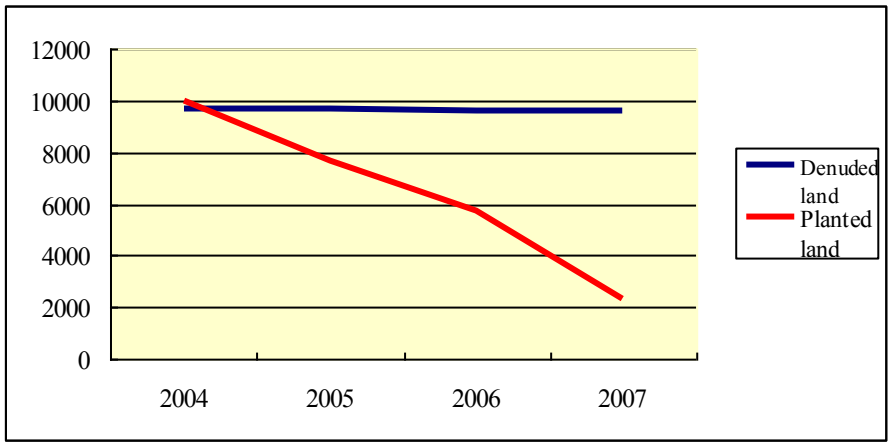
Indicator (units)	County	2001	2007	2010
Forest area (10,000 ha)	Jixian	6.9	8	8.4
	Daning	2.5	4.4	5.3
	Puxian	5.3	6.23	6.52
	Xixian	3.4	4.22	4.65
	Total	18.1	22.85	24.87
Forest coverage rate (%)	Jixian	39.1	45.4	47.6
	Daning	26	46	55
	Puxian	35.1	41.3	43.2
	Xixian	23.8	29.8	32.8
	Total	31	40.625	44.65

Source: County forestry departments

3.4.2 Intended Impacts (Xinshuihe basin sediment flow volume reduction)

As shown in Figure 10, Daning weather/sediment volume measurement center data describes a clear difference between denuded land and planted land in terms of sediment runoff. For denuded land, the sediment runoff was 9,580 tons/km^2 in 2007 compared to 2,310 tons/km^2 for planted land in the 3rd year after planting, less than 1/4. Xinshuihe basin showed dramatic improvement from a forest cover rate of 27.2% in 1998 to 44.65%, and it is likely that the effects of planting were conducive to sediment runoff decreases.

(units: tons/km$^{2)}$



Source: Daning forestry departments

Figure 10 Daning Weather/Sediment Volume measurement center

In the results of surveys of farmers, 32.6% answered that, compared to before the project implementation, sediment runoff had “decreased significantly” and 67.4% answered “decreased somewhat”. A total of 25 % of respondents answered that damage due to sediment runoff had “decreased significantly”, and 69.6% responded that it had decreased somewhat, for a total of 94.6% admitting that such damage had declined. Also, 29.3% of respondents answered that their preoccupations about sediment runoff were significantly reduced and 64.1% indicated these were “somewhat reduced”. A total of 84% of farmers indicated an awareness of sediment runoff, and that it was as big a problem as before. Be that as it may, 90% of farmers admitted the effects of reductions in sediment runoff, so the priority objective can be said to have been achieved.

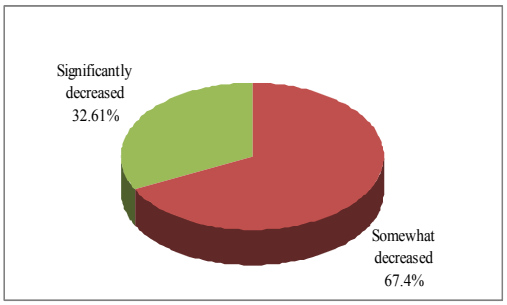


Fig. 11 Sediment runoff before and after implementation of the project

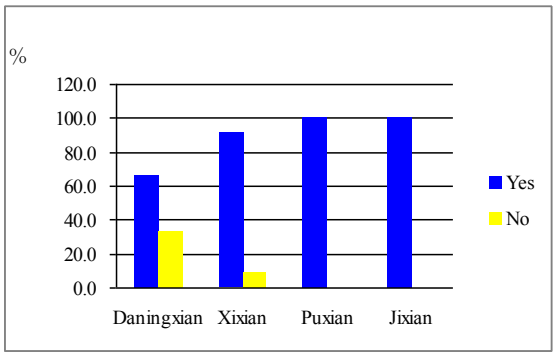


Fig. 12 Sediment runoff awareness

3.4.3 Other Impacts

(1) Impacts on policies

This project was positively evaluated by Chinese leaders and the impacts were the improvement of Shanxi forestry policies. The practical training for the soft component, the farmers, was done on a large scale, and through their training much planting was accomplished in Daning, and the communication of ideas on how to achieve high survival rates on site was another result.

The largest impact was the raising of unit planting value[28]. Unit planting value was based on the specifications or standards by type of operation as well as proper documentation, and the proper implementation was conducive to high survival rates. It has been widely accepted that the low unit planting value before the project implementation was due to specifications and standards not being met. The second policy impact was the adoption of the Plan – Do – See management system by afforestation project participants, emulating the system employed in this project. Now, projects involving more than 50,000 Yuna procurement are required to employ competitive bidding at the planning stage and verification of afforestation outcome is required in ex-post evaluation.

(2) Relocation of residents / land acquisition

Because the target of this project is denuded land, there was no relocation of residents; however, the Chinese side shouldered 2 million Yuna in site acquisition costs.

Not only were Xinshuihe basin area forest cover rates improved, the effects of this project extended widely, thus contributing to the advancement of Shanxi afforestation policies. The planting model for this project is spreading throughout Shanxi province and through the Loess Plateau generally, so its influence can be considered high.

3.5 Sustainability (Rating: ③)

3.5.1 Structural Aspects of Operation and Maintenance

The implementing agency, Shanxi forestry department has 2 offices, 11 sections and 1 committee (76 employees) that are controlled directly as well as 32 agencies and 9 forestry bureaus that are responsible for operations. The Department oversees 11 city/ward forestry bureaus, 120 County forestry departments and 2,400 small and medium-sized forestry stations.

Project liaison office and Daning liaison station were established to manage the project at the beginning, but were removed at the end of the project; however, there was no major change in Shanxi forestry department and there was no problem with operations and maintenance management. At the time of evaluation, the foreign cooperation office was responsible, along

[28] Before this project, unit planting value was 100-200 Yuna / *mu,* however it climbed to 500 Yuna in 2007

with the operations and maintenance sections of the four counties, for this project.

The numbers of officials at the forestry bureaus were 94 in Jixian, 103 in Daning, 230 in Puxian, and 120 in Xixian. As for operations and maintenance management, in Xi and Daning, it was conducted by “Forest office”, in Puxian by “Natural forest conservation desk”, in Jixian by “management conservation station”, and patrol of planted lands was carried out by township conservation officers. During the planning phase, more than 4 full-time conservation staff members were to be stationed; however, during at the time of ex-post evaluation, there were 5 resident conservation officials in Xixian, 5 in Daning, 3 in Puxian, and 3 in Jixian. Because of budgetary constraints, the problem of understaffing had not been corrected, and instead the individual conservation officials patrol wider areas. At some conservation staff stations, cameras are set up, enabling early warning for forest fires, Non-resident County forestry bureau officials are also dispatched, so at present there is no major problem.

3.5.2 Technical Aspects of Operation and Maintenance

In the section on effectiveness, because planting techniques dissemination officials’ skill is improving, and since training and on site counseling are in place for further improvement, there are no problems foreseen in terms of maintenance. However, since there is a lack of experience in nurturing and protection, and since disease damage/pests removal are conducive to tree growth, timely training must be implemented as new work becomes necessary.

No manuals regarding planting operations and construction supervision methods such as ground leveling, planting, support planting, nurturing and protection, etc. have yet been prepared in document forms. Presently individuals come into contact with operations through dissemination activities. Hereinafter, maintenance management manuals should be created and widely distributed to the relevant individuals so that dissemination occurs thoroughly within the province and throughout the Loess Plateau generally.

3.5.3 Financial Aspects of Operation and Maintenance

The forestry department afforestation budget has increased significantly from the planning phase, and the 2009 budget was 6.8 times that of 2001.Though there is a variation for target counties, all the counties’ budgets for 2009 surpassed the amounts foreseen in the plan. That being said, most of the budget is allocated for planting, not for nurturing, protection or supervision. The maintenance management cost for the counties was only around 300,000 to 400,000 Yuna, or 2 to 8 % of the budget as a whole and it covers mostly the personnel cost of the conservation staff.

Table 10 Forestry department and Forestry bureaus budget

(units: 10,000 Yuna)

	2001	2005	2006	2007	2008	2009
Shanxi forestry department	92,000	180,000	300,000	600,000	610,000	630,000
Jixian forestry bureau	450	890	760	900	1,038	846
Daning forestry bureau	320	290	135	175	932	480
Puxian forestry bureau	600	530	720	870	830	950
Xixian forestry bureau	530	900	1,050	1,100	1,200	1,300

Source: Shanxi Forestry Department and County forestry departments

With the aims of increasing forest cover and to improve the quality within the "Shanxi forestry ecologic construction general plan" (2010), for the first time 18.9% of the budget was allocated to maintenance management. This merits a high evaluation for maintainability. Hereinafter, there will be a need for branch trimming and tree thinning for sound tree nurturing and land and water conservation, disease prevention and pest elimination, small animal damage control as well as human damage control such as illegally cutting down trees, forest fire, grazing, and etc.. There is a need for early securing of the budget for maintenance management and for preparation for the operation manuals.

3.5.4 Current Status of Operation and Maintenance

Planted land was granted in lump format by the Japanese government to the Chinese government in 2007, and the 2008 – 2009 nurturing plan, except for Xixian, was mostly according to plan. However, due to chronic budget shortages, the focus from 2010 onwards will have to be on patrols by conservation staff, and growth monitoring will be insufficient. Growth plan development, securing of budget and preparation of monitoring system are needed.

The facilities and equipment maintenance within this project were mostly acceptable, however, weather/sediment volume measurement station, project introduction boards, wireless sets, back pack portable sprayer devices, and fire extinguishers were partly not in use. At Shanxi weather/sediment volume measurement station a construction permit was not obtained at the planning stage, so at the end of the project, weather observation/measurement devices were removed. The wireless set was replaced by cell phone at the end of the project. Fairly heavy use was foreseen for the vehicle from the beginning but because the meter inside showed it was approaching the limits of durability, it was not used for certain parts of the project.

As described above, while some minor problems have been observed in the structural, technical and financial aspects of operation and maintenance, the implementing agency is fully capable of addressing these problems and no major problems have been observed in the

operation and maintenance system, therefore sustainability of the project effect is high.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

As part of the China's national afforestation plan that has as its aim increasing forest cover rate, this project was implemented as a tree planting model for the creation of shelter belts on the Loess Plateau with its desolate denuded land and unfavorable site location. Carefully considering local conditions, a basic design was drafted, and based on this work it was rigorously implemented, and this led to high survival rates. Incorporating farmers from the planning phase and using the soft component and ensuring training of dissemination officials and farmers also contributed synergistically to the success of the project. The afforested area created successfully in this project was highly evaluated, which led to the raising of Shanxi unit planting value and other improvements in policy as well as to the progress in afforestation over the entire area. Hereinafter in order to be maintained as a highly successful afforested area and to be used as a model for afforestation in the Loess Plateau entire region, it will be important to ensure appropriate forest nurturing and protection based on the state of tree growth

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

4.2 Recommendations

4.2.1 Recommendations to the Implementing Agency

(1) In order to maintain the projected areas as well planted stands, sufficient nurturing and forest protection, such as pest preventing measures, animal damage control, and human damage control should be given at proper times. The maintenance program for the five years should be made as soon as possible based on the 12th five-year-plan, so that the budget can be secured. It is requested that the systems for monitoring the growth and nurturing and forest protection operations be prepared.

(2) The result of this project is highly valued and the operation has begun to be adopted in similar areas within and outside of Shanxi. In order to be widely adopted, there should be a bigger focus on public relations activities and adequate ways and means to communicate the contents easily and correctly will be needed. At present, there are no manuals, no guidelines or other documents showing the key points or procedures of planting operation, supervision of the works, dissemination activities, nurturing and protection. Easy manuals with a lot of photos and illustrations should be prepared, delivered and used widely. This will not only make clear the standards for models but also lead to planting higher quality stands with enhanced effectiveness.

(3) Showcase stands should be re-created and utilized in order to encourage the local farmers to plant trees. If economic trees such as fruit trees as well as ecological trees are planted and then

proper operations including good maintenance are provided, good economic effect will be shown in rather short period. Such showcase trees presenting good examples will motivate the farmers and encourage them to plant trees. The project “Promotion of the Dissemination of New Technology for the Loess Plateau Forest in China” that targets seven Loess Plateau provinces includes an inspection tour of the project areas of this project under evaluation. In several years the showcase trees with high exhibition effect will be utilized as inspection tour sites.

(4) The facilities and the equipment developed in this project should be constantly maintained and treated more carefully. Some of the forest lanes, which play an important role in patrolling, monitoring of the tree growth conditions and providing access in emergencies, were found to be not accessible. Indispensable equipment such as sprayers and fire extinguishers were not installed in some places. After the life span of a given piece of equipment is over it is necessary to apply for disposal to properly get rid of it. Then records should be kept in the maintenance record book.

(5) From now on the main planting areas for the purpose of conservation of water and soil will be waste land in bad geographical conditions. There is no data on tree growth after planting nor the amount of soil erosion, and no research has been conducted on the effect of water and soil conservation. In order to enhance the effect of this project and accomplish the long-term purpose of water and soil conservation, first the tree planting areas of this project should be used as planting samples and necessary data should be regularly monitored. That data should then be utilized in later research.

4.2.2 Recommendations to JICA

In this project, tree planting techniques suitable for the waste land and the operating methods were developed on the basis of the soil conservation techniques researched and established through the past technical cooperation projects. These methods are now being widely adopted in areas with similar conditions as model projects. As the model project, it is important to ensure that the effect of this project be sustained. Long periods of time will be necessary for creating forests and therefore an agreement was made between the two countries that China will nurture the trees after the minimum care is applied in project form. It may be desirable that Japan should examine on an as needed basis the nurturing and control measures by China, and support the nurturing as a model using the JICA follow-up scheme.

4.3 Lessons Learned

This project achieved planting survival rate of 95%, a very high achievement. It was shown that even in the Loess Plateau Xinshuihe area with its steep inclines, which is vulnerable to denuding, and where loess accumulates very thickly, afforestation is not impossible. The main

reasons for success are operations supervision at the planning and implementation phases. Through thorough surveying of varieties of tasks, the volume for each, specifications, standards at the planning stage, China and Japan were able to draft deliberate drawings. As a result implementation taking into consideration the proper timing based on plant organization was possible, and only the minimum of changes at the detailed design level were required. At the implementation phase, high quality was obtained through accurate and timely investment of the required funds according to the elaborate drawings. At the detailed design stage, changes and adjustment were made according to the changing conditions in terms of ground clearing methods and tree varieties as well as the number of trees planted and the area of plantation.

In addition to the rigorous supervision of works, the incorporation of famers in the project smoothed the implementation process and increased the effectiveness. To ensure that there was an understanding of the value of forests to the regions, the plan was formulated with direct participation of farmers, through training and awareness seminars in the operation of planting enterprises.

In terms of the achievements of the program, the soft component played an especially large role, and through a combination of planting activities and training and supervision by Japanese consultants, effective dissemination was carried out. If there hadn't been the aim to increase farmers' planting techniques and awareness, the precise afforestation work and the high survival rates achieved would not have been possible.

As was shown above, the incorporation of the soft component synergistically led to increased effectiveness, and this should be considered a successful model for future afforestation projects.

End.

China

Ex-Post Evaluation of Japanese ODA Loan Project

Zhejiang Sewage Treatment Project

External Evaluator: Yuko Kishino, IC Net Limited

0. Summary

In order to achieve its environmental protection objectives, the Chinese government placed top priority on water contamination measures and urban environment measures and implemented various efforts to accomplish these measures. This project is part of these measures and was implemented in the cities of Hangzhou, Jiaxing and Shaoxing in Zhejiang Province, where industrialization and urbanization were progressing rapidly. Hangzhou and Jiaxing were designated as watershed cities of Lake Tai, where pollution is becoming increasingly serious. Shaoxing being a city of history culture was designated as a national priority tourist destination. Thus, all three cities had the highest need and priority for this project which aimed to improve the water quality in rivers by constructing a central sewage treatment facility.

The Hangzhou Sewage Treatment Plant as the wastewater treatment facility for the city's economic development zone, and the Jiaxing Sewage Treatment Plant and the Shaoxing Sewage Treatment Plant being the sole sewage treatment plants in their respective cities, all play a vital role in the sewage treatment of each city. Facility utilization for each is high and the treated water meets standards. The plants are contributing to the improvement of the water quality of the rivers in these cities as well as the living environments of nearby residents. Although there are some financial issues for the implementing agencies for each plant, they have no effect on the sustainability of the project effect.

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

1. Project Description

Project Locations

Shaoxing Sewage Treatment Plant

1.1 Background

The recent dramatic and increasing urbanization and improvements in lifestyles in China have led to a drastic increase in household sewage and industrial wastewater. However, construction of sewage and industrial wastewater treatment plants lagged behind and the sewer coverage ratio was only 26% (1997). In order to secure safe water sources, the Chinese government designated "Three Rivers and Three Lakes" (Hai River, Liao River, Huai River, Lake Tai, Lake Chao, and Dian Lake) and the Seven Great Rivers [1], where water pollution has become a serious issue, as priority regions, as well as designating the strengthening of industrial wastewater regulations and construction of sewers in urban areas, as top priorities.

The watershed for Lake Tai[2], one of the "Three Lakes", is the tributary region located at downstream from the south bank of the Yangtze River water system. The watershed area is 36,500 square kilometers including those of rivers flowing in and out of the Yangtze. Since the 1980s, eutrophication progressed due to the rapid development of industry, modernization of agriculture and the increase in population. Water pollution became prominent even in the Lake Tai water system as well. The Chinese government drew up a ""Lake Tai Watershed Pollution Prevention Ninth Five-Year Plan / 2010 Plan" and established pollution improvement objectives for 2000 in regions where sewage load may flow in and watershed cities related to the Lake Tai water environment. In Zhejiang Province[3], Huzhao City, Changxing County, Anji County, Deqing County, Yuhang City and Lin'an City were designated as Lake Tai Influence Zone. Hangzhou City and Jiaxing City were designated as Lake Tai watershed cities. Measures in order to regulate sewage discharge volume are to be implemented.

At the time of project appraisal, the sewage discharge volume for Zhejiang Province was in excess of 1.4 billion cubic meters per year while sewage treatment capacity was only 400 million cubic meters per year. In Hangzhou, Jiaxing and Shaoxing, the deterioration in the water quality of the rivers was serious. There was a need for immediate water quality measures to be taken from the environmental improvement perspective for Hangzhou, the capital of Zhejiang Province and Jiaxing, and the increasing seriousness of industrial wastewater pollution in Shaoxing.

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[1] Songhua River, Liao River, Hai River, Yellow River, Huai River, Yangtze River, Pearl River
[2] A lake located on the border between the southern Jiangsu Province and northern Zhejiang Province.
[3] 33% of the Lake Tai watershed area accounts for 24% of the watershed population.

1.2 Project Outline

The objective of this project is to improve water quality in the rivers of the cities, Hangzhou, Jiaxing and Shaoxing in Zhejiang Province, where industrialization had progressed rapidly, and Lake Tai by constructing sewage treatment plants in each city, thereby contributing to the improvement of the living environments of the residents.

Figure 1 Subproject Location Map

Loan Approved Amount/ Disbursed Amount	11,256 million yen/ 11,204 million yen
Exchange of Notes Date/ Loan Agreement Signing Date	March 2000 / March 2000
Terms and Conditions	Interest Rate: 0.75% Repayment Period: 40 years (Grace Period: 10 years) Bilateral Tied
Borrower / Executing Agency Implementing agencies	The Government of the People's Republic of China / Zhejiang Provincial People's Government Hangzhou Capital Water Company Limited Jiaxing United Sewage Treatment Co., Ltd. Shaoxing Water Treatment Development Co., Ltd.
Final Disbursement Date	July 2007
Main Contractor	China Anneng Construction Corporation / China Construction Eighth Engineering Division, China Jiangsu Machinery & Equipment I/E Corp. (J/V) (Above are all from the People's Republic of China)
Main Consultant	None
Feasibility Studies, etc.	Feasibility Studies Hangzhou City: Shanghai Municipal Engineering Design Institute, 1999 Jiaxing City: China Northwest Municipal Engineering Design Institute / Beijing Biaoqi Environment Group, 1999 Shaoxing City: Design Institute of Jilin Chemical Industry Company, 1999
Related Projects	Development Survey "Study on Integrated Management Master Plan for Tai Lake Basin Water Management" Grant Aid "The Japan-China Friendship Environmental Protection Center Construction Project", Other[4]

[4] World Bank Loan "Zhejiang Urban Environment Project", German government grant aid "Hangzhou Sewage Treatment Plant Expansion Construction"

2. Outline of the Evaluation Study

2.1 External Evaluator

Yuko Kishino, IC Net Limited

2.2 Duration of Evaluation Study

The evaluation study for this ex-post evaluation was conducted as follows:

Duration of the Study: November 2010 – October 2011

Duration of the Field Study: February 21, 2011 – March 8, 2011 and May 30, 2011 – June 2, 2011

2.3 Constraints during the Evaluation Study

Because some evaluation indicators for the "Improvement of River Water Quality", the objective of this project, could not be obtained, qualitative evaluations were conducted based on a certain number of presumptions. For the evaluation of effectiveness, the original policy was to make a determination based on the operational status of the subprojects and the level of improvement in the water quality of the rivers in the city. However, we were unable to obtain water quality data for the targeted rivers in Hangzhou and Shaoxing. Because of this, a qualitative evaluation was conducted using disclosed data for Hangzhou City and questionnaire survey results by the implementing agencies in Shaoxing City under the following constraints:

- The disclosed data by Hangzhou City was averaged data for all monitoring sections of the target river and have been affected by household sewage and industrial wastewater from areas not targeted by the subprojects as well as being affected by other water quality improvement projects.
- The sample size for the beneficiary survey conducted in Shaoxing City was small, at only 100 people, and the statistical accuracy for the results obtained from the survey is low.

3. Results of the Evaluation (Overall Rating: A[5])

3.1 Relevance (Rating: ③[6])

3.1.1 Relevance with the Development Plan of China

(1) Development plan at the time of the appraisal

In its "National Environmental Protection Ninth Five-Year Plan and 2010 Long-term Goal", the Chinese government established water quality and atmospheric pollution measures and the improvement of urban environments as top priority issues and set an objective of "stopping environmental pollution and degradation of the ecological system, improving the environment of selected cities and regions, and establishing model cities and regions for economic development, environmental safety, ecosystem protection."

In the "Lake Tai Watershed Pollution Prevention Ninth Five-Year Plan / 2010 Plan", six priority pollution control areas, and numeric targets of pollutant emissions volume to be achieved by 2000 were set for each area. In order to achieve these objectives, construction of sewage treatment plants and industrial wastewater treatment facilities were implemented. The Xiagu Pollution Control Area, one of the priority pollution control areas, was included in the target cities of this project along with Hangzhou and Jiaxing, due to the area being a watershed city of Lake Tai.

In the "Zhejiang Lake Tai Watershed Pollution Improvement Project", the objectives set were making the water in Grand Canal clear by 2000, improving the water quality class of the rivers in Jiaxing by one level, and to improve the water quality of the rivers in the Lake Tai watershed to National Surface Water Quality Standard Class II or III[7]. In the Zhejiang Province Development Plan as well, an objective was set to increase the sewage treatment rate to 40% by 2000 and to 60% by 2010 in order to improve the environment in the cities and farming areas. This project was conducted within these plans and the relevance with development plans is high.

(2) Development plans at the time of ex-post evaluation

In the National Environmental Protection Eleventh Five-Year Plan (2006-2010), the objectives laid out included Chemical Oxygen Demand[8] (hereinafter referred to as "COD")

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

[6] ③:High,②:Fair, ①:Low

[7] National Surface Water Quality Standard GB3838－1988 was put into effect in 1988 by the National Environmental Protection Bureau (the current Ministry of Environmental Protection of the People's Republic of China). It categorizes water quality into 6 Classes, I – V, based on 30 water quality indicators such as Chemical Oxygen Demand (COD), with Class I being the highest and V the lowest. For Class I and II, COD must be 15mg/l or lower, 15mg/l for Class III, 20mg/l for Class IV and 25mg/l for Class V. In GB3838－2002, revised in 2002, the standards were partly lowered with COD for Class I and II being 15mg/l or less, 20mg/l for Class III, 30mg/l for Class IV, and 40mg/l for Class V.

[8] Used as a value to measure the level of water pollution. It refers to the volume of oxygen consumed when organic compounds in the water are oxidized using an oxidizing agent.

reduction by 5%, ammoniac nitrogen emissions reduction by 3% in comparison with 2005 figures, as well as an urban sewage treatment rate of over 60%. This shows continued priority being placed on water pollution measures.

In the "Zhejiang Province Lake Tai Watershed Water Environment Consolidated Measures Implementation Plan" based on the 2007 "Lake Tai Water Environment Consolidated Measures Implementation Plan", all of Hangzhou, Jiaxing and Shaoxing were designated as the "Hangjiahu Region" and were specified as the target for the plan. With this, the objective of the plan was to reduce the amount of COD, ammoniac nitrogen and total nitrogen above the allowable limit by 50% of 2005 figures, maintain Class III water quality for the profile inflow into Lake Tai, and to greatly improve the water environment in the entire Zhejiang Province Lake Tai watershed. In regards to the sewage treatment facilities in the cities, the installing of denitrification and dephosphorization equipment by 2010 was mandated and it states that sewage treatment rates for the cities will be over 82% by 2012 and 90% by 2020. This project is a measure to construct sewage treatment facilities in the cities and to improve water quality, which is a major focal point of the national and provincial measures, and thus in regards to the point in time of the ex-post evaluation; too, the relevance with development plans is high.

3.1.2 Relevance with the Development Needs of China

3.1.2.1 Sewer Construction needs

At the time of the appraisal, there were many areas in Zhejiang Province that did not have any sewage treatment plant at all, and the construction of sewage treatment plants in each city and county was an issue that needed to be immediately addressed.

In Hangzhou, domestic sewage and industrial wastewater was increasing due to industrial development and an increase in population. At the time of the appraisal, only the Sipu Sewage Treatment Plant existed in Hangzhou and only sewage from three[9] sewage systems of the city's six sewage systems were being treated and the other three systems[10] were being discharged into the Grand Canal and Qiantang River. The water quality of the rivers were far below Class V standards and were affecting drinking water, agriculture and fishing downstream.

In Jiaxing, there was no central sewage treatment facility and domestic sewage was being discharged directly into the rivers without being treated. Industrial wastewater treatment was also inadequate. As of 1996, of the 27 cross-sectional monitoring sections in the city, 12 recorded water quality far below Class V, and the deterioration of water quality was becoming increasingly serious.

[9] No. 1, No. 2, No.3
[10] Xiasha, Jiangcun, Binjiang

In Shaoxing city and county, sewers and pumping stations had been constructed since 1991, but a sewage treatment plant had yet to be constructed. Industrial wastewater had undergone simple treatment and released into Cao'e River, one of the eight major lines in Zhejiang. Domestic sewage was discharged into a nearby river were it also flowed into Cao'e River Organic pollution in the rivers due to industrial wastewater was by far the worst and cross sectional monitoring in Cao'e River deteriorated from Class III to Class V.

3.1.2.2 Project Relevance[11]

In the materials at the time of the Japan International Cooperation Agency (JICA) appraisal, the stated project objective was to improve the water quality of the rivers in the city as well as Lake Tai through the construction of sewage treatment facilities. The improvements in the water quality of both "rivers in the city" and "Lake Tai" were noted together. It is correct to assume that, in other words, the aim of the project was to improve the water quality in the rivers of Hangzhou, Jiaxing and Shaoxing, as well as to improve the water quality of Lake Tai by implementing the three subprojects. However, no clear roadmaps were shown to achieve the latter "improvement of the water quality of Lake Tai", and no specific objectives were set, resulting in poor relevance in terms of project objective setting and target setting.

(1) Relevance of Project Objective

Based on the "Lake Tai Water Quality Improvement" in the Lake Tai Watershed Pollution Improvement Plan and the "Construction of Sewage Treatment Plants in Urban Areas" in the National Environmental Protection Plan, the Chinese government requested assistance from the Japanese government. The target cities were Huzhou, Yuhang, Hangzhou and Jiaxing, which were cities in Zhejiang Province that required large-scale sewage treatment facilities, and Shaoxing which is not a Lake Tai watershed city, but a city in which the rivers were severely polluted by industrial wastewater and urgently required construction of sewers. After a survey conducted by the Japanese government, Hangzhou, Jiaxing and Shaoxing were selected from the perspective of efficiency and this project, consisting of three subprojects, was formed. Although Huzhou and Yuhand, both of which are cities in the Lake Tai Impact Area, and may have an effect on the water quality of Lake Tai, were not selected, the "Improvement of the Water Quality of Lake Tai" still remained. Although it is certain that this project was implemented to contribute to the overall water environment improvement plan of the Chinese government, it is thought that more realistic

[11] This was not included in the ratings for relevance due to the fact that objective settings drawn from strict project objective and indicators based on logical frameworks were not required at the time of appraisal and that there was a difference in understanding between the two countries as to the role of this project.

and appropriate objective settings were required such as what specifically were to be achieved by implementing this yen loan project made of multiple subprojects.

In this evaluation survey, we were unable to clarify why the "Improvement of the Water Quality of Lake Tai" was stated as a project objective, and we find it hard to expect that this project would lead to an improvement in the water quality of Lake Tai. We believe that the objective for this project should have been kept to an "Improvement of Water Quality of the Rivers in the Cities". According to the executing agency and the Jiaxing city government, the rivers in Hangzhou and Jiaxing are located downstream from Lake Tai and are also sewage waterways from Lake Tai to Hangzhou Port, and therefore have almost no effect on the water quality of Lake Tai[12]. In addition, it is a fact that the rivers in Shaoxing also have no effect on the water quality of Lake Tai.

(2) Relevance of Project Targets Setting

For current JICA projects, when implementing multiple subprojects for sector assistance, a quantitative data collection, to the greatest extent possible, is required for the effects of each subproject, and at the subproject level, targets must be clarified using numerical indicators. The appraisal at the time did not require that much degree of target setting and there are no numerical targets or specific project objectives for the "Improvement of the Water Quality of Lake Tai". According to the executing agency and implementing agencies, they stated that there were no specific discussions between the Japanese and Chinese sides at the time of appraisal regarding the improvement of water quality in the rivers and it is believed that there were problems in the planning during the appraisal. The environmental bureaus of each city do not regularly monitor the water quality improvement situations of the rivers for the sake of this yen loan project, and apart from Jiaxing, no data on the water quality of the rivers was provided for this ex-post evaluation. As a result, it was not possible to quantitatively evaluate the effects of two subprojects. For the river water quality improvement project, the targeted rivers, monitoring cross sections and numerical targets must be clarified and all associated persons must be in agreement.

3.1.3 Relevance with Japan's ODA Policy

In the Economic Cooperation Program for China based on the policy of placing "more emphasis on the areas such as the conservation of environments and eco-systems, the improvement of living standards and social development in the inland regions, human resources development, institution building, and technology transfers" the top priority was

[12] According to the Jiaxing Water Resource Bureau, as one Lake Tai watershed flooding measure, water would be temporarily pumped from the rivers in Jiaxing in the direction of Lake Tai during the flooding season (April – September). However, this has not been implemented in the past 10 years at least.

given to “cooperation towards resolving environmental and other global issues.” In the Country Project Implementation Policy, it is stated that assistance will be provided through construction of sewers and the like.

In light of the above, this project has been highly relevant with the country’s development plan, development needs, as well as Japan’s ODA policy; therefore its relevance is high.

3.2 Efficiency (Rating: ②)

3.2.1 Project Outputs

The construction of sewage treatment plants for each subproject was implemented mostly as planned. In regards to the construction of sewers and pumping stations, although there were changes in the Jiaxing Sewage Treatment Plant and the Shaoxing Water Treatment Plant, these were determined to be appropriate to the change in implementation conditions.

As for the Jiaxing Sewage Treatment Plant, the total extension of sewage pipes were changed from the planned 110km to 136.76km and the number of pumping stations increased from 15 to 18. The expansion of these outputs was designed to respond to the delayed construction of the terminal sewer pipe network by each county and local government, the fact that prevented service to a wider area, and to address the problem of insufficient water delivery capacity of the Number 2 Pumping Station[13]. As a result of expanding the outputs, the sewage area increased from 40.3km^2 to 1,869.2km^2 and the collection and delivery of sewage increased from 300,000 tons/day to 600,000 tons/day. The increase in sewage collection and delivery capacity led to a doubling of the treatment capacity of the Jiaxing Sewage Treatment Plant by implementing a new, second stage construction (inflow volume of 300,000 tons/day).

At the Shaoxing Sewage Treatment Plant, the construction of sewer pipes and pumping stations were not included in the yen loan project and implemented as a Shaoxing county government project. This was due to the background of the specific implementing agency[14] having been divided into the Shaoxing Water Discharge Company and the Shaoxing Water Treatment Development Co., Ltd. in November of 2001. The Shaoxing Water Discharge Company would be responsible for the sewer pipes and pumping stations, and the Shaoxing Water Treatment Development Co., Ltd. would be responsible for the sewage treatment plant. Only the construction of the sewage treatment plant would be the target of the yen loan.

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[13] As a result of the yen loan intermediate monitoring evaluation implemented in March of 2007, the implementing of a project for increased construction of the sewer pipe network and pumping stations which had already been started by Jiaxing city was approved within the limits of the yen loan authorized amount.

[14] Shaoxing Water Supply and Discharge Process Management Station

As will be noted later, the expansion of the output for the Jiaxing Sewage Treatment Plant led to the prolongation of the project period and an increase in project costs. However, the fact that the sewage treatment plant construction project and the terminal sewer pipe network construction project were integrated together to expand the sewage collection volume in the region and to greatly increase the utilization ratio of the treatment facilities can be evaluated highly from the perspective of achieving the objective of this project of improving the river water quality.

Fig. 2 Aeration tank(Hangzhou Sewage Treatment Plant)

Fig. 3 Oxidation ditch (Jiaxing Sewage Treatment Plant)

3.2.2 Project Inputs

3.2.2.1 Project Cost

Compared to the initial plan of 33.081 billion yen[15] (of which 11.256 billion yen was foreign currency), the actual total project cost was 35.967 billion yen (of which 11.24 billion yen and other 1 billion yen was foreign currency), and was slightly higher than planned (109% of the plan). The reason for this was a valid one, caused by an increase in output. The ratios against the plan, taking into account the increase or decrease in output[16] are 92% for the Hangzhou Sewage Treatment Plant, 88% for the Jiaxing Sewage Treatment Plant[17] and 111% for the Shaoxing Sewage Treatment Plant, with the ratio being 94% for the project as a whole.

[15] Although the JICA materials at the time of appraisal note the total amount to be 33.076 billion yen, the total of the breakdown is used here.

[16] Jiaxing Sewage Treatment Plant - A comparison against the actual against the initial planned amount with the project costs for additional sewer pipes and pumping station construction costs added (planned cost). Shaoxing Sewage Treatment Plant – The actual cost was compared to the initial planned cost minus the canceled sewer pipe and pumping station construction costs.

[17] 90% of the plan, 11.877 billion yen (1.426 billion yen in foreign currency, 746 million Yuna domestic currency) was added to the initial planned output. In regards to the expanded portion of the output, in comparison with the planned 6.927 billion yen, the actual amount was 5.883 billion yen (3.45267 billion yen foreign currency, 173.41 million Yuna domestic currency), a plan ratio of 85%.

3.2.2.2 Project Period

The total project period was planned to be between March 2000 and December 2003 (46 months) but the actual period was from March 2000 to January 2010 (119 months) and was significantly longer than planned (259% of the plan) and did not match the increase/decrease in output. When looked at by subproject, the Hangzhou Sewage Treatment was as planned, the Jiaxing Sewage Treatment Plant had a ratio against the plan of 290%[18], and that for the Shaoxing Sewage Treatment Plant was 219%, resulting in an overall average of 203%.

At the Jiaxing Sewage Treatment Plant, the fact that additional construction for expanded outputs took 33 months to decide upon and the construction itself took as long as 47 months, though as planned, added to the prolongation of the project period[19]. At the Shaoxing Sewage Treatment Plant, the reason for delay was that project acceptance was delayed until November of 2004, but formal operation started in June of 2002 and had no effect on project effects.

In light of the above, although the project cost was mostly as planned, the project period significantly exceeded the plan; therefore efficiency of the project is fair.

3.3 Effectiveness (Rating: ③)

3.3.1 Quantitative Effects

The objectives of the project is to "improve the water quality of the rivers in the city and Lake Tai" through the construction of sewage treatment facilities. As noted in the Project Relevance section, due to the fact that there is no clear causal relationship with project implementation and the "water quality improvement of Lake Tai", evaluation of the effectiveness will be performed using 2 stages, (1) An analysis of the operation and effect indicators of each subproject and (2) An analysis of the improvement of the water quality of the rivers and water systems affected by the effects of each subproject.

3.3.1.1 Results from Operation and Effect Indicators of Subprojects

Indicators used to determine whether or not sewage treatment facilities are being fully used include sewage treatment volume[20] and facility utilization rate[21]. For effect indicators,

[18] The sewer pipes and pumping stations in Jiaxing are to be inspected at the same time as the completion of the Stage II construction at the sewage treatment plant. This evaluation deems the start of test operations in January of 2010 as completion of the project. Note that the ratio against the plan for initial planned output that does not include additional construction is 188%

[19] The planned/actual period for additional construction was implemented mostly as planned as follows.
Plan: February 2006 – June, 2009
Actual: February 2006 – December 2009 (Project acceptance was in January 2010. Construction period of 47 months)

[20] Volume accepted by the sewage treatment plant and treated.

[21] Average daily treatment volume/facility capacity

the annual removal volumes for COD, an indicator typically used to represent water pollution level, Biochemical Oxygen Demand[22] (hereinafter referred to as "BOD"), Suspended Solids[23] (hereinafter referred to as "SS") were used.

(1) Increase in Sewage Treatment Capacity (Sewage Treatment Volume and Facility Utilization Rate)

As shown in the table below, the daily sewage treatment capacity of all three subprojects combined in 2010 was 859,600 tons, mostly as planned, and the facilities are being adequately utilized. With the increase in sewage volume at each plant, in addition to Stage 1 construction yen loan projects, each plant is implementing Stage 2 and Stage 3 construction and gradually expanding treatment capacity. Treatment capacity at the time of evaluation was 600,000 tons/day[24] at the Hangzhou Sewage Treatment Plant, the Jiaxing Sewage Treatment Plant had a capacity of 450,000 tons/day[25], and the Shaoxing Sewage Treatment Plant had a capacity of 900,000 tons/day. In addition at the Hangzhou Sewage Treatment Plant, capacity is to be expanded to 1.2 million tons/day by 2012 and to 600,000 tons/day at the Jiaxing Sewage Treatment Plant in order to respond to future increases in sewage volumes.

Table 1 Sewage Treatment Volume for Each Subproject

(Unit: 10,000 tons/day)

	Sewage Treatment Volume (2010)		
	Plan	Actual	Plan Ratio
Hangzhou Sewage Treatment Plant	30	26.2	87%
Jiaxing Sewage Treatment Plant	30	29.76	99%
Shaoxing Sewage Treatment Plant	30	30	100%
Total	90	85.96	96%

As can be seen in Figure 4, the facility utilization rate has steadily increased since the start of operations and in 2010 all the three plants were operating at full capacity with the Hangzhou Sewage Treatment Plant utilization rate at 87.3%, 99.2% at the Jiaxing Sewage Treatment Plant and 100% at the Shaoxing Sewage Treatment Plant. The reason for the increase in facility utilization rate in the span of only two to three years is due to the

[22] A water pollution indicator and one vital regulated item for industrial wastewater. Indicates the amount of oxygen consumed by microbes when they decompose organic compounds in the water. The higher the value, the higher the level of pollution.

[23] Insoluble particulate matters suspended in the water. These include particles from clay minerals, phytoplankton, zooplankton and their carcasses as well as organic and metallic sediment from sewage and factory water discharges.

[24] The sewage treatment volume for the whole of the Hangzhou Sewage Treatment Plant in 2010 was 501,000 tons/day.

[25] Total of Stage 1 construction (yen loan project) 300,000 tons/day and 150,000 tons/day half of the Stage 2 construction of 300,000 tons/day. The remaining 150,000 tons/day from Stage 2 construction is to be completed at the end of 2011.

construction of terminal sewer pipe systems and connection to each household. In Hangzhou and Shaoxing, the sewer pipe system had already been constructed to some degree before the project was implemented, and the use of experience from the construction of the Sipu Sewage Treatment Plant, completed in 1992 in Hangzhou also contributed to this. Because there was no sewer network in Jiaxing, construction of the sewage system network and treatment plant were started at the same time. Although the utilization rate was a low 39% at the time of the start of operations at the treatment plant (2003) due to a delay in sewage system construction caused by the lack of funds and insufficient pump capacity; by expanding output and maintaining and upgrading these systems, the utilization rate gradually improved to 76% in 2006, 83% in 2007, 89% in 2008, and 97% in 2009.

(Unit: %)

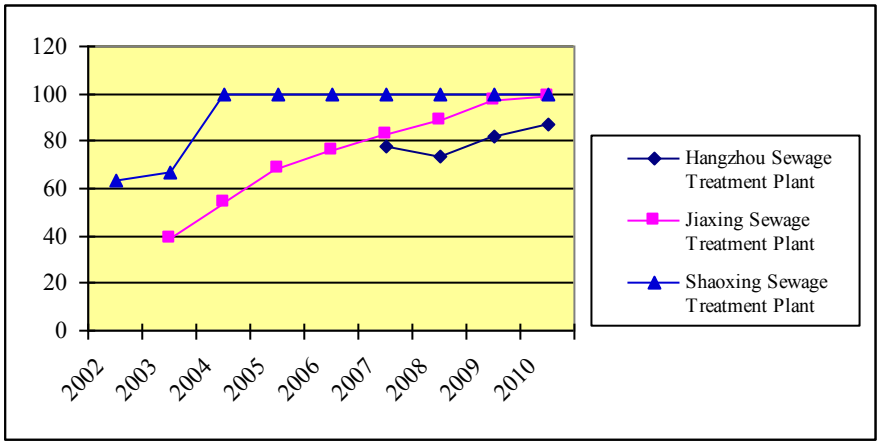

Figure 4 Facility Utilization Rate for Each Sewage Treatment Plant

Source: Hangzhou Capital Water Co., Ltd., Jiaxing United Sewage Treatment Co., Ltd., Shaoxing Water Treatment Development Co., Ltd.

Note: Data only reflects facilities constructed by using yen loans. Data could not be obtained for the Hangzhou Sewage Treatment Plant for 2003 through 2006 (Hangzhou Sewage Discharge Corporation).

(2) Reduction Volume of Pollutants

When a check was conducted in 2010 to determine how much of the pollutants that cause water contamination was removed through the implementation of this project, as shown in Tables 2 through 4, apart from the BOD at the Hangzhou Sewage Treatment Plant, all figures exceeded planned figures. This is due to the fact that the inflow water quality at each treatment plant had deteriorated more than had been anticipated and due to increased pollutant removal capacity through additional measures being taken at the Jiaxing and Shaoxing Sewage Treatment Plants.

The Jiaxing Sewage Treatment Plant in 2003 through the direction of the mayor of Jiaxing started to treat wastewater from the Xiuzhou region where there are many print dye factories. The inflow water quality to the treatment plant deteriorated and even after

treatment, water quality standards could not be met. An oxidation ditch aeration unit was added using yen loans to strengthen and improve the pollutant removal rates. As a result, pollutant reduction volume increased more than planned.

At the Shaoxing Sewage Treatment Plant, COD removal was 150%, BOD 123% and SS 381% over the plan, all substantially exceeding the plan. At the planning stage, a sample of 4,000 to 5,000 tons of polluted water was collected and this was set as the anticipated inflow pollutant density. However, in reality, the inflow water quality was worse than the sample, and with the trend of annually deteriorating quality, a primary settling basin was constructed using own funds to increase removal rates. In addition, in Shaoxing city, due to the fact that it had set an objective of 100mg/l COD or less since 2008, a chemical addition system was added to the primary and secondary settling basins in 2011 as measures to improve treated water quality.

Table 2 Hangzhou Sewage Treatment Plant Pollutant Removal Volume

	Plan (1999)	Actual (2010)	Against Plan
COD removal volume (tons/year)	30,660	45,319	148%
BOD removal volume (tons/year)	18,615	18,036	97%
SS removal volume (tons/year)	24,090	26,939	112%

Source: Hangzhou Capital Water Company Limited

Table 3 Jiaxing Sewage Treatment Plant Pollutant Removal Volume

	Plan (1999)	Actual (2010)	Against Plan
COD removal volume (tons/year)	30,660	35,185	115%
BOD removal volume (tons/year)	14,345	14,591	102%
SS removal volume (tons/year)	12,812	26,256	205%

Source: Jiaxing United Sewage Treatment Co., Ltd.

Table 4 Shaoxing Sewage Treatment Plant Pollutant Removal Volume

	Plan (1999)	Actual (2010)	Against Plan
COD removal volume (tons/year)	89,790	135,123	150%
BOD removal volume (tons/year)	48,180	59,281	123%
SS removal volume (tons/year)	21,900	83,439	381%

Source: Shaoxing Water Treatment Development Co., Ltd.

(3) Discharge Water Quality

The discharge water quality in 2010 for each subproject meets standards. At the Hangzhou Sewage Treatment Plant, the standard for discharge water quality at the time of appraisal was GB8978-1996 Class 2 in the "Integrated Wastewater Discharge Standard" (COD120 mg/L, BOD30 mg/L, SS35 mg/L) but because it was known then standards would be made stricter soon, phosphorus and nitrogen removal processes were added together with the choice of treatment technology to comply with the new standards. At the Jiaxing Sewage Treatment Plant, as noted above, because the quality of the inflow water had deteriorated, it was not possible to meet the standards by 2006-2007. With the setting of treatment plant inflow water standards in 2008, standards were met from 2008 onwards through the improvement of inflow water quality from strengthened wastewater treatment at factories and the additional oxidation ditch aeration facilities installed to increase pollutant removal rates.

At the Shaoxing Sewage Treatment Plant, the COD effort target values are expected to be achieved in Shaoxing through additional measures in 2011 as noted above. In addition, the strengthening of "Textile Industrial Wastewater Discharge Standards" [26] is expected to be passed in the near future and measures are being considered to comply with these standards. It is anticipated that the treated water quality will further improve in the future.

Table 5 Discharge Water Standards and Actual Results for Each Sewage Treatment Plant

(Unit: mg/L)

	Hangzhou Sewage Treatment Plant		Jiaxing Sewage Treatment Plant		Shaoxing Sewage Treatment Plant	
	Standard	Actual	Standard	Actual	Standard	Actual
	GB18918-2002 Class I B	2010	GB8978-1996 Class II	2010	GB4287-1992 Class II	2010
COD	60	43.1	120	95.82	180	113
BOD	20	7.4	30	19.85	40	9.62
SS	25	8.3	30	18.2	100	32

Source: Hangzhou Capital Water Company Limited, Jiaxing United Sewage Treatment Co., Ltd., Shaoxing Water Treatment Development Co., Ltd.

Note: GB18918-2002 – "Urban Sewage Treatment Plant Pollution Emission Standards", GB8978-1996 – "Integrated Wastewater Discharge Standards", GB4287-1992 – "Textile Industrial Wastewater Discharge Standards"

[26] GB4287 -2008: BOD25mg/L, COD100 mg/L, SS70 mg/L, ammoniac nitrogen 15 mg/L, TP mg/L.

Fig. 5 Treated water (Hangzhou Sewage Treatment Plant)

Fig. 6 Before treatment (right) and after treatment (left) (Jiaxing Sewage Treatment Plant)

3.3.1.2 Improvement of Water Pollution

In regards to evaluating the improvement of water quality, rivers which would be affected through the implementation of each subproject based on pre-project implementation untreated water discharge status in the target areas were selected as shown in table 6. We attempted to obtain water quality data from the treated water discharge points as well as monitoring cross-sections downstream.

We were unable to obtain data from the supervising agencies, the Hangzhou Environment Bureau and the Shaoxing Environment Bureau, and therefore for the Hangzhou Sewage Treatment Plant, we referred to data on the water quality of the Qiantang River from the Zhejiang Province Environmental Status Bulletin to conduct evaluations from the perspective of water quality degradation control. Because the Qiantang River is a major river stretching for 688 kilometers and because the water quality is affected by many factors beside this project, it is impossible to analyze the relationship between the effects of the subproject from the disclosed water quality data for the entire Qianting River. For the Shaoxing Sewage Treatment Plant, a qualitative evaluation was conducted based on questionnaire results from the beneficiaries.

Table 6 Target Rivers for Each Subproject

Subproject	Target River	Monitoring Cross-section
Hangzhou Sewage Treatment Plant	Qiantang River	Shangzhakou, Qipu, Zhitoujiao, Number 9 Dam
Jiaxing Sewage Treatment Plant	27 rivers in Jiaxing city	64 locations in the city
Shaoxing Sewage Treatment Plant	Cao'e River	Dongjiang flood gate, Honggi flood gate, Xinsanjiang flood gate

Note: Jiaxing city is located in the center of the Yangtze River delta and the rivers in the city make up the river network. Because it is difficult to specify rivers, the target was set as the water quality of the main rivers (the average of 27 rivers)

(1) Hangzhou City

From Figure 7 we cannot see a clear change in the water quality of the Qiantang River as a whole. The population of Hangzhou city increased by 680,000 people between 2000 and 2009 and the economy grew greatly as well with annual average growth rates of GDP and industrial output at 15.4% and 18.6% respectively. Taking into consideration the fact that increase in population and economic growth are factors in the deterioration of water quality as well as the fact that target treatment area is an economic development zone accounting for 70% of the industrial wastewater discharge, it can be said that this project is contributing to the controlling of the deterioration of the water quality of the Qiantang River.

(Unit: %)

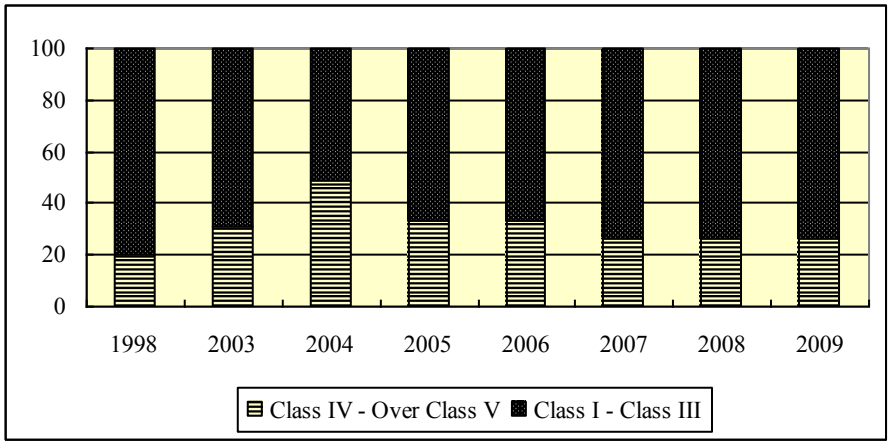

Figure 7 Changes in Qiantang River water quality

Source: Zhejiang Province Environmental Status Bulletin

(2) Jiaxing City

As can be seen from Figure 8, of the 64 monitoring cross-sections in 27 rivers in the city, the ratio of Over Class V, has been gradually declining since 2006 and was drastically reduced in 2009. The treatment area of the Jiaxing Sewage Treatment Plant is large, covering approximately 80% of the entire city, and it is thought this project is having a substantial effect on the water quality of the rivers in the city. The improvement trend since 2006 coincides with the gradual increasing of the facility utilization rate of the treatment plant. It is believed that the effects from the strengthening of wastewater treatment by major polluting companies led to many of the monitoring cross sections showing improvement from Over Class V to Class V.

(Unit: %)

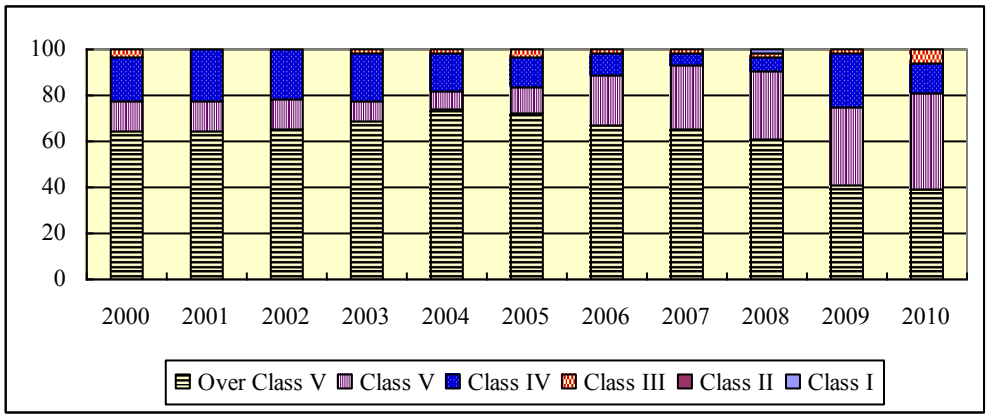

Figure 8 Water quality at 64 monitoring cross sections in the rivers in Jiaxing city

Source: Jiaxing City Environment Bureau

(3) Shaoxing City

The old city area of Shaoxing is enclosed by the Ring River, and rivers in the surrounding areas spread out like a net. Because these rivers flow into the Cao'e River, the city's river network has an effect on the water quality of the Cao'e River.

With a view to confirming the effects of this project, a survey was conducted among 100 residents of the old city area within the Ring River, asking them about changes in the water quality of the rivers in the old city area and the Ring River. The results showed that after implementation of the project, 75% responded that the rivers were "Greatly cleaner" or "Slightly cleaner" and 22% responded that "Not much cleaner" or "Not cleaner at all". We learned that many people were aware of the improvement of the water quality in the nearby rivers as a result of the implementation of this project. Sixty percent of the respondents stated that the cause for the cleaner rivers were "Construction of sewage treatment plant", "Industrial wastewater regulations" and "Construction of sewers". These results confirmed the effects of the project. Regarding uses of the river before and after implementation of the project, "Scenery/Recreation", "Aquaculture", "Use of Wupengchuan boats[27]" responses increased and "For industrial use" and "Polluted water that can't be used for anything" responses decreased. From this, we can see that the improvement in water quality has led to the diversification in the use of the river.

[27]A river boat with black cover for water traffic in Shaoxing City, also used for touristic purposes

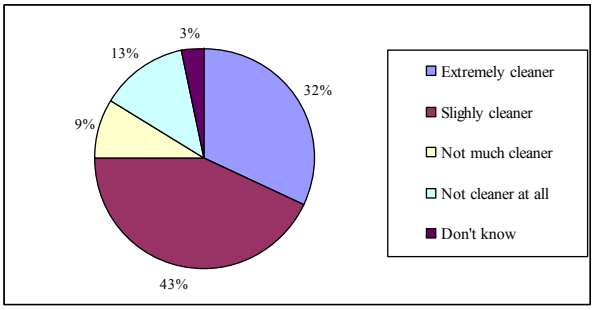

Fig. 9 Changes in river water quality before and after project implementation

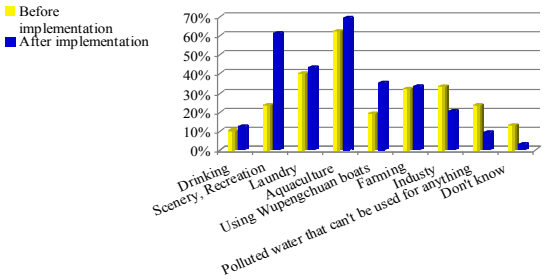

Fig. 10 River use before and after project implementation

Fig. 11 Inland rivers and Wupengchuan boats

As the implementing agency pointed out as well, not only was sewage for Shaoxing city and Shaoxing county being treated after implementation of the project, the number of factories decreased from 500 to 300 due to closures and mergers and the advancement of primary treatment of industrial wastewater led to the improvement trend for the water quality of the Qiantang River[28].

3.3.1.2 Results of Calculations of Internal Rates of Return

At the time of appraisal the Financial Internal Rate of Return (FIRR) was calculated with the project life being 20 years, sewage treatment income being the benefit, and the costs being construction costs, sewage treatment costs and maintenance and management costs. The results were 3.8% for the Hangzhou Sewage Treatment Plant, 2.4% for the Jiaxing Sewage Treatment Plant, and 6.3% for the Shaoxing Sewage Treatment Plant. After a recalculation using data obtained for the Jiaxing and Shaoxing sewage treatment plants at the time of the ex-post evaluation, both came out negative. This was due to the drastic increase in project costs for the Jiaxing Sewage Treatment Plant as well as a 30% increase in maintenance and management costs. For the Shaoxing Sewage Treatment Plant, the actual sewage treatment costs were set lower than that assumed at the time of the appraisal, the income distribution ratio was set at 60% for the company managing the sewer network

[28] This is not a judgment based on quantitative data.

which was lower than the maintenance and management costs, and the facts that the maintenance management costs were 1.3 times that set during the appraisal and taxes were included in the costs affected the numbers.

3.3.2 Qualitative Effects

Refer to the Impact section

In light of the above, this project has largely achieved its objectives; therefore its effectiveness is high.

3.4 Impact

3.4.1 Intended Impacts (Improvement of the living environment of residents)

Through the construction of sewage treatment plants, this project anticipated the improvement of the living environment of the residents. In order to verify this, the Shaoxing Sewage Treatment Plant was selected from the three subprojects[29] and a beneficiary survey was conducted through a questionnaire. The survey area included Luxunguju, Bazi Bridge, Zhou Enlai guju and the area near Cai Yuanpei guju, and conducted among 100 residents on the inside of the Ring River. The details are shown in Table 7. Although these beneficiary survey results are not necessarily representative of all beneficiaries because of the small sample size, it can be seen that beneficiaries generally recognize that the water quality of the rivers in the beneficiary area has improved after implementation of the project and the living environment has also improved.

Table 7 Beneficiary Survey Targets

Gender	Male	64%
	Female	36%
Age	20 - 29	21%
	30 -39	36%
	40 - 49	30%
	50 - 59	9%
	60 and older	4%

[29] The reason why the Shaoxing Sewage Treatment Plant was selected is because, of the 3 subprojects, it had conditions ideal to confirming the effects of the project. In Hangzhou city, there are 4 treatment plants in the city and some discharge their waters into the same river making it difficult to confirm the effects of this project even if the water quality of the river improves. For Jiaxing city, the beneficiary area is expansive and because there is a river network, it is difficult to specify a survey area. In comparison, in Shaoxing city, there are no sewage treatment plants other than the one constructed by this project. In addition, although rivers spread in many areas within the city, the Ring River runs through the center of the city with a residential area in the old-city area with a very long history. The rivers are intimate part of the residents' living and it is an area where improvements in water quality will lead to changes in living environments.

(1) Changes in living environments

The percentage of respondents who responded that the changes in water quality of the rivers after implementing the project gave “a positive effect on living environment” was 81%. To be more specific, 84% responded “Scenery has improved”, 63% responded “There is no more foul odor”, and 60% responded that “We can now enjoy the waterfront”. Comparing the figures for before and after project implementation, the percentage of people who use the river has increased from 72% to 90%, and in particular, the percentage of people who enjoy walks along the river increased from 48% to 83%. In response to the question of what effect the improvement of river water quality has had other than living environment, 86% responded “Improvement of sanitary environment” and 37% also responded “Control of groundwater pollution”. From this, we can see that the improvement of river water quality directly relates to changes in living environment.

(2) Changes in livelihoods from sewer connections

The percentage of households that did not have sewer connections prior to the implementation of the project was 13%. Of the 13%, 77% responded that after being connected to the sewage system “The area around that house has become more sanitary”, 62% responded that “We have a toilet in the house now” as well as “There is less flooding around the house when it rains”. A further 38% responded that “There is no foul odor any more”. There were 54% of respondents that said that they are “Extremely satisfied” with the sewer connections and 46% responded that they are “Mostly satisfied”. Although the cases of new connections to the sewage system through the implementation of the project were not many in number, satisfaction was very high and it can be determined that this has had a positive effect on livelihoods.

(3) Awareness of water quality improvement measures

The percentage of people who responded that they are “Aware” or “Somewhat aware” that the Shaoxing city government was implementing water quality improvement measures was 71%. Awareness and evaluation of water quality improvement measures were high, with 84% being satisfied with these measures.

3.4.2 Other Impacts

(1) Impact on the natural environment

Measures against odors and noise that were planned for all subprojects at the time of appraisal were being taken and we did not find any particular problems at the project locations. The Jiaxing Sewage Treatment Plant and the Shaoxing Sewage Treatment Plants

are located away from residential areas and there are no problems with odor or noise. At the Jiaxing Sewage Treatment Plant, additional measures such as placing covers over the entire sewage storage pool, where odors can easily occur, as well as bio-deodorizing are being taken.

In regards to sludge treatment, we confirmed that sludge of the Hangzhou Sewage Treatment Plant, is dehydrated using the sludge thickener and dehydrator unit and then disposed at a landfill site as originally planned. By the use of most advanced sludge treatment technologies hardly in use by other plants in China, 100% recycling and reuse of the sludge has been achieved since 2009 at the Jiaxing Sewage Treatment Plant and since 2008 at the Shaoxing Sewage Treatment Plant.

At the Jiaxing Sewage Treatment Plant, approximately 400 tons per day of dehydrated sludge is made harmless and converted to resources by the "sludge centralized drying and mix-incineration method." The sludge is transported by truck to the Jiaxing Xiuzhou, Thermal Power Plant where after drying together with sludge from other sources, it is mixed with coal and incinerated. The residue is sold to cement companies. Depending on the dehydration method, at the current stage the moisture content of the sludge is either 60% or 82% and the higher the moisture content, the higher the cost required for reuse. Because of this efforts are being made to realize a sludge treatment method that is economical, safe and reliable. In addition, possibilities were explored to introduce a technology for recovery of phosphorus from sludge incineration ash from a local government or a private company in Japan, but this has not moved forward.

At the Shaoxing Sewage Treatment Plant, sludge is dehydrated and is temporarily deposited at a location within the plant premises protected by measures to prevent uncontrolled release. Leachate of the temporary deposit is mixed with rainwater, re-treated at the treatment plant and then discharged. The dehydrated sludge is burned as fuel at the Central Energy Development Co., Ltd, which is located near the treatment plant. Some of the residue is used as material for cement.

Fig. 12 Sludge with 60% moisture content
(Jiaxing Sewage Treatment Plant)

Fig. 13 Mixture of dehydrated sludge and coal
(Jiaxing New Jies Thermal Power Plant)

In 2009 in China, the "Technical Guideline of Sludge Treatment and Disposal for Municipal Wastewater Treatment Plant" was issued a part of the National Environmental Protection Standards. It mandated the realization of reducing the volume of sludge, stabilizing, detoxifying as well as the total re-use of sludge. However, in order to realize such sludge disposal, there are many issues regarding sludge treatment facility construction costs, sludge treatment costs, treatment technology and sludge treatment guidelines and regulations. With this in mind, the sludge treatment methods started at the Jiaxing Sewage Treatment Plant and the Shaoxing Sewage Treatment Plant are expected to be model examples of sludge dehydration and incineration procedures. Both are efficient and simple methods that combine dehydration and electricity generation through incineration, and require few facilities. Maintenance is easy and relatively low cost at 100 to 120 Yuna per ton. In terms of the environment, there is no dust or odors, and little noise. At the Jiaxing sewage treatment plant, research is currently being conducted on reducing the moisture content of dehydrated sludge as well as on other recycling methods. It is expected to play an advanced role in the Chinese sewage treatment industry.

(2) Relocation of residents, acquisition of land

For the Hangzhou Sewage Treatment Plant, 44 hectares of land was acquired as planned, and 11 households, 57 residents in total, were relocated. According to the executing agency, relocation procedures were duly conducted based on the Land Administration Law of China. At the Jiaxing Sewage Treatment Plant and the Shaoxing Sewage Treatment plant, the land area acquired has changed along with the increase/decrease in outputs. For the

Jiaxing Sewage Treatment Plant, the planned area was 21.9 hectares but the actual acquired land was 30.96 hectares. For the Shaoxing Sewage Treatment Plant, the planned area was 67.2 hectares, but the actual acquired land was 43.2 hectares. No residents were relocated for these two plants.

As noted above, the construction of sewage treatment facilities in Shaoxing has improved the water quality of the river network in the treatment area, which has in turn led to an improvement in the livelihoods of the residents. Although this also depends on how close the relationship between the lives of the residents and the rivers is, we can at the least say that we can assume the same positive impact was felt in Jiaxing as well, where an improvement in the water quality of the rivers in the city were confirmed. The executing agency has evaluated this subproject as having a substantial contribution on city construction in the Jiaxing, a city that aims to become a national environmental city, a national sanitary city, and an environment-friendly city by attracting foreign companies. The beneficiaries of this project were estimated to be 1.76 million people[30] in 2009 and can be said to have a certain degree of positive impact as a project as a whole.

3.5 Sustainability (Rating:③)

Although there have been no changes in the organization of the executing agency or the project as a whole as of the time of ex-post evaluation, there were changes in the implementing agencies. Evaluation of sustainability was mainly based on the implementing agencies that are currently operating, maintaining and managing the subprojects.

3.5.1 Structural Aspects of Operation and Maintenance

(1) Overall structure

The Zhejiang Provincial People's Government oversees the entire project and the operation and maintenance of the three subprojects are implemented by each implementing agency under the jurisdiction of the Hangzhou, Jiaxing, and Shaoxing Municipal People's Governments. The point of contact for the Zhejiang Provincial People's Government was the Urban-Rural Development Bureau, Finance Bureau was in charge of financial monitoring, and the Environmental Protection Bureau was responsible for environmental aspects. However, because the Environmental Protection Bureau was not involved in this project from the time of appraisal, it is not involved in the management of the yen loan project effects, or the monitoring of operations maintenance management.

[30]Calculated from the daily volume of water used per person in each city as well as daily domestic wastewater treatment volume. Hangzhou Sewage Treatment Plant 490,000 people, Jiaxing Sewage Treatment Plant 850,000 people, Shaoxing Sewage Treatment Plant 420,000 people.

(2) Implementing agency of each subproject

1) Hangzhou Sewage Treatment Plant

Although the Hangzhou Sewage Discharge Corporation[31] was the implementing agency until 2006, that year, the Hangzhou government decided to transfer some plants, including the yen loan portion of the Hangzhou Sewage Treatment Plant, from the urban management office that was conducting financial management at the time, to a private organization. As a result of international bidding the Tianjin Capital Environmental Protection Group Co., Ltd. acquired the special operating permits[32] for 25 years under the Transfer-Operate-Transfer (TOT) scheme. A merger in April of 2006 with the Hangzhou Urban Construction & Investment Group Co., Ltd. established the Hangzhou Capital Water Company Limited, the implementing agency[33]. As the management organization for the public aspects of sewer operations, the Hangzhou Sewage Discharge Corporation concluded a sewage treatment service contract with Hangzhou Capital Water Company Limited and implements the monitoring and control of sewer operations.

The Hangzhou Capital Water Company Limited consists of one office, four departments and 100 employees. It is a subsidiary of the Tianjin Capital Environmental Protection Group Co., Ltd., a publicly traded company with experience in sewage treatment in Tianjin. Monitoring of treated water is conducted through measurements of collected samples, and 24-hour, automatic online water quality inspection equipment, the results of which are sent to the provincial environmental protection bureau. The Zhejiang Environmental Protection Bureau and the Hangzhou Environmental Protection Bureau conduct regular and unscheduled water quality inspections and there are no problems in structure.

2) Jiaxing Sewage Treatment Plant

The implementing agency for the Jiaxing Sewage Treatment Plant is the government-owned Jiaxing United Sewage Treatment Co., Ltd, which has one office, seven departments, one sewage treatment plant and 90 employees. The investor is the Jiaxing Water Resources Investment Group Co., Ltd.[34] and the ratio for the 12 counties, districts and the Nanhu Changyuan Sewage Co., Ltd., is 51%, 47.64% and 11.36% respectively. The Jiaxing United Sewage Treatment Co., Ltd. acquired Quality Management Standard ISO9001 certification and Environmental Management Standard ISO14001 certification in

[31] A government-owned company with 100% investment from Hangzhou Urban Construction & Investment Group co., Ltd. which conducts monitoring of sewage treatment. Also conducts operation and maintenance of the Sipu Sewage Treatment Plant in Hangzhou city.

[32] For the 25 years of the special permit period, operates the sewage treatment plant, and after the special permit period ends, hands over the properly operating plant without charge to the urban management office or a specified organization.

[33] Investment ratio is 7 to 3.

[34] A government owned company with 100% investment from Jiaxing State Assets Administrative Committee.

February 2001 and is working towards a well-developed internal management structure.

In addition to treated water monitoring being conducted within the treatment facility, the Jiaxing Environmental Protection Bureau, Zhejiang Environmental Protection Bureau and the Ministry of Environmental Protection of the People's Republic of China also conducts regular and unscheduled inflow and treated water quality inspections. The automatic online water quality inspection equipment measures eight items and sends the results to the provincial environmental protection bureau.

3) Shaoxing Sewage Treatment Plant

At the time of appraisal, the implementing agency was the Shaoxing Environmental Protection and Development Co., Ltd. a public company which the Jiexing Sewage Engineering Administration Department had invested 85% and the Prefectural Environmental Protection Industrial Development Co., Ltd. and Xianlv Industry Co., Ltd. had invested 15%. In November of 2001, soon after the appraisal, Jiexing Sewage Engineering Administration Department had been divided into the Shaoxing Water Discharge Company and the Shaoxing Water Treatment Development Group Co., Ltd. and the Shaoxing Water Treatment Development Group Co., Ltd. was in charge of the operation and maintenance of the sewage treatment plants. This company is a partnership between the Shaoxing City Water Group Co., Ltd. (40%) and the Shaoxing County Water Group Co., Ltd. (60%) with 16 departments and 319 employees. It is one of the largest sewage treatment plants in China and in 2004, it was evaluated as one of the top 10 sewage treatment plants in regards to operational quality management in China, and there are no problems in structure.

Monitoring of treated water is conducted by collecting samples in the treatment plant and measuring the sample. The results are reported to the Shaoxing County Environmental Protection Bureau, the Shaoxing City Environmental Protection Bureau the Shaoxing County Water Group Co., Ltd., the Shoaxing City Water Group Co., Ltd. and the Zhejiang Urban-Rural Development Bureau. In addition, regular and unscheduled water quality inspections are conducted by the Shaoxing County Environmental Protection Bureau (monthly), the Shaoxing City Environmental Protection Water Bureau (six times a year), and the Zhejiang Environmental Protection Bureau (four times a year).

3.5.2 Technical Aspects of Operation and Maintenance

At the Hangzhou Sewage Treatment Plant, a lot of the employees are experience personnel who were transferred there from the Hangzhou Sewage Discharge Corporation. Of the 48 employees in the maintenance management department, approximately 70% are technical specialists and there are no technical problems. At the Jiaxing Sewage

Treatment as well, the persons in charge have an average of 17 years of job experience and workers with a certain level of technical skill perform maintenance management operations. At the Shaoxing Sewage Treatment Plant, of the 43 employees in the maintenance management department, 51% are holders of technical certifications, and the ratio of relatively young workers is high with an average job experience of 11 years. In addition to matching the technical levels of the operations with the employees, appropriate maintenance management is being implemented through internal and external training programs.

As can be seen, technical evaluation standards have been set for operations and maintenance management for all subprojects, and employees that meet these standards are being employed at the sites. There are training and evaluation standards in order to increase knowledge on maintenance management operations and to improve technical skills, and we determine that there are no problems.

3.5.3 Financial Aspects of Operation and Maintenance

1) Hangzhou Sewage Treatment Plant

Although were not able to obtain financial data from the Hangzhou Capital Water Company Limited, we believe that there are no major financial problems based on the following reasons. The main source of capital for the Hangzhou Capital Water Company Limited are contributions from the Tianjin Water Discharge Corporation, a government owned company and it is also the beneficiary of a preferential taxation system such as in real estate taxes and land usage taxes. The sewage treatment service contract concluded between the Hangzhou Water Discharge Corporation and the Hangzhou Capital Water Company Limited provides for payment of compensation based on the treated water volume that meets standards. The contract rate is assessed every year based on the maintenance management costs of the treatment plant. At the time of evaluation, the maintenance management cost was 0.8 Yuna per cubic meter and the contract rate slightly exceeded this.

Although loans are to be paid back from the Hangzhou Capital Water Company via the Hangzhou city government and the Zhejiang provincial government, the flow of yen loans for the subprojects mean that the re-lending contractor is the Hangzhou city government and the loans are protected by government guarantees.

2) Jiaxing Sewage Treatment Plant

Table 8 shows the 2006 to 2008 financial indicators for the Jiaxing United Sewage Treatment Co., Ltd. Net profit to sales and return on capital are both negative with accumulated losses for 2009 being 12.6 million Yuna. The sewage treatment rates are 0.9

Yuna per cubic meter for households, 1.7 Yuna per cubic meter for commercial users, and 2 to 2.4 Yuna per cubic meter for industrial use. All are around the same or higher than that set at the time of appraisal. However, a centralized sewage treatment contract was concluded between the company and the urban sewer network companies in 12 counties and districts that manage the sewer network and profit distribution to the Jiaxing United Sewage Treatment Co., Ltd. is fixed at 70%. The reasons for the negative profit ratio include: the fact that this is lower than the operational costs and the fact that management and financial costs account for over 20% of the sales. According to the implementing agency, an approximately 30% increase in sewage treatment rates were planned in 2011 and losses to be stemmed after the rate increase. Due to the fact that operational efforts are being made to cut costs and the fact that it is a government-owned publicly traded company with a high public nature, we believe that there are no major obstacles in sustainability. There is still a need to keep a careful eye on the plant going forward.

Table 8 Financial indicators of the Jiaxing United Sewage Treatment Co., Ltd.

	2006	2007	2008	2009
Return on assets (%)	-0.7%	-1.8%	-2.7%	-0.7%
Gross margin ratio (%)	7.4%	6.0%	12.9%	12.3%
Net margin ratio (%)	-11.4%	-20.8%	-33.2%	-10.1%
Total asset turnover (times	0.06	0.09	0.08	0.07
Current ratio (%)	550.3%	207.1%	112.7%	193.6%
Equity ratio (%)	43.6%	32.2%	23.5%	19.4%
Cashflow (Yuan)	94,151,214	148,538,720	178,065,484	267,201,855

Source: Jiaxing Water Resources Investment Group Co., Ltd.

3) Shaoxing Sewage Treatment Plant

Although sales for the Shaoxing Water Treatment Development Co., Ltd. are increasing annually, net profit to sales have been negative since 2008. The sewage treatment rates for Shaoxing city in 2010 were 0.5 Yuna per cubic meter for households, 1.5 Yuna per cubic meter for commercial users, and 1.8 Yuna per cubic meter for industrial use. These are relatively lower when compared to other cities. In addition the income distribution between the Shaoxing County Water Discharge Corporation which operates and manages the sewer lines and pumping stations and the Shaoxing Water Treatment Development Co., Ltd. is 4 to 6. Reasons for the negative numbers are the fact that this is lower than operating costs and the fact that the management and financial costs are high. Capital ratio is 18.5% (2010) and current ratio is less than 100%, and therefore mid- and long-term stability as well as solvency is considered low. However, the sewage treatment rates in Shaoxing were changed in December of 2008 and the fact that industrial rates will increase to 3 Yuna per

cubic meter and the possibility of the distribution ratio with the discharge corporation being changed from 4:6 to 3.5:6.5 are positive factors from the financial perspective. When considering the public nature of the sewage treatment, it is hard to think that there will be any major problems with the sustainability of this project.

The government aims for the soundness and profitability of the sewage treatment project, and there is no compensation from the government and going forward, reduction in maintenance management costs through more efficient operations within the sewage treatment plant is required.

Table 9 Financial indicators of the Shaoxing Water Treatment Development Group Co., Ltd.

	2007	2008	2009
Return on assets (%)	0.5%	-2.6%	-1.3%
Gross margin ratio (%)	15.9%	9.8%	19.3%
Net margin ratio (%)	1.7%	-13.3%	-5.5%
Total asset turnover (times)	0.29	0.19	0.23
Current ratio (%)	101.2%	88.6%	66.3%
Equity ratio (%)	19.6%	8.7%	7.5%
Cashflow (Yuan)	69,941,668	78,494,686	83,883,925

Source: Shaoxing Water Treatment Development Group

3.5.4 Current Status of Operation and Maintenance

Although we see issues such as ageing and corrosion in some of the facilities, maintenance and repairs have been strengthened and appropriate upgrading plans have been established and there are no major obstacles. Specifically, every implementing agency has evaluated the status of operations and maintenance as being good and we have confirmed through facility inspections that appropriate operations and maintenance is being conducted.

In light of the above, despite the weak finances of the implementing agencies of the Jiaxing Sewage Treatment Plant and the Shaoxing Sewage Treatment Plant, because there are improvement factors at the time of evaluation, the high public nature of the sewage treatment project and the fair reassessment of rates going forward, we cannot say that there are major problems with sustainability. No major problems have been observed in the operation and maintenance system, therefore sustainability of the project effect is high.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

In order to achieve its environmental protection objectives, the Chinese government placed top priority on water contamination measures and urban environment measures and implemented various efforts to accomplish these measures. This project is part of these measures and was implemented in the cities of Hangzhou, Jiaxing and Shaoxing in Zhejiang Province, where industrialization and urbanization were progressing rapidly. Hangzhou and Jiaxing were designated as watershed cities of Lake Tai, where pollution is becoming increasingly serious. Shaoxing being a city of history culture was designated as a national priority tourist destination. Thus, all three cities had the highest need and priority for this project which aimed to improve the water quality in rivers by constructing a central sewage treatment facility.

The Hangzhou Sewage Treatment Plant as the wastewater treatment facility for the city's economic development zone, and the Jiaxing Sewage Treatment Plant and the Shaoxing Sewage Treatment Plant being the sole sewage treatment plants in their respective cities, all play a vital role in the sewage treatment of each city. Facility utilization for each is high and the treated water meets standards. The plants are contributing to the improvement of the water quality of the rivers in these cities as well as the living environments of nearby residents. Although there are some financial issues for the implementing agencies for each plant, they have no effect on the sustainability of the project effect.

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

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

In the management of a JICA yen loan project, it is expected that the project effects be monitored on a continual basis as an element of project operation and management even after the completion of the project. While the executing agency of this project has not been officially requested to monitor the project effects, the executing agency and implementing agencies are well-advised to monitor by themselves not only the project effects at the treatment plants but also the effects on water quality of the rivers concerned. It is hoped that all the agencies involved soon agree on an organizational structure necessary to enable either data acquisition from the competent environmental bureaus of their cities, or otherwise collect alternatively reliable data.

4.2.2 Recommendation to JICA

At the Jiaxing Sewage Treatment Plant and Shaoxing Sewage Treatment Plant, reuse and

detoxification treatment of dehydrated sludge for use as fuel at thermal power plants has already started and it has progressed to the stage where it can almost be used as a model for sludge dehydration and incineration processes. On the other hand, lowering of the moisture content of the sludge has become an issue.

In Zhejiang, the effort target is to incinerate 80% of the sludge, and going forward, technology and know-how will be required in order to recycle resources in a stable manner and at low cost in order to decrease the volume, stabilize and detoxify sludge. Sludge treatment is an area where the superiority of Japanese technology is expected to be able to contribute to, and it is hoped that indirect support will be provided to the sustaining and development of the field based on the JICA's efforts in the sludge treatment field to date.

4.3 Lessons Learned

This project was implemented using three subprojects with the objective of "The improvement of water quality in the rivers in the city and Lake Tai". However, in regards to the project objective of "Improving the water quality of Lake Tai", there was a divergence between the project implementation and the project objective. Taking into consideration the conditions at the time of the appraisal, one interpretation of the planned project concept may be "multiple subprojects with a common objective." Another interpretation would be that the project was planned as a sort of sector assistance project, as requested by the Chinese side, consisting of subprojects designed to achieve the higher goal of "Improving river water quality." If the former interpretation holds, concrete project objectives should have been defined when laying out the project plans and subprojects selection should have been made and their respective targets set in realistic and appropriate manners with full attention to their rationale to the defined project objective. If the latter interpretation holds, plans should have been laid out so that the effects of each subproject can be quantitatively grasped to the best extent possible. Either way, in order for JICA to perform consistent, coherent project management, it is essential to set appropriate and specific targets, as well as to explain and share these project targets with the associated persons of the recipient country already from the project appraisal stage.

End

Comparison of the Original and Actual Scope of the Project

Item	Plan	Actual
(1) Project Ouput 1. Hangzhou Sewage Treatment Plant construction	(1)Inflow volume 300,000 tons/day (2)Sewer pipe extension 25km	(1)As planned (2)Sewer pipe extension 18.3km
2. Jiaxing Sewage Treatment Plant construction	(1)Inflow volume 300,000 tons/day (2)Sewer pipe extension 110km (3)15 pumping stations	(1)As planned (2)Sewer pipe extension 136.76km (Initial plan length 92.36km, additional 44.4km) (3)18 pumping stations (Initial planned amount 14, additional 4)
3. Shaoxing Sewage Treatment Plant construction	(1)Inflow volume 300,000 tons/day (2)Sewer pipe extension 16km (3)4 pumping stations	(1)As planned (2)Canceled (3)Canceled
(2) Project Period	March, 2000 – December, 2000 (46 months)	March, 2000 – January, 2010 (119 months)
(3)Project Cost Amount paid in Foreign currency Amount paid in Local currency Total Japanese ODA loan portion Exchange rate	 11,256 million yen 21,825 million yen (1,445 million Yuna) 33,081 million yen 11,256 million yen 1 Yuna＝15 yen (As of March, 2000)	 11,204 million yen 23,763 million yen (1,694 million Yuna) 35,967 million yen 11,204 million yen Hangzhou Sewage Treatment Plant 1 Yuna=13.95 yen (1999 – 2004 average) Jiaxing Sewage

		Treatment Plant 1 Yuna=14.01 yen (1999 – 2010 average) Shaoxing Sewage Treatment Plant 1 Yuna=14.15 yen (1999 – 2002 average)

China

Ex-Post Evaluation of Japanese ODA Loan Project

"Tianjin Wastewater Treatment Project"

External Evaluator: Yuko Kishino, IC Net Limited.

0. Summary

This project is intended to improve the water quality of the rivers that flow through Tianjin city by improving wastewater treatment facilities in the central part of Tianjin city, one of national cities of the China, where water contamination is a serious problem. This project plays a major role in wastewater treatment in the central part of Tianjin. It has also had great importance in terms of the improvement of water quality in the rivers within the city and an impact on the water quality of the Bo Hai area. The implementation of the project improved the water quality of rivers into which untreated wastewater had been discharged, giving as well a positive impact on the living environment of residents in the vicinity of the rivers.

The properties that were constructed by the use of the yen loan were sold to and are owned, run, operated, maintained and managed by Tianjin Capital Environmental Protection Group Co., Ltd. at the time of the ex-post evaluation. No major problems were found in any of structural, technical, or financial aspects. There were not any serious concerns from the viewpoints of achieving the development objectives and the sustainability of the project. On the other hand, this privatization was led by Tianjin Municipal People's Government and it is considered that its process to select an organization in competitive procedures would have been appreciated.

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

1. Project Description

Project Locations

Xianyanglu Sewage Treatment Plant

1.1 Background

With recent rapid urbanization and the improvement of people's living standards, the total sewage volume is increasing rapidly and the quality of surface water is deteriorating in China. Among the rivers in China, the "Three Rivers" (Hai, Liao and Huai Rivers) especially have serious water quality problems. To secure safe water sources, the Chinese government has strengthened the regulations on industrial effluents and has implemented measures that focus on improving sewage systems in urban areas.

One of the Three Rivers, Hai River[1], is formed by five rivers, i.e. North Canal, South Canal, Daquing River, Ziya River and Yongding River, which meet in the city area of Tianjin and finally flows into the Bo Hai. At the time of the appraisal, the rivers running into the Tianjin city area were substantially contaminated. Polluted rainfall water and irrigation drain water ran into the mainstream of the Hai River. Since there was no inflow of water from upstream during non-rainy seasons, even the National Surface Water Quality Standard of Class V[2] had not been met for more than six months. To stop the contamination of the Hai River in the Tianjin city area, drainage canals had been open-cut in the northern and southern parts of Hai River since the late 1950s and the drain system had been formed in the central area of the city. However, as a result of the rapid increase of domestic drainage and the lack of sewage treatment capacity in recent years, a great amount of untreated sewage water was discharged into the drainage canals and rivers. The water quality of water channels of the city got worse to such a level that could not satisfy the national surface water quality standards, which led to adverse effects on the water quality of related first-class rivers and the Bo Hai area.

Against this background, the Chinese government decided to put in place a sewage system in Tianjin city to improve the water quality of the rivers running through the city.

1.2 Project Outline

The objective of this project is to improve the quality of the rivers in Tianjin city (including the Bo Hai) by putting in place sewage treatment facilities and drainage canals in Tianjin city, where the population is increasing and production activities are expanding, thereby contributing to the improvement of the people's living environment in Tianjin city

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[1] One of the biggest rivers in North China that runs through Hebei province, Henan province, Shandong province, Shansi province, Inner Mongolia Autonomous Region, Beijing city and Tianjin city.

[2] National Surface Water Quality Standard GB3838－1988 was put into effect in 1988 by the National Environmental Protection Bureau (the current Ministry of Environmental Protection of the People's Republic of China). It categorizes water quality into 6 Classes, I – V, based on 30 water quality indicators such as Chemical Oxygen Demand (COD), with Class I being the highest and V the lowest. For Class I and II, COD must be 15mg/l or lower, 15mg/l for Class III, 20mg/l for Class IV and 25mg/l for Class V. In GB3838－2002, revised in 2002, the standards were partly lowered with COD for Class I and II being 15mg/l or less, 20mg/l for Class III, 30mg/l for Class IV, and 40mg/l for Class V.

Loan Approved Amount/ Disbursed Amount	7,142 million yen/7,014 million yen
Exchange of Notes Date/ Loan Agreement Signing Date	March 2001/March 2001
Terms and Conditions	Interest rate: 1.3%(South-East Suburb Area) 0.75％ (Other areas) Repayment period: 30 years (South-East Suburb Area), 40years (Other areas) (Grace Period: 10 years) General untied (South-East Suburb Area) Bilateral tied (Other areas)
Borrower / Executing Agency Implementing agency at the time of appraisal Implementing agency at the time of evaluation	The Government of the People's Republic of China/ Tianjin Municipal People's Government Tianjin Sewage Corporation Tianjin Capital Environmental Protection Group Co., Ltd.
Final Disbursement Date	July 2008
Main Contractor	Tianjin Machinery & Electric Equipment Imp. & Exp. Co., Ltd. (The People's Republic of China)
Main Consultant	None
Feasibility Studies, etc.	F/S North China Municipal Engineering Design & Research Institute, Tianjin Municipal Engineering Administration Bureau July 1999
Related Projects	Technical cooperation project, "Project for Upgrade and Improvement of Wastewater Treatment System", Other[3]

[3] The World Bank loan "Tianjin Jiefang South Road Area Sewage Treatment Improvement Project" and the Asian Development Bank loan "Beicang Wastewater Treatment Plant Construction Project"

2. Outline of the Evaluation Study

2.1 External Evaluator

Yuko Kishino, IC Net Limited.

2.2 Duration of Evaluation Study

This ex-post evaluation was conducted in the following period:

Duration of the Study: November 2010 – October 2011

Duration of the Field Study: January 9, 2011 – January 22, 2011; June 3, 2011 – June 9, 2011

2.3 Constraints during the Evaluation Study

Since it was not possible to obtain some of the indicators needed to evaluate the level of achievement of the project objectives, a qualitative evaluation was conducted based on certain presumptions. In evaluating the effectiveness, the original policy was to make a determination based on the water quality improvement levels of rivers in the city as well as the operation status of the subprojects. For the field study, it was planned to identify the rivers in the city that must have been affected by the project, quantitatively analyze the trends of their water quality, and study the factors other than those of this project that might have impacted changes in water quality. Attempting to obtain water quality data for the rivers, the Environmental Protection Bureau of the Tianjin Municipal People's Government had a policy of not being able to provide related data. This has led the evaluation policy to be changed, mainly investigating the operation status of the subprojects, and as to the water quality improvement of the rivers, a qualitative evaluation was conducted supplementary based on surveys of the beneficiaries[4].

[4] Since it was impossible to conduct a sample survey with sufficient statistical significance given the time period and the budget for this ex-post evaluation survey, the number of samples was small, namely 100, and the result of the beneficiary survey does not represent the entire population.

3. Results of the Evaluation (Overall Rating: A[5])

3.1 Relevance (Rating: ③[6])

3.1.1 Relevance with the Development Plan of China

(1) Development plan at the time of appraisal

In its National Environmental Protection Ninth Five-year Plan and 2010 Long-term Goal, the Chinese government set an objective of "stopping environmental pollution and degradation of the ecological system, improving the environment of selected cities and regions, and establishing model cities and regions for economic development, environmental safety, ecosystem protection." The State Environment Protection Administration (SEPA) developed the Hai River Basin Pollution Prevention and Control Plan and set a target to substantially reduce the discharge of chemical oxygen demand[7] (hereinafter COD) in urban areas and rural areas in the Hai River Basin[8] including Tianjin city, in order to secure safe drinking water. To achieve this target, the improvement of drainage systems for sources of industrial pollution and the construction of sewage treatment plants in urban areas were positioned as priority projects.

Tianjin city, which is one of the four major direct-controlled municipalities in China, set a goal to improve its sewage treatment rate from 52% to 84.5% and sewage pipe line development rate from 55% to 94.5% by 2010 in the Ninth Five-year Plan. It also planned to construct sewage systems for the six drain systems (i.e. Zhaoguli, Beicang, Zhangguizhuang, Xianyang, Jizhuangzi and Shuanglin Sewage systems) in the central area.

(2) Development plan at the time of ex-post evaluation

The improvement of the water environment is one of the priority areas of the National Environment Protection Eleventh Five-year Plan and the measures that focus on the urban area sewage treatment project have been implemented continuously. Tianjin city was designated a priority city in the Hai River Basin Water Quality Contamination Prevention Rule (2006 – 2010, 2011 – 2015). Tianjin city is required to substantially reduce the COD discharge by improving urban sewage treatment plants and industrial effluent.

This project aims to put in place sewage treatment plants in the central area of Tianjin city as well as improving the water environment that is deemed to be a priority issue in the National Environment Protection Plan. It has a high relevance with the development plan.

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

[6] ③:High,②:Fair,①:Low

[7] Chemical oxygen demand is used as an indicator to show the degree of water pollution and refers to the amount of oxygen consumed when organic substances in the water is oxidize with an oxidizing agent.

[8] Four provinces, i.e. Hebei, Henan, Shandong and Shansi, and two cities, i.e. Beijing and Tianjin

3.1.2 Relevance with the Development Needs of China

3.1.2.1 Needs for sewage system improvements in Tianjin city

At the time of the appraisal, only two of the six sewage systems in the central area of Tianjin city were equipped with sewage treatment plants: Jizhuangzi Sewage system (Jzhuangzi Sewage Treatment Plant) and Zhaoguli Sewage system (Dongjiao Sewage Treatment Plant). As for the four other drain systems, domestic and industrial wastewater was discharged into the Yongding Xin River and the artificially open-cut Beicang Drainage Canal located in the northern part of the city, and the Dagu Drainage Canal located in the southern part of the city to prevent such wastewater from flowing directly into the Hai River. There was no drainpipe network in the South-East Suburban Area of the Zhangguizhuang Sewage system and wastewater was discharged into the Hai River via the Tianjin Outer River. A great amount of untreated sewage water was discharged into the Bo Hai via rivers in the city, causing serious contamination to the Bo Hai area. There was an urgent need to improve the sewage treatment system in the central area of Tianjin.

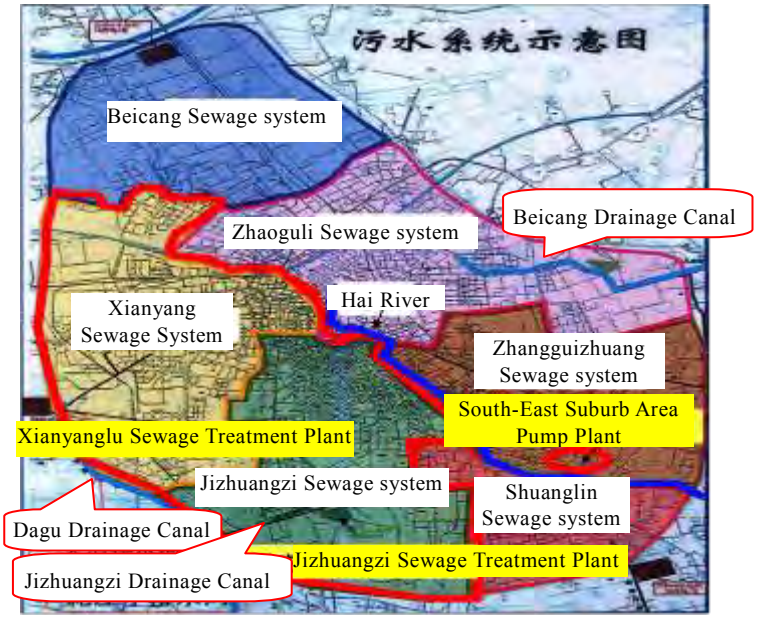

Figure 1 Map of sewage treatment systems in the central area of Tianjin city

Note: Areas enclosed with red bold lines were covered by this project.

3.1.2.2 Project Relevance[9]

(1) Relevance of set project objectives and project goals

The plan for this project partly lacks relevance in terms of clarity and logic. In the materials used at the time of the project appraisal by JICA, it was clearly stated as an

[9] The relevance of project planning is not included in the evaluation of the overall relevance rating, because at the time of the project appraisal it was not required to set a goal based on strictly-defined project objectives and indicators. In addition, there has been an apparent difference in recognition of the role of the project between the two countries.

objective of the project that the water quality of the rivers in Tianjin city including the Bo Hai would be improved, and that as a qualitative effect the water quality of the Hai River would also be improved as a result of removing pollutants. However, whether the target of the project was the Hai River or other rivers in the city was not clear, and nor was a water quality goal set. Meanwhile, considering the structure and scale of the subprojects, it is not logical to make the Hai River a target of the project. Wastewater from the sewage systems covered by the two subprojects, the Jizhuangzi Sewage Treatment Plant Expansion Project and Xianyanglu Sewage Treatment Plant Construction Project, was to be discharged into the Jizhuangzi Drainage Canal and the Dagu Drainage Canal and then emptied into the Bo Hai, which is approximately 70km away. There is no geographical linkage between this route and the Hai River. Another subproject, the Drainage Project in South-East Suburb Area to construct a pumping station in the South-East Suburban Area, makes an impact on the water quality of the Hai River, and the impact on the water quality of Tinajin city area is limited due to the scale of the subproject, considering the fact that the water quality in the Tinajin city area, which lies downstream of the Hai River water system, is greatly affected by upstream water quality. In addition, although the project targets the water quality improvement of the Bo Hai, it is difficult to expect a direct impact because of the geographical distance of the project area. According to the executing agency and implementing agency on the China side, they recognized that the objective of the project was to improve the quality of water treated at the sewage treatment plants, which clearly showed a difference in recognition of project objectives between China and Japan.

It is suspected that the project plan became unclear because the project objectives, the rivers targeted by the project and the specific goals such as numerical targets had not been adequately discussed between the two countries at the time of the project appraisal. The supervisory authority, the Environmental Protection Bureau of Tianjin, did not regularly monitor the water quality status of the rivers as intended by the Japan side, under this project between the two countries. As a result, the water quality data for the rivers was not provided at the ex-post evaluation of the project, and it was impossible to make a qualitative evaluation based on this data.

The current Japan International Cooperation Agency (JICA) evaluation system is based on comparisons between the plan at the time of appraisal and actual. In developing a project plan, specific goals should have been set, defining appropriate and clear project objectives to reach an agreement between Japan and China.

(2) Relevance of project scale

At the time of the appraisal, the treatment capacity was planned to be 540,000 tons/day at the Jizhuangzi Sewage Treatment Plant and 450,000 tons/day at the Xianyanglu Sewage

Treatment Plant. As mentioned below, the actual sewage volume in the treatment area did not increase as predicted and the capacity utilization rate of the project stayed at around 70% in 2009 even when the sewage treatment rate exceeded 80% in Tianjin city.

This is due to the problem of demand overestimation and capacity overdesign at the time of project appraisal rather than the effectiveness of the project. The treatment capacity of each sewage treatment plant was determined based on the sewage volume and the expected population increase in 1996 when the wastewater flow increased rapidly. However, as a result of the water shortages in Tianjin city and water-saving measures taken by the Tianjin Municipal People's Government, the sewage volume in Tianjin is now lower than in 1996. Especially in the treatment areas, the amount of wastewater was less than prediction partly because the Government took measures such as encouraging plants that used a lot of water to move to suburban areas. Since the amount of wastewater that flows into the sewage treatment plan may change depending on the amount of water resources and the treatment plans in the area, it can be said that a more careful planning was required.

3.1.3 Relevance with Japan's ODA Policy

In the Economic Cooperation Program for China in 2001, the Japanese government positioned "Cooperation to address global issues such as environmental problems" as a high-priority issue, with a policy to put greater focus on areas such as the preservation of environmental and ecological systems, the improvement of people's livelihoods and social development in inland areas, the development of human resources, the establishment of systems and technological transfers. Also the Guidelines for Overseas Economic Cooperation Operations (1999) positioned environment as a priority area, and took up environmental protection as one element of Japan's economic cooperation, to encourage the balanced development of China and to promote a shift to a market economy. In the Country Project Implementation Policy, a policy to provide assistance through improving sewage systems was announced more specifically based on the recognition that the "construction of sewage treatment plants was delayed and the decrease in safe water sources due to water pollution was a problem."

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

3.2 Efficiency (Rating: ②)

3.2.1 Project Outputs

Construction of the Jizhuangzi Sewage Treatment Plant and Xianyanglu Sewage Treatment Plant was conducted almost as planned. At the Jizhuangzi Sewage Treatment

Plant, in addition to expansion, modification was done to all the existing facilities. A sewer culvert was constructed for all of the three subprojects[10].

Fig. 2 Jizhuangzi Sewage Treatment Plant aeration tank

Fig. 3 Xianyanglu Sewage Treatment Plant aeration tank

A change was made to the plan that was presented at the time of appraisal with regard to the rainwater pumping station in the South-East Suburban Area. In the original plan, three pumping stations were to be constructed, the Shaliulu Rainwater, Huangyanlu Road and Yuejin Road Pump Stations. Construction of the Shaliulu Rainwater Pumping Station was cancelled because its construction site overlapped the new road that was to be constructed under the Tianjin Hai River Banks Comprehensive Development Plan, which was developed later. There was no choice but to review the arrangement and begin construction after the Tianjin Hai River Banks Comprehensive Development Plan had been finalized. Based on the request from the Chinese government, JICA extended the loan disbursement deadline by two years[11], and tried to address the situation. In spite of that, it took a long time to finalize the plan and the plan was cancelled because it looked impossible to begin construction of the pumping station by the new loan disbursement deadline. As a result, while the rainwater conveyance capacity decreased, the two pumping stations are capable of managing the situation, because the South-East Suburban Area is still undeveloped and rainwater penetration is relatively high. In addition, the rainwater contamination level is low in the area, and even though untreated rainwater is directly discharged into the rivers, it is not likely to make a great impact on water quality. A new pumping station is to be constructed in the future depending on the development status and necessity of the area.

[10] It was not provided as a plan in the appraisal document. It was included in the plan made by the Chinese side and implemented according to the plan.
[11] Changed from original deadline, July 27, 2006, to July 27, 2008

Fig. 4 Rainwater pump

Fig. 5 Yuejin Road pumping station

A change was made to the Jizhuangzi Sewage Treatment Plant after the completion of the project. In 2009, the capacity of the treatment facilities was reduced from 540,000 tons/day to 450,000 tons/day. In 2008, under the Urban Sewage Treatment Plant Pollutants Discharge Criteria, GB18918-2002, Class I-B was newly applied[12]. The change was made as a result of the addition of a treatment processes such as biological denitrification to satisfy the criteria for phosphorus, nitrogen and ammoniac nitrogen. A space to install the related equipment became necessary in order to add treatment processes. Since it was impossible to expand the site, they reduced the capacity of the treatment facilities to secure treatment effects. Since 2005, the Tianjin Municipal People's Government has tried to stop the increase of sewage volume; some industrial plants served by the Jizhuangzi Sewage system were told to move out to suburban areas to reduce the industrial effluent load in the city and households were asked to reduce the domestic use of water through water-saving measures. As shown in Figure 6, the sewage volume in Tianjin city has remained at the same level over recent years and there has been no impact from the reduction of treatment capacity.

[12] Changed from the "the Comprehensive Wastewater Discharge Standard" GB8978-1996 Class II

(Unit: 10,000 tons)

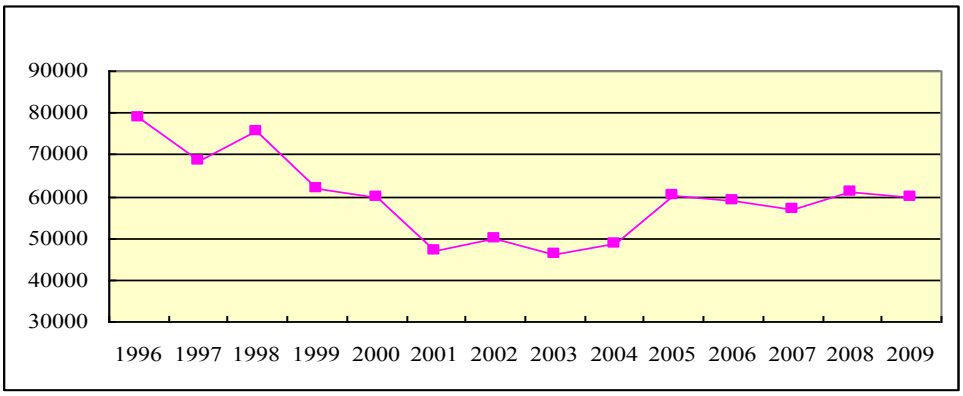

Figure 6 Sewage volume in Tianjin

Source: Tianjin Environmental Information Newsletter

3.2.2 Project Inputs

3.2.2.1 Project Cost

The total project cost was 28.326 billion yen (of which 7.14 billion yen was in foreign currency), which fell within the planned cost of 28.592 billion yen (of which 7.142 billion yen was in foreign currency). While the cost for constructing the Xianyanglu Sewage Treatment Plant was kept low and the construction of one pumping station in the South-East Suburban Area was cancelled, the cost for constructing the Jizhuangzi Sewage Treatment Plant increased with the additional procurement of deodorization facilities, etc., and the Yuan increased in value against the yen[13]. In total, there was not a big difference between the total planned and the actual costs.

3.2.2.2 Project Period

The total project period was planned to be 40 months: starting in March 2001 and ending in June 2004. The actual period was 60 months that started in March 2001 and ended in February 2006. The total period was one and half times as long as the plan. By subproject, the project period was 200% of the planned period for the Jizhuangzi Sewage Treatment Plant, 181% for the South-East Suburban Area and 135% for the Xianyanglu Sewage Treatment Plant compared to the plan.

The reasons for the substantial delay in the project period were the change in construction processes at the Jizhuangzi Sewage Treatment Plant and some external factors in the South-East Suburban Area. According to the original plan, upgrading the existing facilities and capacity expansion construction were to be conducted in parallel at the

[13] 1 Yuan = 13 yen in the plan at the time of appraisal, 1 Yuan = 14.3327 yen at the time of the evaluation

Jizhuangzi Sewage Treatment Plant. However, it turned out that the operation of the existing facilities was restricted more severely than anticipated by the expansion work, to the extent that sewage treatment would be entirely impaired. The construction schedule was changed to make upgrades only after the completion of the expansion, which led to the extension of the work period. As mentioned above, the South-East Suburban Area was affected by the Tianjin Hai River Banks Comprehensive Development Plan. Since the plan for the upstream area of the Hai River was finalized first, it took a long time for the plan for the South-East Suburban Area to be finalized as it was located downstream. As a result, construction began four years later, and completion was delayed by 30 months. There were other factors that caused a delay in the project: it took a long time to procure materials because of the Severe Acute Respiratory Syndrome (SARS) outbreak in 2003, and there was a delay in the delivery of some materials due to the impact of the 2005 Sumatra earthquake.

Although the project cost was within the plan, the project period was exceeded; therefore efficiency of the project is fair.

3.3 Effectiveness (Rating: ③)

3.3.1 Quantitative Effects

As mentioned in the section "2.3 Constraints during the Evaluation Study," the evaluation of effectiveness is made mainly in terms of the operation status of the sewage treatment plants, and the evaluation of water quality improvements is made qualitatively based on the results of the beneficiary surveys. The indicators used for the evaluation of the operation status of the sewage treatment plants are: capacity utilization rate, sewage treatment volume, pollutant removal volume and effluent water quality.

3.3.1.1 Results from Operation and Effect Indicators at sewage treatment plants

(1) Increase in Sewage Treatment Capacity (Facility Utilization Rate)

The sewage treatment rate increased from 51.8% in 1999 to 80.1%[14] in 2009 in Tianjin and almost achieved its goal. The daily treatment capacity at the sewage treatment plants in the central area of Tianjin increased from 660,000 tons at the time of appraisal to 1,400,000 tons[15], 64% of which came from the Jizhuangzi Sewage Treatment Plant and Xianyanglu Sewage Treatment Plant that were improved under this project. It can be said that the project greatly contributed to the improvement of the sewage treatment capacity in the central area of Tianjin.

[14] Tianjin Statistical Yearbook

[15] 450,000 t/day at Jizhuangzi Sewage Treatment Plant and Xianyanglu Sewage Treatment Plant. 400,000 t/day at Dongjiao sewage treatment plant, and 100,000 t/day at Beicang Wastewater Treatment Plant

Looking at the capacity utilization rate[16], an indicator of how well the sewage treatment facilities are operated, the rate has been on a certain increasing trend at both the Jizhuangzi Sewage Treatment Plant and Xianyanglu Sewage Treatment Plant from around 40%, the level achieved at the completion of the project in 2005. However, the capacity utilization rate went down in 2010 except for at the Xianyanglu Sewage Treatment Plant. This is related to the fact that the Tianjin Municipal People's Government reviewed the industrial facilities arrangement plan of the entire city in 2009 and encouraged the relocation of plants out of the central area, which was using a large amount of water, to the suburbs. The sewage volume decreased in the covered areas and this led to the drop in the capacity utilization rate. Since the Xianyanglu Sewage Treatment Plant expanded its coverage area to outside of the central area, its capacity utilization rate increased. The current status of each treatment plant is as follows.

At the Jizhuangzi Sewage Treatment Plant, the capacity utilization rate had been more than 95% before implementing the project and its treatment capacity had almost reached its limit. After the capacity expansion was completed and more terminal sewer networks came to be connected, the plant become able to receive sewage from boarder areas and its daily sewage treatment volume increased from approximately 259,000 tons in 2004 to 337,800 tons in 2009. The capacity utilization rate rose to 75%, partly because the plant started to accept three to four tons of wastewater daily from the Shuanglin Sewage system and the treatment capacity was reduced to 450,000 tons/day in 2009. As mentioned above, the capacity utilization rate declined to 68% in 2010 due to a decrease in the wastewater volume in the service areas.

[16] Average daily treatment volume/facility capacity

(Unit: %)

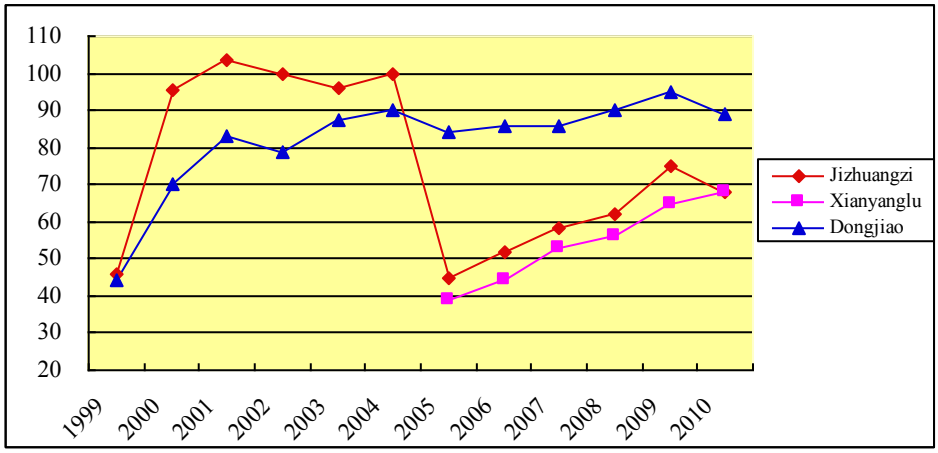

Figure 7 Facility utilization rate at the three sewage treatment plants

The capacity utilization rate is low, namely 39% in the first year at the Xianyanglu Sewage Treatment Plant. This is because the service area was limited, as three pumping stations were planned to be constructed but one of them had not been completed (which was not covered by a yen loan). When the remaining pumping station was completed in 2008, the capacity utilization rate rose to 56%. Then, after the Xianyanglu Sewage Treatment Plant started to treat the sewage generated in the development area that was located outside the central area of Tianjin city, the rate increased and reached 68% in 2010.

As a result of the improvements in pumping stations and the sewage system under this project, it became possible to transfer sewage from the Zhangguizhuang Sewage system, in addition to that of the Zhaoguli Sewage system which had already been transferred to the Dongjiao Sewage Treatment Plant in the South-East Suburban Area. The sewage intake area of the Zhangguizhuang Sewage system increased from approximately 70% to 100%, and the capacity utilization rate of the Dongjiao Sewage Treatment Plant rose from 84% in 2005 to 90% in 2008 and then 95% in 2009. The operation rate dropped to 89% in 2010 due to the same reason as for the Jizhuangzi Sewage Treatment Plant.

As mentioned above, the implementation of this project substantially improved the sewage treatment capacity and the sewage service area in central Tianjin. The reason why the capacity utilization rate remains at around 70% is largely a result of the water-saving measures taken by the Tianjin Municipal People's Government. Since 2005, the year in which the city suffered a significant water shortage[17], the water-saving measures have been implemented throughout the city. When compared to the level in 1995 to 1996, the base

[17] The amount of water resources of Tianjin city was 1.063 billion tons in 2005, decreasing by 26% year-on-year. The amount per person is at the lowest level in China.

level for the plan at the time of appraisal, the use of domestic noncommercial water decreased by approximately 29% from 238.12 million tons in 1996[18] to 169.2 million tons in 2007[19], and daily water use per person dropped by approximately 25% from 149.1 liters in 1995[20] to 122.38 liters in 2007[21]. In the central area, the Tianjin government tried to stop the increase in sewage volume by encouraging factories, which were major users, to move to suburban areas. On the other hand, in the plan at the time of the appraisal, the treatment capacity was determined based on the sewage volume in 1996 when a great amount of wastewater was generated, i.e. 466,900 tons in the Jizhuangzi Sewage System and 399,500 tons in the Xianyang Sewage system. For the Jizhuangzi Sewage system, the estimation that the population would increase at an annual rate of 2.3% until 2000 was also used as a base. Although no specific population data for each treatment area[22] was available, this assumed rate turned out to be higher than the average annual population increase in the past eleven years of 1.9%, in the Tianjin urban area[23].

As seen from the above, the estimation was actually too high. It can be said that the low capacity utilization rate resulted from an excess in the design capacity of the sewage treatment plants. As mentioned in the section "Relevance," this was a problem with the plan itself, and the restrained sewage volume is indeed consistent with the intended objectives of this project, namely, "Reduction of pollutants" and "Water quality improvements of rivers within the city." Therefore it should not be evaluated as a negative point in effectiveness.

(2) Sewage Treatment Volume and Reduction Volume of Pollutants

To know the quantity of pollutants that were eliminated through the implementation of this project, the target values and actual values of wastewater treatment volume and water quality indicators were compared. The results are shown in Table 1. As representative indicators of water quality, COD, biological oxygen demand[24] (hereinafter BOD) and suspended solids[25] (hereinafter SS) were used.

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[18] China Statistical Yearbook (1997)
[19] Tianjin Statistical Yearbook (2010)
[20] Material prepared at the time of JICA appraisal
[21] Tianjin Statistical Yearbook (2010)
[22] No data was taken about the population of the sewage service area. It is impossible to know the population as the service zone boundary and the administrative boundary are different.
[23] Includes 15 administrative regions, Economic and Technical Development Zone and Tianjin Iron Plant
[24] Biological oxygen demand is an indicator of water pollution and is important as one of the items for regulation in industrial wastewater. It is expressed as the amount of oxygen consumed when microorganisms decompose organic substances in the water. A bigger value represents a higher water contamination level.
[25] Suspended solids are infusible particle matter that is suspended in water, and includes fine particles originating in clay mineral, living and dead zooplankton and phytoplankton, organic substances originating in sewage and industrial wastewater, deposition of metal, etc.

Table 1 Quantity of pollutants removed (overall)

	Plan (2005)	2nd year Actual (2006)			3rd year Actual (2007)			6th year Actual (2010)		
			Elimination rate	Rate to plan		Elimination rate	Rate to plan		Elimination rate	Rate to plan
Sewage treatment volume (10,000㎥/day)	99	48.1	–	49%	55.7	–	56%	61.1	–	62%
COD elimination quantity (t/year)	80,600	78,365.3	93%	97%	55,804.2	85%	69%	109,616.4	89%	136%
BOD elimination quantity (t/year)	42,000	33,687.7	95%	80%	29,002.8	90%	69%	48,619.3	96%	116%
SS elimination quantity (t/year)	59,600	49,498.5	98%	83%	35,493.4	94%	60%	79,285.1	95%	133%
Total elimination quantity (t/year)	182,200	161,551.5	–	89%	120,300.3	–	66%	237,520.8	–	130%

Source: Tianjin Capital Environmental Protection Group Co., Ltd.
Note: Removal rate is the average of that at the Jizhuangzi Sewage Treatment Plant and Xianyanglu Sewage Treatment Plant

The targeted values at the appraisal were for the year 2005. In that year, the Jizhuangzi Sewage Treatment Plant was in the third year of operation after expansion and the Xianyanglu Sewage Treatment Plant was in its second year of operation. When comparing the targets and the actual figures for the two treatment plants collectively, while the sewage treatment volume was roughly half, the total quantity of pollutants removed was higher: 89% in the second year and 66% in the third year compared to the plan. The achievement-to-target ratio can thus be said to be moderate. The removal rate was high in both years, namely more than 85%. When considering the sewage treatment volume only, if the treatment volume is lower than the planned value, the quantity of pollutants removed should become lower as well. Actually, however, there were some cases (as in the second and the sixth years) that the removed quantity was almost the same as the above plan. This is due to the change in the quality of incoming sewage and fluctuations that have been especially high at the Xianyanglu Sewage Treatment Plant. Since 2009, the Xianyanglu Sewage Treatment Plant has accepted wastewater from factories located in the development district. The quality of accepted wastewater significantly declined in 2010, which led to the increase in the quantity of pollutants removed.

It can be said that the Drainage Project in the South-East Suburban Area contributed to a decrease in pollutant discharges in terms of decreasing the volume of untreated wastewater discharged by allowing the Zhangguizhuang Sewage system to expand its service area. Before the implementation of the project, wastewater was emptied into the Hai River via channels and circular rivers, and most rainwater flowed into the Hai River untreated in the South-East Suburban Area. After the project was implemented, wastewater started to be collected in separate systems for rainwater and sewage respectively and all was treated at the Dongjiao Sewage Treatment Plant, except for rainwater at times of heavy rain.

(3) Discharge Water Quality

The water quality of final effluent after treatment made possible by this project satisfied the integrated wastewater discharge standards specified by the Chinese government and by the Tianjin government both at the time of the completion of the project and the ex-post evaluation.

At the time of the appraisal, the "Integrated Wastewater Discharge Standard", GB8978-1996 Class II[26] was applied. Then, the application of the "Urban Sewage Treatment Plant Pollutants Discharge Standard", GB18918-2002 Class II[27] started in 2002. When the project was completed, the water treated at the Jizhuangzi Sewage Treatment Plant and the Xianyanglu Sewage Treatment Plant both satisfied this standard. However, compliance with the standard equivalent to GB18918-2002 Class I-B[28] was required starting from 2008 and it became impossible to satisfy the concentration standards for total phospho, total nitrogen and ammoniac nitrogen only with the facilities improved by the yen-loan project. To address this situation, self-financed construction work was started to modify the existing facilities to add a biological process for nitrogen and phosphor removal and equipment for the addition of phosphor removal chemicals. Major construction work was completed by the end of 2010 and the water quality level of final effluent achieved the Class I-B standard.

3.3.1.2 Improvement of Water Pollution

(1) Beneficiary's Recognition of Water Quality of Rivers

For the purpose of this evaluation, the Jizhuangzi Drainage Canal and Dagu Drainage Canal (into which wastewater of the Xianyang Sewage System and the Jizhuangzi Sewage System had been discharged before the implementation of the project) are regarded as rivers that received effects from the project. This is because the treatment plant has become the only source of water inflow in each of these canals after the implementation of the project; they are free from any effects from the quality of upstream water and enabled a clear examination of the effects of the project.

While no quantitative evaluation using water quality data from the rivers was possible, a beneficiary survey was conducted covering 50 residents in the Huayuan residential area, Xiqing District, located at the intersection of the Dagu Drainage Canal and the Chentaizi Drainage Canal in the south of the Xianyanglu Sewage Treatment Plant, which showed that

[26] In 2006, the National Environmental Protection Agency made an announcement of the application of Class B Criteria to those urban sewage treatment plants that discharged wastewater into important areas. In response, Tianjin Environmental Protection Department issued the Tianjin local standard, "Comprehensive Sewage Discharge Standard" DB12/356-2008 in 2008. Provisions for contaminant concentration: COD-120mg/l、BOD-30 mg/l, SS-30 mg/l l

[27] Provisions for contaminant concentration: COD-100mg/l, BOD-30 mg/l, and SS-30 mg/l

[28] Provisions for contaminant concentration: COD-60mg/l, BOD-20 mg/l, SS-20 mg/l

most did recognize that the water quality of the Dagu Drainage Canal had been improved after the construction of the Xianyanglu Sewage Treatment Plant. Another beneficiary survey was conducted on any changes in water quality, covering 50 residents in the Cuijia Matou Cun, Dongli District[29], located in the south suburban area of the Zhangguizhuang Sewage system. The results showed that they recognized an improvement in the water quality as a result of the implemented project.

After the project was completed, 64% of the respondents of the Huayuan residential area, Xiqing District and 68% of those of the Cuijia Matou Cun, Dongli District answered that the rivers were "Significantly cleaned up" or "Slightly cleaned up." As reasons for such improvements, 66% in the Huayuan residential area, Xiqing District and 47% in the Cuijia Matou Cun, Dongli District cited the "Improvement of the sewage treatment plant" and 44% in the Huayuan residential area, Xiqing District and 47% in the Cuijia Matou Cun, Dongli District cited the "Improvement of the sewage system." Approximately half of the respondents recognized the positive effects of the project. In the Huayuan residential area, Xiqing District, while 46% of the respondents had thought that water in the rivers was "wastewater that can be utilized for nothing" before implementing the project, this was reduced to 8% after the project. Also in the Cuijia Matou Cun, Dongli District, the respondents who answered in this manner decreased from 28% to 0%. These results show there was a change in recognition toward the rivers. On the other hand, respondents who answered that the rivers were "Hardly cleaned up" or " Not significantly cleaned up" were 16% in the Huayuan residential area, Xiqing District and remained as low as 10% in the Cuijia Matou Cun, Dongli District.

[29] Rural area that is located in the vicinity of the construction site for the South-East Suburban Area Pump Station and whose sewer culvert was linked with the Dongjiao Sewage Treatment Plant by this project.

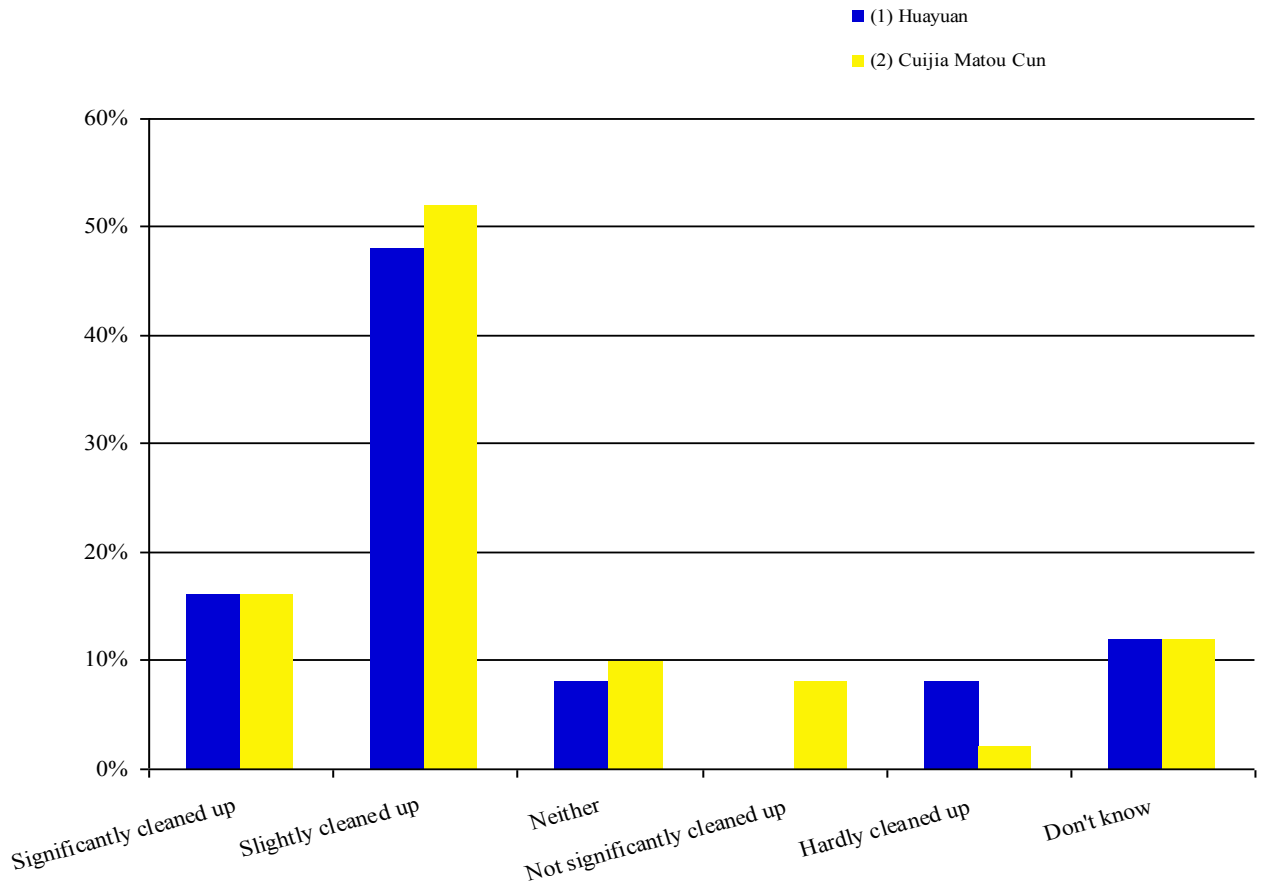


Figure 8　Changes in water quality

Since the number of samples was small, the results of the beneficiary survey do not necessarily represent the view of all of the beneficiaries of this project. However, it was confirmed that a certain level of water improvement had been accomplished by the project.

When calculating from the water use per person[30] and the living drainage treatment volume[31] in Tianjin city, the beneficiaries of the project were estimated to be approximately 800,000 people[32].

(2) Water Quality of the Bo Hai

The Jizhuangzi Drainage Canal, which has the project site in its most upstream area, meets the Dagu Drainage Canal to empty into the Bo Hai. On the other hand, there is a 70km distance to the Bo Hai, and zones that are distant from the areas covered by the project are affected by domestic and the industrial wastewater, as well as water quality

[30] 186.6m^3 (2009) Source: Tianjin Statistical Yearbook
[31] Domestic wastewater is 67% and industrial wastewater is 33%.
[32] Estimated to be 1.96 million people at the time of appraisal

improvement projects other than this one. Considering this, even though the project objective was cited as “Water quality improvements in the rivers in Tianjin city (including the Bo Hai)”, it is not realistic to expect an improvement in water quality of the Bo Hai as a direct effect of this project. Likewise, it is also impossible to verify the relationship of the project with the water quality of the Bo Hai. If, by way of reference, one looks at the composition by national surface water quality classification of the seawater quality in the the Bo Hai coastal area, it can be seen that Over Class V decreased from 61% in 2000 to 42% in 2009. And although Class I to III dropped to 14.4% in 2001, they recovered to 34.4% in 2009.

(Unit: %)

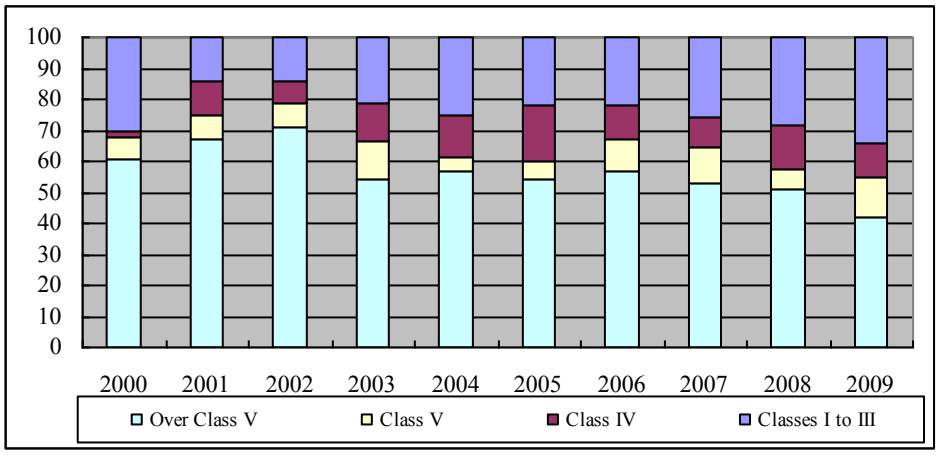


Figure 9 Seawater qualities in the Bo Hai coastal area by national surface water classification

3.3.1.3 Financial Internal Rate of Return

At the time of the appraisal, the Financial Internal Rate of Return was calculated based on the following conditions: project life of 40 years: benefits of income from sewage treatment, and expenditures consisting of construction costs, sewage treatment costs, maintenance costs and taxes. The results were 14.5% for the Jizhuangzi Sewage Treatment Plant and 1.1% for the Xianyanglu Sewage Treatment Plant. In this ex-post evaluation, recalculation was made on the same basis and the results were negative for both plants. Looking ahead, the sewage treatment volume is not expected to significantly increase and the facility utilization rate will remain at 60 to 70%. The actual unit price for sewage treatment doesn’t differ largely from the value used at the time of planning. The lower-than-expected income due to decreased treatment volume is a primary factor of these results. An increase in the project cost also affected the FIRR at the Jizhuangzi Sewage Treatment Plant.

As mentioned above, both the sewage treatment capacity and the sewage treatment rate in Tianjin city were significantly improved. It was confirmed that this project played a big role in the central area. As a result of the efforts by Tianjin city to reduce the sewage volume, sewage volume is in a decreasing trend. The sewage treatment volume and the facility utilization rate are lower than the planned values as the plan itself cited excessive values at the time of appraisal. However, the pollutant removal rate is constantly high, hovering at 85 to 98%. As a result, the volume of pollutants discharged has been lower than planned at the time of appraisal, which has substantially contributed to improving the water quality of the rivers. When evaluating comprehensively against the project objective, it can be said the effectiveness of the project is high.

3.4 Impact

3.4.1 Intended Impacts (Improvement of the Living Environment of Tianjin Citizens)

The living environment of Tianjin citizens was expected to improve with the implementation of this project. To confirm how this was achieved, a beneficiary survey was conducted for 100 residents in the vicinity of the rivers at two locations ((1) and (2) in Figure 10) that were close to the project site. The results showed that many people recognized the landscape in the vicinity of the rivers was improved with the water quality improvements and the living environment was also improved as insects and bad smells were reduced. The rivers have been utilized more than ever. It can be said that the project had a certain positive impact on the living environment.

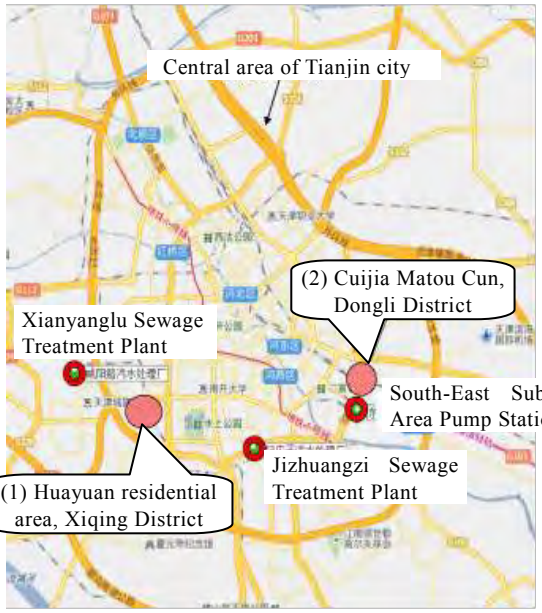


Fig. 10 Sites for beneficiary survey

Fig. 11 Chentaizi Drainage Canal (Huayuan residential area, Xiqing District)

The percentage of respondents who answered that the change in water quality had a "Significant positive effect" or a "Slight positive effect" was high: 82% in the Huayuan residential area, Xiqing District and 76% in the Cuijia Matou Cun, Dongli District. On the other hand, the percentage of respondents who answered that the change in water quality "Had no significant positive effect" was low: 6% in the Huayuan residential area, Xiqing District and 16% in the Cuijia Matou Cun, Dongli District.

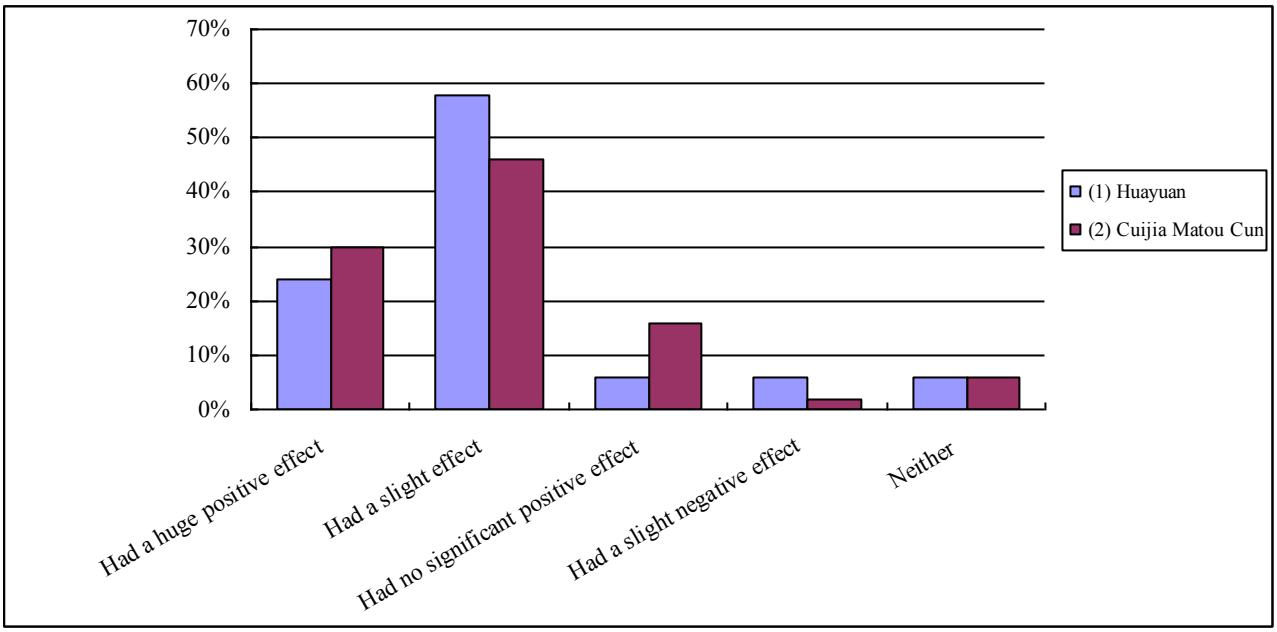


Figure 12 Impact of changes in water quality on life

Of respondents who answered that the project had a positive impact, those who answered that the "Landscape was improved" were at 72% in the Huayuan residential area, Xiqing District and 58% in the Cuijia Matou Cun, Dongli District, and those who answered that "Bad smells were eliminated" were at 62% in the Huayuan residential area, Xiqing District and 46% in the Cuijia Matou Cun, Dongli District. Those who answered that "Harmful insects such as flies and mosquitoes had decreased" were at 42% in the Cuijia Matou Cun, Dongli District. This suggests that the improvement of storm sewers reduced flood and inundation damage. Those who use the waterside for walking, fishing and swimming increased from 30% before implementing the project to 66% after the project in the Huayuan residential area, Xiqing District and from 16% to 54% in the Cuijia Matou Cun, Dongli District, respectively. In the Cuijia Matou Cun, Dongli District, 40% of respondents answered that the "Environment around the house became cleaner" because sewerage was connected to the city sewage system.

3.4.2 Other Impacts

(1) Impacts on the natural environment

Environmental measures taken in the project included measures against bad odors and noise and the treatment of sludge, a by-product generated in the process of sewage treatment. As measures to address bad odors, a green belt and a separation belt were constructed, and additionally, deodorizing equipments as well as covers for the primary settling pond and the aeration tank were installed. These are in response to the need to satisfy the National Odorous Pollutants Discharge Standard at a higher level, because houses and schools had become concentrated in the vicinity of the Jizhuangzi Sewage Treatment Plant with the recent development of Tianjin city. As measures against noise, equipment to reduce noise and vibrations was installed. For the treatment of sludge, a plan was made to reuse part of the sludge that met the standard as agricultural fertilizer, but this reuse has not been realized. It is disposed of in landfill after dehydration[33] at a suburban location away from the location contemplated at the time of appraisal. The population had rapidly increased in the vicinity of the planned site since 2005 and it had become impossible to dispose of the sludge there. Disposal to the new site started in April 2011, at the discretion of the treatment plant management. In the course of this ex-post evaluation, it was not possible to investigate whether there were any problems with the landfill site.

Other than the above, the reuse of treated water and the improvement of energy efficiency were included as project impacts. Treated water is recycled at the Tianjin Reclaimed Water Company's plants that are situated next to each of the sewage treatment plants and is reused as reclaimed water and for landscape preservation and washing and other sundry treatments in factories[34]. Methane gas, which is generated in the process of the sludge treatment, is reused as fuel to heat the boiler in the sewage treatment plant as planned.

[33] Dehydrated until the water content becomes 75% at Jizhuangzi Sewage Treatment Plant. Half of the sludge is hydrated until the water content becomes 75%, and the remaining half is hydrated and dried until the water content becomes 10%.

[34] Both Jizhuangzi Sewage Treatment Plant and Xianyanglu Sewage Treatment Plant have a capacity to produce 50,000 tons of reclaimed water.

Fig. 13 Sludge digester chamber[35]
(Jizhuangzi Sewage Treatment Plant)

Fig. 14 Sludge dryer
(Xianyanglu Sewage Treatment Plant)

(2) Land Acquisition and Resettlement

The land acquired for this project was 0.28 ha for the Jizhuangzi Sewage Treatment Plant, 67.87 ha for the Xianyanglu Sewage Treatment Plant and 0.8 ha for the Drainage Project in the South-East Suburban Area, and the land acquisition costs were 1.02 million Yuan, 53 million Yuan and 5.04 million Yuan respectively. No resettlement occurred.

Even though areas where the living environment improvements could be expected are believed to be limited to the vicinity of the project site, it was confirmed from the results of the beneficiary survey that the project led to an improvement of the living environment for local residents. Considering the fact that there are no negative impacts from the project, the project can be rated as having a certain degree of positive effects.

3.5 Sustainability (Rating: ③)

The executing agency that oversaw the entire project was the Tianjin Municipal People's Government, and the implementing agency that was planned at the time of the appraisal to be engaged in operation and maintenance was Tianjin Sewage Corporation. According to the policy of the Tianjin Municipal People's Government, the assets upgraded and newly-constructed under this project have been sold, and the implementing agency at the time of evaluation was Tianjin Capital Environmental Protection Group Co., Ltd.

Therefore, sustainability is evaluated mainly for Tianjin Capital Environmental Protection Group Co., Ltd. in this section. Also evaluated are questions as to whether due process was taken for privatization, whether the benefits of the creditor have been

[35] This equipment reduces the organic substances contained in sludge utilizing the activities of microorganisms, and decomposes them into digestion gas that mainly consists of inorganic substances and methane gas.

protected despite privatization, and whether the achievements of the development goals have been ensured.

3.5.1 Structural Aspects of Operation and Maintenance

The executing agency of the project was the Tianjin Municipal People's Government. The Water Resources Bureau was responsible for supervising the project and the Finance Bureau was responsible for monitoring its financial aspects. The Environmental Protection Bureau, which is the environmental supervising agency, doesn't conduct monitoring for the yen-loan project, partly because it was not involved at the time of the appraisal.

Tianjin Capital Environmental Protection Group Co., Ltd., the implementing agency of the project, is a government-owned listed holding company[36] that was established in 2000 at the initiative of the government and has no structural problems. Its headquarters have 13 departments, 1 office, 1 research center and 576 employees. It also has 15 subsidiaries that manage the reclaimed water production business, the water purification business, and the sewage treatment business of rural areas. The department that is in charge of this project is the Tianjin Water Supplies Department (with 372 employees[37]) and it is engaged in the operation and management of four sewage treatment plants in the central area of Tianjin.

3.5.2 Technical Aspects of Operation and Maintenance

When Tianjin Infrastructure Construction & Investment Group Co., Ltd. was established, some staff members were transferred to it from the Tianjin Sewage Corporation Jizhuangzi Sewage Treatment Plant and Dongjiao Sewage Treatment Plant. Partly because of this, most staff members are experienced workers who had been engaged in similar work before the establishment of the company, and who had the necessary qualifications and required technical level. Accumulated operation, maintenance and management know-how was utilized, and it is considered that the company was at the appropriate technical level considering its operation status. Manuals are in place by task for operation and maintenance and a regular training program and retest system has been established. The company has a structure to ensure a certain technical level. The maintenance and management of sewer culvert and pumping stations are consigned to a specialized company and there is no technical problem with operation and maintenance.

3.5.3 Financial Aspects of Operation and Maintenance

Judging from the major financial indicators of Tianjin Capital Environmental Protection

[36] Tianjin Infrastructure Construction & Investment Group Co., Ltd., a solely national government-owned single capital company where the Tianjin Municipal People's Government owns a 53.6% share.

[37] Of which 105 employees work at Jizhuangzi Sewage Treatment Plant and 82 at Xianyanglu Sewage Treatment Plant.

Group Co., Ltd. as shown in Figure 2, it is considered that there are no significant problems with financial sustainability. The capital ratio is as high as around 60% and the company has mid- to long-term stability. While the current ratio is slightly higher than 100% in 2009, it can be said that the stability of immediate cash management is secure. The reason is as follows. To ensure the sustainable development of the Tianjin city sewage sector, a 30-year sewage treatment consignment agreement was concluded[38] between Tianjin Sewage Corporation, which are a solely owned public benefit corporation of the Tianjin Municipal People's Government, and Tianjin Capital Environmental Protection Group Co., Ltd. and a system is in place to pay consignment fees according to the volume of sewage treatment water that meets the standard.

As to profitability, net profit to sales has increased at a relatively high level year by year: 23.1% in 2007, 26.3% in 2008 and 28.2% in 2009. This is mainly because of its system: the unit price of consignment fees is set at a level that can cover the operation and maintenance cost per unit of the sewage treatment plant, and 100% of the treatment costs are paid regardless of the sewage treatment fee collection rate.

Table 2 Financial indicators of Tianjin Capital Environmental Protection Group Co., Ltd.

	2007	2008	20
Return on asset (%)	3.6%	3.5%	4
Ratio of gross profit to sales (%)		60.4%	
Ratio of net profit to sales (%)		23.1%	
Total asset turnover (time	0.16	0.13	0
Current ratio (%)	80.9%	90.3%	1
Capital ratio (%)	60.2%	51.2%	6
Cash flow (10,000 yuan)	80,633	262,440	2

Source: Tianjin Capital Environmental Protection Group Co., Ltd.

3.5.4 Current Status of Operation and Maintenance

The results of interview surveys for the executing agency and the implementing agency show that operation and maintenance was appropriately controlled based on safety control standards and the operation maintenance manual and there were no major problems. Each treatment plant develops monthly and annual maintenance plans. They conduct maintenance and inspections of the facilities and the procurement of spare parts, and the management department performs monthly monitoring.

Since many procured parts are made in foreign countries, there is a problem with the

[38] This agreement is based on the system to conduct exclusive management within a certain zone for the purpose of avoiding unreasonable increases in sewage treatment fees to pursue corporate profitability, maintaining the fee at an appropriate level and ensuring the implementation of operations and maintenance.

replacement of parts at the Xianyanglu Sewage Treatment Plant, taking a long time. Except for important parts, they are switching from foreign parts to domestic ones in stages. It is desirable to take into consideration maintenance costs and convenience in procuring materials.

3.5.5 Privatization

The assets that were put in place with the yen loan were officially sold from Tianjin Sewage Corporation to Tianjin Capital Environmental Protection Group Co., Ltd. in December 2010. With this, not only the operation and maintenance of the assets of the sewage treatment plants but also the ownership was transferred to Tianjin Capital Environmental Protection Group Co., Ltd., and Tianjin Sewage Corporation assumed the position of supervising Tianjin Capital Environmental Protection Group Co., Ltd. concerning sewage treatment.

As mentioned above, Tianjin Capital Environmental Protection Group Co., Ltd. does not have any major problems in structural, technical or financial terms, and there are no concerns in terms of the achievement of development objectives and the sustainability of this project. While privatization was promoted at the initiative of the Tianjin Municipal People's Government with the ratification of the Chinese government, it would have been preferable to use a competitive bidding process or other similar approach[39].

The body with which this project has a sublease agreement remains Tianjin Sewage Corporation and Tianjin Capital Environmental Protection Group Co., Ltd., which is a wholly-owned public benefit corporation of the government, and credits are protected as the borrowing body is the Chinese government.

No major problems have been observed in the operation and maintenance system, technology or financial aspects, therefore sustainability of the project effect is high.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusions

This project is intended to improve the water quality of the rivers that flow through Tianjin city by improving wastewater treatment facilities in the central part of Tianjin city, one of national cities of the China, where water contamination is a serious problem. This project plays a major role in wastewater treatment in the central part of Tianjin. It has also had great importance in terms of the improvement of water quality in the rivers within the

[39] According to the yen loan project privatization handbook, re-examination of the likelihood of achieving development objectives and of sustainability of the project is required in any privatization process for a yen loan project after the final disbursement date.

city and an impact on the water quality of the Bo Hai area. The implementation of the project improved the water quality of rivers into which untreated wastewater had been discharged, giving as well a positive impact on the living environment of residents in the vicinity of the rivers.

The properties that were constructed by the use of the yen loan were sold to and are owned, run, operated, maintained and managed by Tianjin Capital Environmental Protection Group Co., Ltd. at the time of the ex-post evaluation. No major problems were found in any of structural, technical, or financial aspects. There were not any serious concerns from the viewpoints of achieving the development objectives and the sustainability of the project. On the other hand, this privatization was led by Tianjin Municipal People's Government and it is considered that its process to select an organization in competitive procedures would have been appreciated.

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

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

Drying has been introduced into the sludge treatment process at Xianyanglu Sewage Treatment Plant, and approximately 50% of the generated sludge is now given drying treatment after being dehydrated. The water content of dried sludge is extremely low, namely 10%. Low water content is a preferred factor for sludge incineration, and incineration is an effective method for reducing the weight of sludge, turning it into resource and rendering it harmless. Today, however, the treated sludge is disposed by landfill together with the remaining dehydrated sludge. There is a good example of sludge incineration already in China in which treated sludge is received by an electric power plant at similar transportation and treatment costs. There the sludge is incinerated and combusted with coal and the residue is recycled into construction materials. It is hoped that the feasibility of recycling sludge should be studied further with a view to achieving the use of sludge as a resource at an early opportunity.

4.2.2 Recommendations to JICA

None

4.3 Lessons Learned

When implementing a project that consists of multiple subprojects, the intended effect should be made clear as an achievable and measurable project goal and realistic project objectives should be set in light of the project scale. This project cited water quality improvements with the construction of sewage treatment plants as the project objective,

and in such a case, the rivers that are to receive the effects of the project should be the target of goal setting.

This ex-post evaluation survey revealed a difference in the recognition of project objectives with the executing agency. Up to now, the indicators of water quality improvement for rivers have not been monitored as intended by the Japanese government, and water quality data for the rivers was not provided to the ex-post evaluation survey. To conduct a scientific and objective evaluation under a consistent management system prior to ex-post evaluations, the management of evaluation indicator monitoring is required. To promote the effects of the project, it is required to discuss the project objectives and the project goals thoroughly at the appraisal stage, agree on them, and clearly state them in a record of the discussion.

End

Comparison of the Original and Actual Scope of the Project

Item	Original	Actual
(1) Project Outputs 1. Jizhuangzi Sewage Treatment Plant Expansion Project (Although items (6) and (7) in "Actual" column are not provided in the appraisal record, they are included in the original plan according to interviews with the implementing agency.)	(1) Expansion of treatment plant capacity from 260,000 tons/day to 540,000 tons/day (2) Primary sedimentation basins at 2 locations (3) Reaction ponds at 4 locations (4) Secondary sedimentation basins at 8 locations (5) Sludge treatment facilities	(1) As planned (However, reduced to 450,000 tons/day at present) (2) As planned (3) As planned (4) As planned (5) Sludge treatment facilities (modification) (6) Sewer culvert 9km (7) Modification of existing facilities (Primary sedimentation basin, reaction pond, and secondary sedimentation basin)
2. Xianyanglu Sewage Treatment Plant Construction Project (Although item (6) in "Actual" column is not provided in the appraisal record, it is included in the original plan according to interviews with the implementing agency.)	(1) Treatment plant capacity 450,000 tons/day (2) Pumping stations at 2 locations (3) Primary sedimentation basins at 5 locations (4) Secondary sedimentation basins at 10 locations (5) Sludge treatment facilities	(1) As planned (2) As planned (3) As planned (4) As planned (5) As planned (6) Sewer culvert 13.8km
3. Drainage Project in South-East Suburb	(1) Construction of new	(1) Construction of pumping

Area (Although items (3) and (4) in "Actual" column are not provided in the appraisal record, they are included in the original plan according to interviews with the implementing agency.)	pumping stations at 3 locations (2) Upgrading of pumping station at 1 location	stations at 2 locations (rainwater) (2) As planned (3) Rainwater sewer culvert 40km (4) Wastewater sewer culvert 33.2km
(2) Project Period	From March, 2001-June, 2004 (40 months)	From March, 2001-February, 2006 (60 months)
(3) Project Cost Amount paid in Foreign currency Amount paid in Local currency Total Japanese ODA loan portion Exchange rate	 7,142 million yen 21,450 million yen (1,650 million Yuna) 28,592 million yen 7,142 million yen 1 Yuna=13 yen (As of March, 2001)	 7,014 million yen 21,312 million yen (1,464 million Yuna) 28,326 million yen 7,014 million yen 1 Yuna=14.3327 yen (December, 2005)

China

Ex-Post Evaluation of Japanese Technical Cooperation Project

Dairy Farming and Industry Development Project in Heilongjiang Province

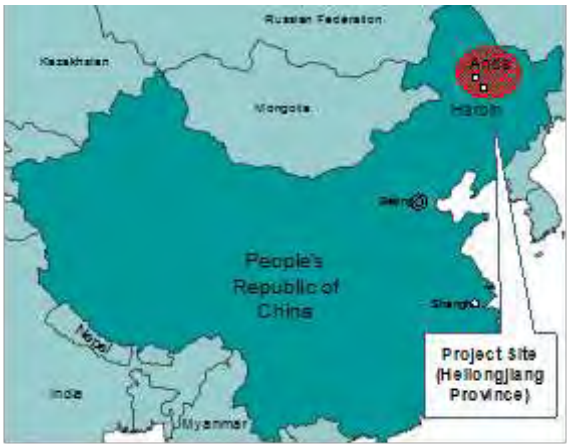
External Evaluator: Naoko Inada, IC Net Limited

0. Summary

Heilongjiang Province in China, ranking high in dairy production, had been making efforts to develop and promote dairy farming and the dairy industry but had issues in the quality/quantity of cattle forage and the productivity of raw milk, as well as problems such as delays in the development of dairy products. This project was intended to address such development needs while aiming for improvement of the technologies for forage production, feeding management and dairy processing. Therefore, its relevance was high. The goal of this project was to establish a model for dairy farming and dairy industry in the province, and this was achieved through the improvement of technologies for forage production and feeding management in the dairy farming sector, and through the diversification and quality improvement of dairy products in the dairy industry. Since the completion of the project, the established model, that is to say the systematized technological methodology, has been promulgated by the authorities concerned to the entire province, and its effects have been manifested in the improvement of raw milk production and the increase in dairy farmers' earnings, thus substantiating its positive impact. Furthermore, since the project has been implemented in accordance with the schedule and the results have been proportionate to the inputs, the implementation can be considered to have been efficient. With regard to the sustainability of the project, although some challenges remain in the technological and financial aspects concerning the technical advancement of the extension workers, no problems have been observed in terms of the project policy and structure.

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

1. Project Description



Project Location

Cattle Shed at the Project Model Stock Farm

1.1 Background

Situated in an extremely cold region with long winters and boasting vast stretches of grassland and huge amounts of unutilized forage resources, Heilongjiang Province has long been more committed to dairy farming rather than other forms of agriculture as a means of gaining income throughout the year, producing the largest volume of raw milk and dairy products nationwide. From the perspective of these regional characteristics, the Heilongjiang Provincial Government had attached importance to the development of the province's dairy farming and dairy industry and had been taking various measures to promote animal husbandry. However, the province was mired in problems such as poor quality and production of pasture, low milk yield per cow, and delays in the development of forage management technology. On the other hand, in the 1990s when this project was being planned, grain was the main foodstuff consumed by the Chinese. Therefore, the intake of animal protein was low, posing the problem of poor nutritional balance. In this context, the government put effort into the promotion of animal husbandry, especially dairy farming, which would enable the efficient utilization of unused natural resources and provision of animal protein. However, due to the small scale of the dairy industry and its obsolete quality control technology, almost all the dairy factories were incapable of manufacturing any other products but powdered milk, making them unable to develop products or provide quality control services catering to the needs of consumers. In order to overcome these predicaments, the Chinese Government requested the Japanese Government in 1996 to extend technical support in a comprehensive project to research and develop new technologies concerning dairy farming and the manufacturing of dairy products.

In response, the Japanese side conducted a preliminary survey on the basic framework of the first project in 1997. As a result, although the relevance of implementing the project was substantiated based on the condition of dairy farming and the dairy industry in Heilongjiang Province and other circumstances, it emerged that a considerable narrowing down of the project scope was necessary as the content of the request by the Chinese side was extensive compared to the scale and budgetary constraints of the typical scheme of project-type technical cooperation. The contents of the request were as follows: (1) development of grassland improvement and forage production technologies; (2) development and guidance of forage-feeding technologies; (3) development and guidance of comprehensive livestock management technologies for increased milk yield; (4) development and guidance of quality control technologies for raw milk; and (5) development and guidance of comprehensive technologies for manufacturing staple dairy products. Besides, there were several project sites. Following a series of consultations between the Japanese and Chinese sides either directly or in writing for the subsequent few years, both sides reached an agreement on the cooperation scheme for this project in 2001. The agreed cooperation scheme specified that the project activities would cover four technical fields: forage production and feeding management in dairy

farming, and raw milk quality control and dairy product manufacturing in the dairy industry. In addition, part of the project activities would be handled by counterparts trained in Japan instead of dispatched Japanese experts. Furthermore, as a result of the number of project sites having been narrowed down to one per each project field, the initially-planned cooperation between the dairy farming and dairy industry fields was abandoned, and instead, it was decided that a project with two elements would be implemented.

1.2 Project Outline

Super Goal		To improve the earnings of dairy farmers in Heilongjiang Province through the development of its dairy farming and dairy industry.
Overall Goal		To disseminate the model established in the project[1] throughout entire Heilongjiang Province.
Project Purpose		To establish a model for dairy farming and dairy industry suitable for Heilongjiang Province in the project area.
Outputs	Output 1	To ensure that dairy farmers in the project area are able to produce high quality forage.
	Output 2	To ensure that dairy farmers in the project area are able to feed dairy cattle appropriately while improving the quality of raw milk.
	Output 3	To achieve the quality improvement and diversification of dairy products.
Actual Inputs		[Japanese Side] 1. Dispatched experts: 44 personnel 13 long-term experts from 7 fields: chief advisor, forage production, feeding management, raw milk quality control, dairy product processing (cheese and fermented milk), and coordinator. 31 short-term experts from 27 fields: silage preparation technology, alkali soil modification technology, cow feeding environment arrangement, milking hygiene control, manufacturing technology for various types of cheese, collection and storage of lactic acid bacteria, equipment operation and maintenance, etc. 2. Accepted trainees: 37 people (counterpart training in Japan) 3. Equipment provision: 2,7 million yen (including consumption taxes, transport charges and insurance fees) 4. Local operating expenses: 530 thousand yen

[1] The "model" mentioned in the project purpose is defined as the "aggregation of dairy farming and dairy industry technologies introduced in the project." The model areas were Youyi Village and Hongxing Village in Xianyuan Township of Anda City, and the model stock farm was Youyi Ranch in Anda City. The monitor farmers consisted of 60 dairy farmers in total (20 households in Youyi Village of Xianyuan Township, 20 households in Hongxing Zhun of Hongxing Village, and 20 households in Bayi Zhun of Tong Village). Of them, 3 households comprised the model farmers.

	5. Others (including dispatch of inspection teams): management guidance inspection teams dispatched 2 times [Chinese Side] 1. Counterparts: 89 personnel 2. Land/facility provision, project offices, electricity/water bills 3. Local-borne costs: 26.63 million yuan, counterpart payment, training budget
Cooperation Amount	1.035 billion yen
Cooperation Period	July 1, 2001 – June 30, 2006
Chinese Organizations Concerned	Department of Science and Technology Government of Heilongjiang, Heilongjiang Livestock Department, Heilongjiang Province Livestock Research Institute, Anda City Livestock Department, Xianyuan Township Government Livestock Farming Center, Dairy Engineering and Technical Research Center and Longdan Milk Industry Company
Japanese Organizations Concerned	Ministry of Agriculture, Forestry and Fisheries; National Livestock Breeding Center; Snow Brand Milk Products Company, Limited; Nippon Milk Community Co., Ltd.
Relevant Matters	-

In order to realize the aforementioned three outputs, the following activities have mainly been implemented:

- Improvement of Forage Production: Establishment of forage improvement technologies through grassland improvement and effective use of unutilized resources; demonstration exhibition at the model stock farm, Youyi Ranch; practice at the nearby monitor farmers.
- Quality Improvement of Raw Milk: Establishment of feeding management and milking hygiene technologies; demonstration exhibition at Youyi Ranch; practice at the nearby monitor farmers.
- Quality Improvement/Diversification of Dairy Products: Improvement of raw milk quality control and dairy production technologies.

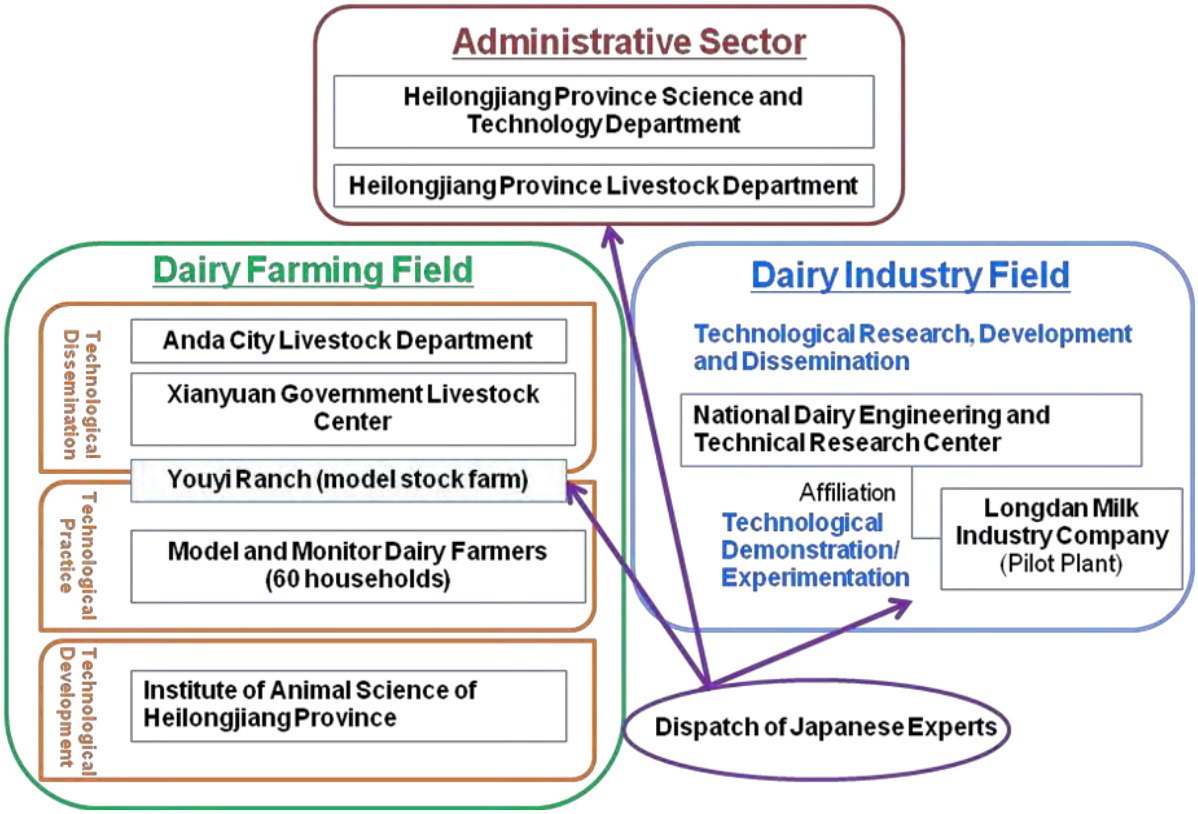


Figure 1 Schematic Diagram of the Project

This project was aimed at establishing the technology model[2] for the fields of dairy farming and dairy industry. Since the project sites for these two fields were physically distant from each other, the project was virtually regarded as consisting of two sub-projects. In the dairy farming field, with the view to increasing milk yield and improving milk quality, demonstration exhibitions of technologies were held at the model stock farm, Youyi Ranch located in Xianyuan Township of Anda City, thereby transferring the technologies to nearby farmers as the dissemination targets. Furthermore, the livestock research institute of the province implemented technology transfer activities pertaining to the research and development of certain technologies[3]. In the dairy industry field, the National Dairy Engineering and Technical Research Center implemented technology transfer activities in Longdan Milk Industry Company serving as its pilot plant, aiming to achieve quality improvement and diversification of its dairy products. The Science and Technology Department and the Livestock Department of the provincial government set up a project management office, thereby assuming responsibility for the operation and management of the project.

[2] This refers to technologies concerning forage production and feeding management in the dairy farming field, and technologies for raw milk quality control, dairy product manufacturing, and lactic acid bacteria collection/storage. The dairy farming and industry model aimed for by the project was not defined properly during the project period. In the interview survey conducted at the time of the terminal evaluation, interpretations varied between project stakeholders concerning the model stock farm, style of dairy management, dairy products accepted by consumers, technologies transferred in the project, summarization of technologies and so on. This revealed that a common understanding was not reached.

[3] Forage analysis technologies, alfalfa seed production technologies, embryo transfer technologies.

It was expected that after the completion of the project, the dairy farming technology dissemination departments of provincial, city/county and township/town municipal governments and the National Dairy Engineering and Technical Research Center[4] would take the initiative in disseminating the respective dairy farming and dairy industry technologies.

1.3 Outline of Terminal Evaluation

1.3.1 Prospects of Overall Goal Achievement at Terminal Evaluation

The overall goal was "to disseminate the model established in the project throughout entire Heilongjiang Province." Although the project's effects manifested at the time of the terminal evaluation were limited within and in the vicinity of the project areas and the direct beneficiaries, the Science and Technology Department and the Livestock Department of the province had already taken the initiative and formulated a dissemination strategy in order to accomplish an index of the overall goal: "to start implementing a dissemination program including the model established in the project in six areas[5]." It was planned that the project team would travel around the six dairy areas in Heilongjiang Province to disseminate dairy technologies for the rest of the project period, and after the project was finished, a three-year dissemination plan would drawn up for the said six areas in consultation with the administrative bodies of each area regarding which technologies to be disseminated, so that the project's effects could be applied to each area. As above, it was concluded that, provided that the dissemination activities were implemented smoothly and the strategy for the dissemination plan was formulated in detail, there would be a high likelihood of achieving the overall goal.

1.3.2 Prospects of Project Purpose Achievement at Terminal Evaluation

The project purpose was "to establish a model for dairy farming and dairy industry suitable for Heilongjiang Province in the project area." Based on the extrapolation of the production volume of high-quality raw milk in the project area from the production growth rate during the project period, the volume was expected to exceed the target value of 11,000 tons by the completion of the project. There had already been a tentative manual regarding dairy farming and dairy industry technologies systematized through the demonstration in the project, and a final version was expected to be compiled during the cooperation period by the end of the project. Therefore, it was concluded that the project purpose would largely be achieved.

1.3.3 Content of Proposals at Terminal Evaluation

(1) Short-term Proposals (by the end of the cooperation period)

1) With a view to summarizing the technologies that had been established in the project by its completion into a model, proposals were made to draw up final versions of technical manuals

[4] The Dairy Product Technical Training Center in this center takes charge of the technology transfer.
[5] Six areas: Shuangcheng City, Fuyu of Qiqihar City, Beian of Heihe City, Mishan of Mudanjiang City, Dumeng of Daqing City, Suburbs of Mudanjiang City

regarding dairy farming and dairy industry, and to hold technical guidance and dissemination seminars catering to a wide range of stakeholders around the province. In response to these proposals, a technical manual was finalized for each of the dairy farming and dairy industry fields, and copies were distributed to the organizations concerned. In addition, peripatetic seminars aimed at technical guidance and dissemination were held in six locations within Heilongjiang Province.

2) In preparation for technology dissemination after the completion of the project, proposals were made to formulate dissemination plans under the leader ship of the Project Management Office[6]. The proposals included several precautions to be taken during the planning such as the screening of the technological fields to be disseminated based on the results of the guidance, clarification on the sharing of responsibilities among the organizations concerned, concrete budgetary provision, utilization of trained engineers, and confirmation of the monitoring procedures. Although the Project Management Office had failed to come up with any dissemination plan by the end of the cooperation period, the Livestock Department of the province formulated a plan for the following year by the end of the year concerned.

(2) Long-term Proposals (after the end of the cooperation period)

1) In accordance with the dissemination plan and strategy, proposals were made to disseminate dairy farming and dairy industry technologies in Heilongjiang Province, conduct periodic monitoring of the progress under the initiative of the Science and Technology Department and Livestock Department of the province, and review the dissemination plans. At the time of the ex-post evaluation, the Livestock Department was playing a central role in the planning, execution and monitoring of the technology dissemination program.

2) For the sake of further development of Chinese dairy farming and dairy industry, proposals were made to publicize the results of technology dissemination to dairy farming and dairy industry stakeholders not only in Heilongjiang Province but also across the country, and actively create opportunities for technological exchange with Japanese counterparts. In relation to these proposals, several events such as the national convention of the National Dairy Association served as occasions to make public the project's technological achievements for the dairy farming sector by the time of the ex-post evaluation.

[6] This signifies the "Management Department" in Figure 1.

2. Outline of the Evaluation Study

2.1 External Evaluator

Naoko Inada, IC Net Limited

2.2 Duration of Evaluation Study

This ex-post evaluation study was conducted as follows:

Duration of the Study: November, 2010 – October, 2011

Duration of the Field Study: March 18 – March 30, 2011; June 28 – July 2, 2011

2.3 Constraints during the Evaluation Study

Concerning dairy industry field, information about institutional aspects, technologies and financial affairs of National Dairy Engineering and Technical Research Center is limited, due to changes of implementation structure and its role.

3. Results of the Evaluation (Overall Rating[7]: A)

3.1 Relevance (Rating[8]: ③)

3.1.1 Relevance with the Development Plan of China

In the "9th Five-Year Plan (1996 – 2000)," the national development plan of China around the time of the project start, the development of the agricultural sector was regarded as the highest priority issue for the domestic economy. Since around 2004, when the project was in the cooperation period, the Chinese Government has been struggling to resolve low agricultural productivity, disparity between urban and rural regions, and farmers' low income, the so-called "Three Rural Issues," regarding them as priority matters. Meanwhile, the "11th Five-Year Plan Outline (2006 – 2010)," which was the national policy around the time of the project completion, advocated a new rural community reform in the name of "Socialist New Rural Community," thereby promoting the innovation of agricultural technology, improvement of productivity through the expansion of agricultural investments, and enhancement of public services.

As described above, the agricultural sector has been the top priority in the Chinese development policy, with its strategic importance consistently unchanged from the start to the end of the project. Therefore, this project's goal of promoting dairy farming and dairy industry technologies with the aim of boosting the earnings of small to mid-size dairy farmers is considered to be relevant to the policy needs

[7] A: Highly satisfactory; B: Satisfactory; C: Partially satisfactory; D: Unsatisfactory

[8] ③: High; ②: Fair; ①: Low

3.1.2 Relevance with the Development Needs of China

Since the economic reform, China has witnessed growth exceeding 10% in the production of the livestock industry on a year-on-year basis every year, with stockbreeding contributing to the increase in farmers' incomes, improvement of dietary habits, and economic development.

Amid such circumstances, Heilongjiang Province, located in a cold climate region with long winters, attached special importance to the livestock industry as it guarantees earnings throughout the year. At the same time, the province was suitable for dairy farming on account of its vast expanses of grassland and huge amounts of unutilized forage resources, producing the largest volumes of raw milk and dairy products nationwide back when the project was commenced. Placing emphasis on the development of its dairy farming and dairy industry, Heilongjiang Provincial Government had been making efforts toward its promotion under the slogan of "Ban Bi Jiang Shan (to make the livestock industry account for 50% of agriculture)." However, the province had various problems such as poor quality and production of forage, low productivity of raw milk, and delays in the development of dairy products.

This project was aimed at lending support to the efforts to improve and advance technologies in the fields of forage production, feeding management and dairy processing, and thus the project was regarded as one of the endeavors to solve these problems. In the field of dairy farming, it was necessary for dairy farmers to improve the productivity of forage crops and feeding management for milk cows for the reinforcement of raw milk production and quality[9]. Meanwhile, in the dairy industry, the National Dairy Engineering and Technical Research Center, one of the executing agencies, deemed the improvement and diversification of quality control and product processing technologies for raw milk to be a challenge.

By the completion of the project, the demand for milk and other dairy products had soared in line with the improvement in people's standard of living. Heilongjiang Province still ranked high nationwide in the production of raw milk and dairy products and was regarded as one of the most important production bases. Therefore, the project has been consistently relevant to the development needs during the cooperation period.

3.1.3 Relevance with Japan's ODA Policy

In the Economic Cooperation Program for China (formulated in 2001), Japan placed emphasis on the "cooperation on the development of agriculture and farming communities in the inland regions where natural conditions are poor." In this context, this project's goal was to support the small-size dairy farmers and the local dairy industry in Heilongjiang Province, where environment and natural conditions are harsh. Therefore, its relevance was high.

As described above, this project has been fully consistent with the development policies and needs of China, as well as Japan's ODA policy; therefore, its relevance is high.

[9] For example, the Heilongjiang Livestock Research Institute required the technologies for producing alfalfa (forage grass rich in protein) seeds and embryo production/transplantation to be transferred from Japan.

3.2 Effectiveness and Impact (Rating: ③)

3.2.1 Effectiveness

3.2.1.1 Project Outputs

The goal of this project was "to establish a model for dairy farming and dairy industry suitable for Heilongjiang Province in the project area" To that end, the project proposed the following three outputs: "to ensure that dairy farmers in the project area are able to produce high quality forage;" "to ensure that dairy farmers in the project area are able to feed dairy cattle appropriately while improving the quality of raw milk;" and "to achieve the quality improvement and diversification of dairy products."

(1) Output Achievements

1) Output 1: To ensure that dairy farmers in the project area are able to produce high quality forage

With the aim of achieving these outputs, various activities were conducted to establish forage production technologies including small-scale grassland improvement, conversion of unutilized resources into forage, silage preparation, forage analysis, and alfalfa seed production, and exhibitions to demonstrate these technologies were also held.

As a result, technologies for grassland improvement, conversion of crop residues into forage, and preparation of maize silage were established in Youyi Ranch in Xianyuan Township, Anda City, which was the model stock farm of this project. Subsequently, through the technical guidance to the model farmers and monitor farmers in the vicinity, the forage production technology was improved. Specifically, the unit crop of silage maize produced by the monitor farmers (Index 1) reached 3,850 kg by one year prior to the end of the project as opposed to the target value of 4,000 kg, mostly achieving the target index. Furthermore, the yield of grass in Youyi Ranch exceeded the target, reaching 104% of the target value by the end of the project.

Aside from the aforementioned technical guidance catering to dairy farmers, project activities to modify crop cultivars and introduce new technologies such as excellent seeds contributed to the improvement of forage crop production.

Table 1 Changes in Index Data of Output 1

Index/Unit	Before Project in 2000	Target Value	Achieved Value in 2006	Achievement Rate at Project Completion	Achieved Values after Project			
					2007	2008	2009	2010
Index 1: The green forage yield per unit of maize used for maize silage recommended by the project increases in the monitor farmers.								
kg/Mu[10]	2,500	4,000	3,850*	96%*	-	-	-	-
Index 2: The green forage yield per unit of dry grass increases in Youyi Ranch.								
kg/Mu	220	300	311	104%	309	313	312	310

Source: Data provided by JICA and Youyi Ranch

Note: *Data in 2005

2) Output 2: To ensure that dairy farmers in the project area are able to feed dairy cattle appropriately while improving the quality of raw milk.

In order to achieve this output, the following activities have been conducted: feeding management for dairy cows; milking hygiene control; establishment of feeding technologies such as embryo transplant technology; and demonstration exhibition of such technologies.

With regard to Index 1, the average annual milk yield per dairy cow in the monitor farmers exceeded the target value by more than 10% by the end of the project. As the collection of index data regarding raw milk quality in relation to Index 2 required specialized techniques and equipment, there only exist data collected one year prior to the end of the project. Nevertheless, the total bacterial count in raw milk had already decreased below the target value to 300,000/mL by that time, and the ratio of total dissolved solid had also exceeded the target value of 12%. Therefore, this output is considered to have been achieved in relation to both indices.

Table 2 Changes in Index Data of Output 2

Index/Unit	Before Project in 2000	Target Value	Achieved Value in 2006	Achievement Rate at Project Completion	Achieved Values after Project			
					2007	2008	2009	2010
Index 1: The average milk yield per dairy cow in the monitor farmers increases.								
kg	5,300	5,800	5,882	111%	5,896	5,931	5,929	5,936
Index 2: The quality of raw milk produced in the monitor farmers improves.								
Decrease in Total Bacterial Count (number/ml)	2 million	0.5 million	0.3 million*	Decrease	-	-	-	-
Increase in Ratio of Total Dissolved Solid	11.6%	12.0%	12.2%*	Increase	-	-	-	-

Source: Data provided by JICA and the Xianyuan Township Government Livestock Farming Center

Note:* Average value between January and September, 2005

[10] 15 Mu = 1 hectare

In this project, in addition to the transfer of technologies such as feeding environment improvement and milking hygiene control to the model stock farm Youyi Ranch, activities for technology dissemination and educational guidance have been carried out by the model stock farm and extension workers, targeting the model and monitor farmers in the vicinity. As a result, the dairy farmers' attitudes toward the feeding environment have changed and they have started taking actions such as improving the materials for the cattle sheds and cleaning them, eventually leading to improvement in the quantity and quality of raw milk.

Moreover, according to the interviews with the dairy farmers, the improvement in the feeding environment has resulted in reduction in the incidence of diseases such as mastitis among their dairy cows by more than half, thereby contributing to the increase in the raw milk yield. As shown in Table 3, the dissemination of technologies has led to the decrease in diseased cattle in not only the farms of the direct beneficiaries but also those in other areas (see the section 3.2.2.1 Overall Goal Achievements for details).

Table 3 Changes in Number of Dairy Cattle with Diseases such as Mastitis before and after Technology Transfer[11]

	Dairy Farmers in Anda City				Dairy Farmers in Shuangcheng City	
	Monitor		Non-monitor			
	Before	After	Before	After	Before	After
Number of diseased dairy cattle (annual)	2.18	1.11	5.32	2.28	4.4	2.8
Number of dairy cattle owned	6.16	9.54	8.6	11.2	11.7	16.2
Ratio of diseased dairy cattle (annual)	35.4%	11.6%	61.9%	20.4%	37.6%	17.3%
Ratio of farmer housholds owining diseased cattle	83%	53%	83%	83%	93%	93%

Source: Results of the beneficiary survey

[11] The data prior to the technological transfer are from 2000 for the monitor dairy farmers in Anda City, from 2003 for the non-monitor dairy farmers, and from 2004 for those in Shuangcheng City. The data after the technology transfer are the achievement data from 2010.

Fig.2 Forage Grass

Fig.3 Milk Quality Inspection in Milking Plant at Model Stock Farm

3) Output 3: To achieve the quality improvement and diversification of dairy products.

This output was scheduled to be achieved through the improvement of technologies such as raw milk quality control, dairy product manufacturing, and collection and storage of lactic acid bacteria in the Dairy Engineering and Technical Research Center and Longdan Milk Industry Company[12], which was a pilot plant within the center.

As an index to measure quality improvement, which was one of the outputs, standard deviation data on the acidity of yoghurt have been adopted. Although no data at the time of the project completion are available, the acidity was decreasing steadily between 2003 and 2005, thus indicating the achievement of the index. Furthermore, the acceptance rates of dairy products manufactured by the said center also increased during the two years prior to the end of the project. Therefore, quality improvement is considered to have been achieved.

With regard to the other output, i.e. diversification, no data at the time of the project completion are available on Index 2 regarding the number of trial products. Nevertheless, considering the achievements in 2005 and the fact that 20 processed cheese products and 10-12 fermented milk products were available by 2010, the output achievements are considered to have exceeded the target values.

[12] A dairy company that is also a counterpart executing agency. It was state-owned at the time of the project start and was affiliated to the National Dairy Engineering and Technical Research Center, but was privatized in 2004 when the project was in progress. The company underwent a phased privatization process during the project period, and in the end was fully privatized in 2004. At this point, the Chinese project stakeholders confirmed in official writing that the privatization would not change the activities and framework of the project

Table 4 Changes in Index Data of Output 3

Index	Before Project	Target Value	Achieved Value	Achievement at Project Completion	Achieved Value after Project in 2010
Index 1: Quality dispersion in the existing dairy products of the National Dairy Engineering and Technical Research Center decreases.					
Standard Deviation of Yoghurt Acidity	6.80 (2003)		4.47*	Decreased	
Additional Index: Acceptance rates of dairy products manufactured by the National Dairy Engineering and Technical Research Center (Longdan Milk Industry Company)					
	98.3% (2004)		98.9%	Increased	99.7%
Index 2: Trial products of product candidates manufactured in the National Dairy Engineering and Technical Research Center increases.					
Natural Cheese		3 items	5 items*	Increased	None
Processed Cheese		5 items	6 items*	Increased	20 items
Fermented Milk		1 item	Over 10 trial items*	Increased	10-12 items
Additional Index: Production Volume of Fermented Milk Products by Longdan Milk Industry Company					
			12 tons	-	17 tons

Source: Data provided by JICA and Longdan Milk Industry Company

Note:*2005

Although several factors that could potentially affect the achievement of the outputs were envisaged during the planning stage of the project, it turned out that no effects were observed in general, with the actual outputs being as follows:

Table 5 Potential Factors Anticipated to Affect Output Achievement

Anticipated Factors	Actual Outcome
Administrative Support for Farmers in Adopting Technologies Recommended in Project	The following items of governmental support were available and were appreciated highly by the farmers: - Preferential pricing of silage forage crop seeds (2 Yuan/kg) - Allowance for silage storage (5 Yuan/m^3) - The government allowance for artificial insemination was initiated after the project. - Government allowance paid for maize cultivation
Weather Stability	Although there were some unstable periods such as a drought in 2001 and localized downpours in August 2003, these events did not have a significant influence on the project outcome.
Outbreaks of Cattle Diseases/Epidemics	There were no outbreaks of cattle diseases that could affect the project outcome.
Transfer of Counterparts	The frequency of counterpart transfer during the cooperation period was limited to the minimum, and the project was not affected.

Sources: Heilongjiang Livestock Department, Anda City Livestock Department, Xianyuan Township Government Livestock Farming Center, Youyi Ranch, and interviews with farmers.

3.2.1.2 Achievement of Project Purpose

Project Purpose: To establish a model for dairy farming and dairy industry suitable for Heilongjiang Province in the project area.

The purpose of the project was to establish a technological model in the project area through the enhancement of forage production, optimization of feeding management, and quality improvement of raw milk and dairy products.

As a result of the increase in average milk yield and the improvement of milk quality through the project, the raw milk sales volume in the model area has nearly doubled compared to before the project, exceeding the initial target by almost 50%. This, therefore, has corroborated the efficacy of the model developed in the project in Heilongjiang Province. Furthermore, the information pertaining to the technologies introduced in the project has been compiled into manuals and other educational materials, which have facilitated the creation of an environment conducive to technological dissemination. Therefore, the indices for the project purpose are considered to have been achieved.

Table 6 Changes in Index Data of Project Purpose

Index/Unit	Before Project in 2000	Target Value	Achieved Value in 2006	Achievement Rate at Project Completion	Achieved Values after Project			
					2007	2008	2009	2010
Index 1: The annual sales volume of high-quality raw milk[13] produced in the model area increases.								
Ton	8,300	11,000	15,806	144%	19,142	21,890	23,735	26,061
Index 2: Manuals regarding dairy farming and dairy industry technologies are compiled by the completion of the project.								
Dairy Farming	Manual booklets, training materials, instruction manuals for major equipment, etc.							
Dairy Industry	Manual booklets, training materials, instruction manuals for major equipment, etc.							

Sources: Heilongjiang Livestock Department, Xianyuan Township Government Livestock Farming Center, and Youyi Ranch

The items covered by the dairy farming manuals include those related to forage production, feeding management, and mechanical maintenance. These manuals explain the technologies practiced by the model and monitor farmers by item with the use of pictures and diagrams. These are not intended for dairy farmers but for extension workers who are engaged in technical guidance for dairy farmers.

Aside from the compilation of these manuals described in the index, the extension workers have been instructed on how to transfer technologies through the inspection of technical application to the model farmers, thereby promoting the establishment of these technologies.

The technologies covered by the dairy industry manuals mainly include those related to raw milk quality inspection and management, manufacturing of dairy products such as yoghurt and cheese, collection, storage and cultivation of lactic acid bacteria, and utilization of equipment. These manuals have been distributed to the relevant entities in Heilongjiang Province including dairy companies.

In the planning stage of this project, various factors that could affect the achievement of the project outputs were anticipated. In reality, however, no effects have been observed in general, with the actual outcome being as follows:

[13] The definition of high-quality raw milk is pursuant to the national standard (revised in 2010). Besides, dairy companies that purchase raw milk also have their own standards.

Table 7　Potential Factors Anticipated to Affect Project Purpose Achievement

<table>
<tr><th>Anticipated Factors</th><th>Actual Outcome</th></tr>
<tr><td>Stabilization and Increase of Milk Demand</td><td>Throughout the cooperation period, the demand for milk in the project province increased in a stable manner as below:

Table 8 Changes in Raw Milk Yield in Heilongjiang Province
<table><tr><td>Year</td><td>2001</td><td>2006</td><td>2010</td></tr><tr><td>Production (10 thousand tons)</td><td>189.0</td><td>432.6</td><td>687.0</td></tr></table>Source: Heilongjiang Province Livestock Department</td></tr>
<tr><td>Continuation of Duties by Trained Personnel</td><td>Of the 34 counterparts who had participated in the training courses in Japan, 27 continued to engage in related duties by the end of the project. In addition, the newly assigned personnel were provided with training opportunities so that the progress of the project would not be affected.</td></tr>
</table>

Sources: Heilongjiang Livestock Department, Anda City Livestock Department, Xianyuan Township Government Livestock Farming Center, Youyi Ranch, and Longdan Milk Industry Company.

In light of the above, the project purpose is considered to have been largely achieved in relation to each index.

3.2.2 Impacts

3.2.2.1 Sustainability of Project Outputs

In this section, it is examined whether the effects confirmed in section “3.2.1 Efficacy” have been manifested in a sustainable manner since the end of the project. According to the results of field surveys, it has been confirmed that many of the effects have generally been manifested to date in a sustainable manner. In particular, the annual sales volume of raw milk and the number of commercialized dairy products in the model area, i.e. two of the indices that enable precise measurement of the effects, have continuously been increasing.

The forage (grass) yield in the model stock farm, the index of Output 1, was maintained between the end of the project and the time of the ex-post evaluation (see Table 1).

The average milk yield per dairy cow in the monitor farmers, the index of Output 2, has remained above the target value since the end of the project (see Table 2).

With regard to the index of Output 3, of the three types of dairy products that were subject technology transfer in the project, there was no demand for natural cheese since it did not suit the palate of local people, and thus, no natural cheese products have been commercialized. On the other hand, fermented milk and processed cheese products have been diversified and their quality has been improving. The acceptance rates of dairy products manufactured by the implementing entities in the dairy industry have been increasing steadily since the end of the project (see Table 4).

Longdan Milk Industry Company, which assumed responsibility in the dairy industry field of this project, was privatized during the project period. Accordingly, both this project and corporate efforts have had an impact on the subsequent improvement, diversification and expansion of products. The following examples show the manifestation of the project effects:

(1) Commercialization of Products Utilizing Original Lactic Acid Bacteria

Longdan Milk Industry Company succeeded in isolating lactic acid bacteria from traditional pickles of Harbin in Heilongjiang Province, with counterparts working in tandem with specialists. They then contributed the results of this experiment to a Japanese scientific journal. This strain of bacteria has been utilized for the development of the company's in-house products since the end of the project.

(2) Promotion of Cheese Production.

Prior to the project, Longdan Milk Industry Company had scarcely manufactured cheese products, but as a result of the smooth implementation of technological transfer, the move toward the commercialization of cheese products has gradually been accelerating. It was planned at first that they would request the government to start subsidizing the construction of cheese factories by around two to three years after the end of the project. However, since the market demand for cheese has not increased that much, the production scale has not expanded more than the capacity of the production line in the factory. With the relocation of the factory scheduled at the end of 2011, they are currently considering adding a production line for children-oriented cheese products, depending on the results of market research.

Fig.4 Longdan Milk Industry Company's Products (Yoghurt)

3.2.2.2 Sustainability of Project Purpose

Since the completion of the project, the total raw milk sales volumes in the project model area and Xianyuan Township area have been steadily increasing as shown in the table below.

Table 9 Changes in Annual Sales Volumes of High-Quality Raw Milk in Model Area and Xianyuan Township Area

	Model Area	Xianyuan Township	
Year	Raw Milk Sales Volume (ton)		Number of Dairy Cattle (head)
2006	15,806	47,988	18,805
2007	19,142	49,448	17,519
2008	21,890	56,080	18,577
2009	23,735	64,620	21,260
2010	26,061	72,280	23,278
Target Value	11,000		

Source: Xianyuan Township Government Livestock Farming Center

One of the potential factors that was anticipated to affect the sustainability of the project effects was whether the demand for milk could be maintained. Due to the incident that occurred in 2008 involving powdered milk containing toxic substances, the consumption of dairy products as a whole declined temporarily, but it has recovered gradually thereafter. Although the demand for powdered milk is still low, the demand for yoghurt has been growing on account of the national government's policy to popularize dairy products as well as the change in people's taste in step with the economic growth, and the trend is expected to continue in the future.

Furthermore, due to the momentum toward corporate privatization and foreign dairy companies making inroads into the Chinese market after the country's joining the WHO, the approval standards for newly-established ventures have become stricter in terms of environment, technology and equipment. In this context, the quality-control technologies transferred in the project are capable of satisfying these standards and requirements. Therefore, for all intents and purposes, the efficacy of the technologies introduced in this project has been maintained.

3.2.2.3 Model Utilization Status at Dairy Farmers' Level

Hearing surveys with the organizations concerned and project beneficiaries have confirmed that the model established in this project has been in use for five years after the end of the project by the direct beneficiaries, i.e. Youyi Ranch, the monitor farmers, and Longdan Milk Industry Company. Moreover, in the field of dairy farming, it has been revealed that the government's efforts to disseminate and transfer technologies have helped this model to be

utilized not only by the direct beneficiaries of the project but also dairy farmers in other cities outside the project area (see the section "3.2.2.4 Overall Goal Achievement" for dissemination).

The technologies transferred in the project have both been utilized continuously and have become widespread. This is because the technologies—both conventional and new ones—have been selected in a flexible manner depending on the environment and condition, and have been improved and applied in accordance with the situation and needs on the ground.

Of the technologies transferred to the monitor farmers, those utilized and unutilized at the time of the ex-post evaluation were as shown in the table below.

Table 10 Utilization Status of Technologies Transferred in the Project

	Field	Technical content	Factor
Utilized Technologies	Fodder Production	Silage production technology, Mixed fodder production, improvement of corn cultivars and cultivation methods, utilization of residues, forage storage	These technologies were easily asscepted due to the manifestation of production increase effects.
	Feeding Management	Improvement of feeding environment (ventilation, lighting), use of cryopreserved semen of excellent breeds, milking hygiene control, hoof cutting, feeding management for calves	The technical levels and input scales of these technologies were applicable to even small-scale farmers. Since dehorning requires machinery, only farmers in the vicinity of Youyi Ranch are implementing it.
Unutilized Technologies	Feeding Management	Physique appraisal of dairy cattle, weight/height measurement, hair shaving	Application of the appraisal and measurement technologies to small-scale dairy farmers was difficult because these were more suitable for medium- to large-scale dairy farmers both technically and financially. The hair shaving technology was transferred with the intention of preventing mastitis. However, as its effects failed to be fully understood, the technology never took hold.

Source: Created based on the information obtained from the Heilongjiang Livestock Department, Anda City Livestock Department, Xianyuan Township Government Livestock Farming Center, Youyi Ranch, and beneficiary survey.

In addition to the above technologies, a mastitis examination technology was transferred to stock farms and dissemination centers of the township government providing services to dairy farmers. At present, however, examinations are commonly conducted by dairy companies at the time of raw milk shipment collection. Therefore, the organizations concerned in this project are not utilizing this technology in their services catering to dairy farmers.

The government support packages for dairy farmers to complement the dissemination and establishment of technologies are as follows. The beneficiary[14] survey has confirmed that the beneficiaries were highly content especially with vaccination and artificial insemination services for excellent cultivars.

[14] The beneficiary survey covered 40 households of monitor dairy farmers and 30 households of non-monitor dairy farmers in Anda City, as well as 50 households of dairy farmers in Shuangcheng City, one of the areas subject to technological dissemination selected at the end of the project.

Table 11 Percentage of Farmers Receiving Subsidies from Government

(Unit: %)

	Dairy Farmers in Anda City		Dairy Farmers in Shuangcheng City
	Monitor	Non-monitor	
Silage Subsidy	42.5	86.6	0.0
Crop Seed Subsidy	0.0	0.0	60.0
Preventive Vaccination	100.0	86.6	100.0
Cryopreserved Semen of Excellent Breeds	95.0	86.6	100.0
Farm Equipment Subsidy	85.0	26.7	6.0

Source: Results of beneficiary survey

3.2.2.4 Overall Goal Achievement

Overall Goal: To disseminate the model established in the project throughout entire Heilongjiang Province.

Index: The dissemination program including the model established in the project is implemented in the six areas.

The dairy farming and dairy industry technologies established in the project were expected to be disseminated throughout the province after the end of the project.

The index of the overall goal was based on the six areas in the province as the scope of technological dissemination. Prior to the end of the project, seminars were held and manuals were distributed in these areas. In reality, the dissemination activities after the end of the project were not limited within particular areas, but the technologies and expertise demonstrated in the project have been incorporated into the conventional dissemination programs of the province. Consequently, the technologies have become more widespread than initially targeted throughout the province.

The model established in the project, namely the systematized group of technologies, has been utilized by the relevant entities in dissemination activities for small-scale dairy farmers, and its effects have been manifested in the improvement of the production of forage and raw milk.

(1) Activities during Project Cooperation Period (six months between terminal evaluation and end of cooperation)

During the six months running up to the end of the project, the final versions of the technical manuals were completed, and peripatetic instruction sessions on dairy technology were held in the said six areas.

(2) Activities after Project Completion

Since the end of the project, the provincial government, with a view to applying the project effects to each area, has examined appropriate technologies to be disseminated and has reflected the technologies introduced in the project in its annual dissemination plan for dairy farming technology. On the other hand, it was each of the city and county governments that were supposed to take the initiative in formulating dissemination strategies and plans specifically catering to the said six areas in accordance with the dissemination plan of the province. Therefore, the project stakeholders were not directly involved in the formulation process.

Afterward, the organizations concerned have implemented the monitoring of the dissemination activities and progress status of dairy faming and industry technologies in line with the dissemination plans of the province as well as each of the cities and counties, thereby corroborating the following achievements and effects thus far.

1) Dairy Farming

The manuals and other training materials compiled through the project have been distributed to the organizations concerned and dairy technology extension workers. The Heilongjiang Livestock Department and the project stakeholders in Anda City have highly appreciated the efficacy of these materials. The manuals are being utilized by the provincial, city, county, township and town[15] governments in formulating their dissemination plans and holding training courses, primarily referring to the technological items intended for small-scale dairy farmers. As shown in Table 12, small-scale dairy farmers account for over 90% of all the dairy farmers in the province; thus, the content of the manuals satisfies the needs of the province. The technological items utilized mainly include those pertaining to the improvement of feeding environment, preparation of silage forage, use of cryopreserved semen of excellent breeds, blending of forage, prevention of mastitis, hoof cutting, and feeding management for calves.

Table 12 Number of Dairy Farmers by Scale in Heilongjiang Province

Scale of Dairy Farmers	Number of Dairy Cattle	2006	2010
Small-scale	40,693	65,238	99,707
Medium-scale	30-200	3,246	5,764
Large-scale	200 or more	295	997
	Total	68,779	106,468

Source: Heilongjiang Province Livestock Department

The model stock farms and areas of the project have also been continuing their activities as the bases for technological dissemination.

In Xianyuan Township, where the model area of the project was located, training sessions

[15] In general, Chinese administrative divisions have a three-tiered structure, with provinces, cities/counties, and townships/towns. Townships/towns are the smallest administrative divisions.

targeting a total of 400 dairy farmers are being held six times annually. In addition, peripatetic door-to-door technical instruction activities have continued to be implemented, covering about half of the dairy farmer population in the township, and the number of instructed dairy farmers has been increasing compared to during the project period. The content of the training is renewed every time, with the technologies established in the project being improved to keep abreast of the situation so that they can be disseminated promptly.

Approximately 35 inspection teams visit Youyi Ranch, the model stock farm, annually. Consequently, the stock farm is playing a role as a base for technological dissemination, where demonstration exhibitions for the technologies transferred in the project are held.

To measure the effects of technological dissemination outside the project area, data pertaining to the production of forage crops and raw milk were collected, which were identical to the output indices, via a beneficiary survey. The results were as follows: The yield of forage maize has increased by 30% owing to technology transfer. Furthermore, an analysis of the effects of technology transfer that promotes the improvement of feeding management has confirmed that the milk yield has increased by 10% to over 20%.

Table 13 Changes in Annual Production of Silage Maize before and after Technological Transfer

(Unit: kg/ha)

	Before	After	Growth Rate
Anda City	4,926	6,400	130%
Shuangcheng City	-	-	-

Source: Beneficiary Survey Results

Table 14 Changes in Annual Milk Yield per Cow before and after Technological Transfer

(Unit: kg/cow)

	Before	After	Growth Rate
Anda City	4,470	5,542	124%
Shuangcheng City	3,318	3,848	116%

Source: Beneficiary Survey Results

In the beneficiary survey, over 90% of the beneficiaries have responded that their raw milk yields have increased after they received technical instruction. Specifically, the improvement of the feeding environment has led to the decrease in the incidence of disease among dairy cattle (see Table 3), and the improvement of forage has led to increase in the production and quality of raw milk.

2) Dairy Industry

On account of the privatization of the dairy industry[16], the roles played by the government to disseminate technologies in this field have been reduced. The introduction of competition due to privatization has prompted each company to take unique approaches such as cooperation with foreign firms and research institutions, business partnerships between companies, and investments in facilities and equipment. Thereby, these companies are proceeding with the development of dairy products catering to the taste of consumers and the streamlining of operations.

The manuals created in the project have been distributed to the relevant entities such as dairy companies in the province and are being referred to and utilized for research and product development purposes.

Table 15 Major Dairy Companies in Heilongjiang Province

Company Name (Chinese Name)	Products other than Milk	Daily Milk Production (ton)
Feihe International, Inc.	Powdered Milk	1,000
Heilongjiang Beingmate Dairy Industry, Ltd.	Powdered Milk	300
Hei Longjiang Yaolan Dairy Co. Ltd	Powdered Milk	300
Heilongjiang Hui'Erkang Qingxin Dairy Industry Co. Ltd.	Sterilized Milk, Milk Beverages	160
Harbin Prince Dairy Products Industrial Co. Ltd.	Milk Beverages, Powdered Milk	60

Source: Heilongjiang Province Livestock Department

At present, the Chinese Government is making efforts toward technological dissemination in the field of dairy industry only on a small scale. The Dairy Product Technical Training Center within the National Dairy Engineering and Technical Research Center, which was one of the executing agencies of the project, is taking the initiative in providing college students in relevant faculties with training courses on the manufacturing of processed cheese. The actual annual number of trainees in 2010 was approximately 80.

3.2.2.5 Prospects of Super Goal Achievement

Super Goal: To improve the earnings of dairy farmers in Heilongjiang Province through the development of its dairy farming and dairy industry.

Index: The average dairy farming income of dairy farmers in Heilongjiang Province increases.

(1) Growth of Dairy Farming and the Dairy Industry in Heilongjiang Province

1) Dairy Farming and the Dairy Industry in Heilongjiang Province

Dairy farming and dairy industry in Heilongjiang Province have grown dramatically in the past decade including the 5 years of the project period and the subsequent 5 years. For example,

[16] The Chinese Government's policy of privatizing state-owned enterprises started in the late 1990s and this reform became full-fledged from around 2003.

the raw milk production within the province has more than tripled since the start of the project, and even compared the end of the project, the amount is 1.5 times greater (Table 8). Furthermore, the annual milk yield per dairy cow has increased by around 20% compared to before the technology transfer to dairy farmers (Table 14), thus demonstrating the effects of the transfer. In the dairy industry field, the government encouraged citizens to consume dairy products, and the privatized companies competed against each other to improve their products. This has led to the increased production and diversification of dairy products.

2) Impacts of the Project on Dairy Farming and the Dairy Industry in the Entire Province

This project was aimed at disseminating a model established via the project throughout Heilongjiang Province. As mentioned above, this model is being utilized as part of the dissemination plan of the province and is playing a certain role in the overall dissemination effort of the province. In the dairy farming field, in particular, the model is being utilized as an affective manual and teaching material by small-scale dairy farmers, who account for more than 90% of all the dairy farmers in the province. In interviews, extension workers highly appreciated the model. In the dairy industry field, the scope of the government's activities in the technology transfer was limited after the privatization of dairy companies. Accordingly, the government's involvement in this project was indirect. Nevertheless, the manuals prepared in the project have been distributed to relevant entities such as dairy companies in the province, where they have been referred to and utilized for research and product development purposes. Therefore, they can be evaluated as contributing to the growth of these private companies. In addition, Longdan Milk Industry Company, which was a project implementing organization in the dairy industry field, has seen the quality of its yoghurt products improve through the project, and this effect has been maintained ever since the end of the project. As a result, the company's market share of yoghurt products has expanded within the province, exceeding 50% at the time of the ex-post evaluation. Given the increase in the raw milk yield so far (see Table 8) and the production of fermented milk by the company (see Table 4), the share is expected to continue growing in the future.

In order to maximize the effect of technical cooperation within the constraints of limited inputs, the dissemination process after the project implementation holds the key. In the case of this project, as stated above, technologies were selected and transferred in accordance with the actual needs and conditions in the province. As a result, the results of the technical cooperation have been successfully incorporated into the overall dissemination plan of the province. Given the successful implementation of cooperation with an eye on the dissemination phase, this project can be evaluated to have played a role in boosting the effectiveness of the overall dissemination policy of the province.

(2) Improvement of Dairy Farmers' Income in Heilongjiang Province

As mentioned above, the effects of technological dissemination have been confirmed in the form of increase in the raw milk yield per cow. However, according to the beneficiary survey, factors such as increasing costs for purchasing forage have caused the dispersion of dairy farmers' earnings from area to area. The table below shows the survey results on the actual income of dairy farmers in the cities of Anda and Shuangcheng before and after the technological transfer[17].

Table 16 Changes in Dairy Farmers' Income before and after[18] Technological Transfer

(Unit: Yuan)

	Household Income			Profit per Dairy Cow		
	Before	After	Amount of Increase	Before	After	Amount of Change
Dairy Farmes in Anda City (monitor)	19,449	33,741	14,292	4,164	3,842	-322
Dairy Farmes in Anda City (non-monitor)	37,640	31,529	-6,111	4,395	3,761	-634
Dairy Farmers in Shuangcheng City (non-monitor)	9,712	67,052	57,340	1,133	4,723	3,590

Source: Beneficiary Survey Results

* The income figures before the technical transfer have been adjusted for inflation.

As shown in the table above, the actual incomes of the monitor farmers have increased since the start of the project and exceeded the average income of the non-monitor farmers, thus clearly demonstrating the effects of the technical transfer in the project. However, the profit per head of cattle has decreased, albeit slightly. According to the explanation by the livestock departments of Heilongjiang Province and Anda City, this is probably attributable to the increase in the production expenses including the forage costs. In fact, in Shuangcheng City where the home production of forage is possible, the effects have been greater, with the profit margin per head of cattle having increased significantly. The table below compares the costs per head of cattle between both cities. In Anda City, due to restrictions pertaining to natural environment and land resources such as its arid climate, alkaline soil and limited cultivated area, there are limits as to how much forage can be produced. Accordingly, the purchase costs for forage have significantly added to the production expenses, resulting in the decreased profitability of the dairy industry.

[17] Taking into account the price escalation rate, the actual incomes adjusted for inflation were compared. Since the number of the samples is limited and other conditions also vary, the figures were analyzed as references.

[18] The data prior to the technological transfer are from 2000 for the monitor dairy farmers in Anda City, from 2003 for the non-monitor dairy farmers, and from 2004 for those in Shuangcheng City. The data after the technology transfer are the achievement data from 2010.

Table 17 Changes in Production Costs before and after Technological Transfer

(Unit: Yuan)

	Cost per Dairy Cow		
	Before	After	Growth Rate
Anda City	2,380.9	3,558.2	149%
Shuangcheng City	2,271.1	1,435.1	63%

Source: Beneficiary Survey Results

* The income figures before the technical transfer have been adjusted for inflation.

The other factors contributing to the significant rise of the dairy farmers' income in Shuangcheng City compared to that in Anda City include its higher accessibility to the market and the greater number of dairy cattle owned. With Shuangcheng City located on the outskirts of the provincial capital Harbin and the dairy farmers there owning five more cows on average than those in Anda City, there is clear difference in the production scale between those two cities (see Table 3).

In comparison of the earnings between the monitor and non-monitor farmers in Anda City, while a certain level of income improvement has been confirmed among the monitor farmers, the actual income of the non-monitor farmers has decreased. This may derive from the difference in the achievement status of productivity enhancement[19] between these two types of farmers.

On the other hand, the market price of raw milk, which can have a potential impact on the dairy farmers' income, has been stabilized, partially owing to the price adjustment efforts by the government. The price of raw milk plummeted temporarily after the incident that occurred in 2008 involving powdered milk containing toxic substances, whereas the price of forage went up when its supply could not keep up with the demand due to the decrease in the number of farmers producing forage. The price fluctuated thereafter until the government took price adjustment measures, thanks to which the dairy farmers were spared from the major effects of the price fluctuation. When asked to evaluate the current price level (degree of satisfaction) in the beneficiary survey, 12% of the dairy farmers responded that they are "satisfied," 64% "somewhat satisfied," and 24% "unsatisfied," thus indicating a relatively stable degree of satisfaction.

[17] As shown in Table 16 in the previous section, the raw milk production of the non-monitor farmers has been growing. However, the annual yield per cow is still 400 kg lower than that of the monitor farmers. Therefore, the production improvement effects are still not sufficient.

Table 18 Changes in Raw Milk Price (Actual Price) in Heilongjiang Province

Year	2006	2010	Growth Rate
Actual Price (yuan/kg)	1.78	2.75	
Price Adjusted for Inflation (yuan/kg)	1.99	2.75	138%

Source: Heilongjiang Province Livestock Department

In light of the above survey results, the current status and factors regarding the income improvement of dairy farmers are summarized as follows:

Table 19 Current Status and Factors Regarding Dairy Farmers' Income Improvement

Factors of Income Improvement	Actual Income	Profitability of Dairy Cattle	Market Prices	Production Costs (Forage)	Average Number of Cattle (Scale)
Anda City					
Monitors	Increased	Decreased	Stabilized	Significantly impacted	10 head (increased)
Non-monitors	Decreased	Decreased	Stabilized	Significantly impacted	11 head (increased)
Shuangcheng City (Non-monitors)	Significantly increased	Improved	Stabilized	Stabilized	16 head (increased)

By present time, the sales price of raw milk has been stabilized, and productivity has improved on the whole. However, factors such as the increase in production costs due to the rising prices have resulted in the dispersion of the dairy farmers' earnings depending on the area and business environment. That said, the super goal is considered to have been achieved to a certain extent.

In order to harness the dissemination of the dairy farming model to improve the farmers' income throughout the province, it will be necessary to maintain advantageous conditions for the farmers to own at least a certain head of cattle, in addition to the improvement of productivity and the streamlining of production costs.

3.2.2.6 Factors to Promote or Inhibit Achievement of Overall Goal and Super Goal

(1) Promoting Factors

Although it is the national government that takes the initiative in implementing technical instruction and assistance programs for dairy farmers, entities other than governmental authorities are observed to have played and exerted the following roles and influence:

- There is a livestock producers' association that wields a strong influence over sales and distribution. The affiliated members of the association are companies and large-scale

dairy farmers in the province. Although the membership does not include small-scale farmers who were covered by this project, the association has a say in proposals to the government and milk price negotiation, and thus, is involved in the promotion of the farmer assistance program of the province and the stabilization of sales prices.

- According to the beneficiary survey, about 10% of the dairy farmers were receiving technical instruction not only from the dissemination agencies of the government but also from forage companies and dairy companies. In particular, raw milk whose production quality and quantity has improved as a result of instruction from dairy companies tends to be shipped to the same companies. Furthermore, dairy farmers have become more conscious of the quality control of their raw milk in conformity with the company-specific quality standards[20] for raw milk.

Although it is difficult to fathom how the above-mentioned promoting factors influenced the project effects, a certain degree of synergistic effect must have come into play as association activities and companies were involved in the technical dissemination.

(2) Inhibiting Factors

Due to China's joining the WTO in 2001, the import volume of low-priced foreign-made powdered milk products has been increasing since 2005, thus raising concern of either the milk price dropping or the sales of domestic raw milk being impeded.

3.2.2.7 Other Impacts

(1) Impacts on Natural Environment

In Xianyuan Township, which was one of the project areas, approximately 1,000 Mu of grassland were recovered during the period between 2003 and 2006. Furthermore, thanks to the transfer of manure treatment technologies, environmental health problems such as the stench around Youyi Ranch and the monitor dairy farms have been alleviated. There have been no other environmental problems resulting from the project.

(2) Land Acquisition and Resettlement

The implementation of the project has not entailed any resettlement of residents or land acquisition.

(3) Other Indirect Impacts

1) Organization of Dairy Farmers

The staff at Youyi Ranch, who have been trained in Japan during the project, under the support of the Xianyuan Township Government, established the Youyi Village Dairy Cattle

[20] Although there are government-imposed standards for raw milk quality, these company-specific standards can sometimes be stricter.

Association in 2004 along with other dairy farmers in the vicinity, by referring to the Japanese Agricultural Cooperative. The association was continuing its activities at the time of the ex-post evaluation, and three other dairy farmers' associations have been founded in the township. The activities of the associations include the transfer of feeding management technologies supported by the government, provision of disease prevention services, price negotiation with forage companies, and coordination of payment. These activities are thought to be contributing to the improvement in the technology and income of dairy farmers.

2) Regional Infrastructure Development

Since the project completion, Youyi Ranch and the Anda City Government have developed roads in the dairy farming project area. This has enabled regular collection of raw milk by dairy companies.

The implementation of this project has led to the achievement of the project purpose of establishing dairy farming and dairy industry technologies and the overall goal of disseminating dairy farming technologies to a certain extent. Moreover, the effects of the project have been manifested as planned. Therefore, the efficacy and impacts of this project have been high.

3.3 Efficiency (Rating:③)

3.3.1 Inputs

The planned inputs and achievements of this project were as follows:

Input Element	Plan	Achievement (at completion)
(1) Expert Dispatch	- Long-term experts from six fields - Short-term experts: to be dispatched as necessary in accordance with the basic plan. Number: To be determined	- 13 long-term experts from 7 fields: chief advisor, forage production, feeding management, raw milk quality control, dairy product processing (cheese and fermented milk), and coordinator. 31 short-term experts from 27 fields: silage preparation technology, alkali soil modification technology, cow feeding environment arrangement, milking hygiene control, manufacturing technology for various types of cheese, collection and storage of lactic acid bacteria, equipment operation and maintenance, etc.

(2) Trainee Acceptance	Main training fields To be accepted as necessary No concrete plans	Main training fields: Forage production, feeding management, raw milk quality control, dairy product manufacturing, fertilized egg production, etc. 37 trainees
(3) Equipment Provision	Main input equipment: Material and equipment necessary for the following operations (forage production, feeding management, raw milk quality control, and dairy product manufacturing); material and equipment necessary for offices, vehicles, etc.	Main input equipment: Milking facilities, machinery necessary for forage production, cheese ripening air conditioning equipment, raw milk analytical machinery, etc.
Total Cooperation Amount	NA	1.3562 billion yen in total
Chinese Government Input Amount	Personnel expenses and other allowances for the counterparts and other Chinese stakeholders, expenses and depreciation charges necessary for the development of land, buildings and incidental facilities, technology dissemination costs, and expenses necessary for other project activities. Amount To be determined	Personnel expenses, material/equipment purchasing costs, building maintenance expenses, technology research expenses, etc. 26.63 million yuan in total

3.3.1.1 Input Elements

(1) Japanese Side

The dispatch of experts satisfied the planned fields and was implemented while making changes to correspond to the needs during the project period. In particular, a certain Chinese stakeholder expressed the view that the long-term dispatch and multiple dispatch of the same experts were highly effective in understanding the local needs, building a trusting relationship, and selecting and relocating appropriate technologies. However, there have been some problems such as frequent replacement of short-term experts, which slightly delayed the progress of the project. Nevertheless, this did not affect the ultimate achievements of the outputs.

The counterparts who received training in Japan have stated that they were able to put what

they learned into practice in the project activities in one way or another.

Fig.7 Inspection/Analytical Equipment at the Dairy Industry Site

Fig.8 Milking Plant Developed at the Dairy Farming Site

(2) Chinese Side

Of the 89 counterparts allocated, 71 remained stationed by the end of the project; therefore, the retention ratio was relatively high.

3.3.1.2 Cooperation Amount

Since the ex-ante evaluation amount could not be confirmed, no comparison between the plan and the achievement is available.

3.3.1.3 Cooperation Period

The cooperation period was as planned, lasting for 60 months between July 1, 2001 and June 30, 2006.

As above, although the absence of a planned value for the cooperation amount renders it impossible to make a comparison between the plan and the achievement, the inputs made in the project were appropriate in proportion to the achievement outputs, and the cooperation period was as planned. Therefore, the efficiency of the project was high.

3.4 Sustainability (Rating: ②)

3.4.1 Policy and Institutional Aspects

The policies at the time of the ex-post evaluation were as follows: The policies for dairy farming production were aimed at promoting the expansion, sustainability, dissemination and effects of the technologies introduced in the project. By contrast, the government has promoted the privatization of the dairy industry, and thus, has not taken the initiative in formulating policies to encourage technological development in this field.

(1) Dairy Farming Field

In the National People's Congress convened in March 2011, it was declared that the nation would continue to attach utmost importance to the support for agriculture and rural development, and a fiscal expenditure of 988.45 billion Yuan was earmarked for the period between 2011 and 2010 (a year-on-year increase of 130.48 billion Yuan).

According to the "Heilongjiang Province Million Tons of Milk Strategic Business Plan (2008-2012)," the province is aiming for the promotion of excellent breeds, increase of model stock farms, expansion of their operation scale, increase of forage production, and recycling of livestock manure. In addition, the dairy farming support system[21] currently introduced by the government is serving as an incentive for dairy farmers to maintain the project effects and introduce new technologies. According to interviews with dairy farmers, they were especially appreciative of the fact that semen used for artificial insemination of excellent breeds and vaccination are free of charge.

(2) Dairy Industry Field

Since the privatization of many of the state-owned dairy companies, private companies have been independently promoting the development of dairy industry technologies, and at the same time, the roles played by the government agencies in technology dissemination have been reduced. Although the National Dairy Engineering and Technical Research Center regards promotion of the dairy industry, support for market revitalization, and encouragement for increased consumption of dairy products as its three main missions, it has now virtually no functions as a research and inspection body, according to project stakeholders.

3.4.2 Structure of Counterparts

In the dissemination of dairy farming and dairy industry technologies, the organizations shown in the table below are sharing responsibilities. In the field of dairy farming, extension workers are assigned to the livestock department of each local municipality, which is responsible for formulating and supervising its activity plans. In the field of dairy industry, on the other hand, the privatization of dairy companies has enabled each company to develop technologies and products on its own, thus diminishing their roles in technological dissemination.

[21] Preferential pricing for silage forage crop seeds, allowances for silage storage, artificial insemination services, allowances for forage corn production, etc.

Table 20 Organizations Involved in Dissemination of Dairy Farming and Industry Technologies and their Roles

Roles	Dairy Farming	Dairy Industry
Formulation of dissemination policies/plans; supervision of dissemination activities	Heilongjiang Province Livestock Department, city/county livestock departments	National Dairy Engineering and Technical Research Center
Implementation of dissemination activities	Technical extension staff at province, city/county, and township/town livestock departments	National Dairy Engineering and Technical Research Center
Development of technologies	Heilongjiang Province Livestock Research Institute	Each dairy company (private)

Sources: Created based on the information obtained from the Heilongjiang Livestock Department, Anda City Livestock Department, Xianyuan Township Government Livestock Farming Center, and Longdan Milk Industry Company.

(1) Dairy Farming Field

There is an established technological dissemination structure in place in the field of dairy farming, where technical extension staff assigned to each of the administrative units from province to village have been providing dairy farmers with necessary services such as artificial insemination and preventive vaccination pursuant to the plans. According to interviews with the organizations concerned, although the number of extension workers is sufficient, challenges remain concerning their technical levels and the paucity of financial resources for dissemination activities. In the beneficiary survey, no respondents voiced dissatisfaction with the technical instruction by the government.

The model stock farm of the project, Youyi Ranch, is cooperating with the Xianyuan Township Government Livestock Farming Center (in charge of technical dissemination and instruction) and the Anda City Government Livestock Department in disseminating technologies. Youyi Ranch is engaged in technological dissemination activities for dairy farmers on a daily basis along with the Xianyuan Township Government, and holding meetings to share information on the progress of their activities with the Anda City Livestock Department at a frequency of about every month. Youyi Ranch has seen hardly any transfers of project stakeholders in the field of dairy farming, and many of the staff at the Anda City Government have been assigned to duties related to dairy farming even after personnel transfers. Therefore, the structure to implement dissemination and monitoring activities to maintain the project effects has scarcely been affected.

In Anda City, to which the project model area belongs, there are a total of 130 township/city government personnel in charge of technological dissemination and public relations. On the

village level, there are 500 to 6,000 extension workers[22]. In Xianyuan Township, where the project model area was located, the number of extension workers has been unchanged at seven for the past 10 years. There are 40 extension cooperators in the nine villages within the township.

(2) Dairy Industry Field

One of the executing agencies in the dairy industry field, Longdan Milk Industry Company, was privatized in conformity with the government policy in 2004, when the project was still in progress. Consequently, the mobility of human resources since the end of the project has been high. The only thing the provincial government could do was to request the company to keep the outflow of human resources to a minimum, but as many as 30 workers have transferred to other companies in the same line of business within the province. According to an interview with Longdan Milk Industry Company, the majority of these workers are engaged in research and development in their new companies. This may have adversely affected the sustainability of the project in the short run, but from the perspective of technological dissemination, it may also be said to have contributed to the dissemination of the dairy technologies transferred in the project.

On the other hand, with regard to the technological dissemination structure for the dairy industry, the other executing agency, the National Dairy Engineering and Technical Research Center, has taken the initiative in providing training courses catering to university officials. At present, it is private companies that are taking charge of the dairy industry, with each company developing technologies at its own discretion. Therefore, the government is not conducting technological dissemination activities targeting private companies.

3.4.3 Technologies of Counterparts

The equipment and facilities supplied and allocated in the project have been utilized, and there appears to be no problem regarding operation and maintenance in the future. In the dairy industry field, despite some outflow of technologies due to the transfer of human resources trained in the project from Longdan Milk Industry Company, efforts have been made, for example, to provide training courses for new talent. Consequently, the outflow has not significantly affected the maintenance of the technologies transferred in the project.

In the dairy farming field, the extension workers are playing crucial roles in promoting technological dissemination throughout the province. Although the minimum skill levels of the extension workers are being maintained through periodic testing, there are financial constraints in implementing training programs to transfer new technologies. These constraints are serving

[22] Village extension workers are in charge of providing services under the technology dissemination structure of the Chinese Government. They are paid by the Government and need an academic background and expertise in a specialized field. In order to maintain and improve the skill levels, they are required to renew their licenses by passing periodic examinations. In the field of dairy farming, they are engaged in services such as preventive vaccination and artificial insemination.

as inhibiting factors in promoting technological dissemination to dairy farmers. This problem was pointed out unanimously in interviews with the dairy farming technology extension staff of the provincial, city/county, and township/town governments.

(1) Equipment

It was macroscopically confirmed that most of the supplied equipment was maintained in good condition and fully utilized. The table below shows the utilization status of the major equipment:

Table 21 Utilization Status of Equipment Worth over Five Million Yen

Use Frequency (A: Always - B: Often - C: Sometimes); Condition (A: Good - B: Normal - C: Bad)				
Machinery Name	Price (1000 yen)	Installation Location	Use Frequency	Condition
Milking Facilities	8,364	Youyi Ranch	A	A
Tractor	7,570	Youyi Ranch	A	B
Tractor	6,536	Youyi Ranch	A	B
MilkoScan	12,376	Longdan Milk Industry Company	A	A
Ripening Room and Air Conditioning for Natural Cheese	29,103	Longdan Milk Industry Company	A	A
Power Shovel	5,946	Youyi Ranch	A	B
Wrapping Machine for Processed Cheese	8,462	Longdan Milk Industry Company	B	A
Decentralized Stability Analyzer	5,590	National Dairy Engineering and Technical Research Center	A	C*

Sources: Youyi Ranch, Longdan Milk Industry Company
Note:* With some of the parts difficult to obtain, operation is done manually.

Some of the equipment and facilities supplied to Youyi Ranch are being operated and maintained by outsourcing experts. Longdan Milk Industry Company keeps the machinery and equipment for the dairy industry field because the company has space for storage, and the company shares it with the National Dairy Engineering and Technical Research Center. During the project period, Longdan Milk Industry Company relied on the project manuals for operation and maintenance, but has been using its own versions and revisions thereafter.

(2) Dairy Farming Field

There are some challenges in improving the skills of extension workers who are directly responsible for dissemination activities in townships/villages and cities/counties. Although the extension workers in cities/counties and townships/villages take a one-to-two-week training course provided by the provincial government once every couple of years, the frequency of the training is too low for them to reach a technical level that allows them to provide instructions on technical improvement. As a result, the quality of the extension workers has not reached a

satisfactory standard yet. With the technologies related to dairy farming being renewed on a daily basis, the current frequency and length of personnel training are clearly insufficient for the extension workers to undergo proper technological transfer.

In order to continue the technological dissemination activities demanded by dairy farmers, it will be necessary to increase the opportunities of training for extension workers.

(3) Dairy Industry Field

Approximately a quarter of the personnel trained in the project were still engaged in the operations at the time of the ex-post evaluation. According to the Longdan Milk Industry Company, the newly-assigned personnel have inherited the skills through training courses. Therefore, there should be no problem concerning the maintenance of the technologies.

3.4.4 Financial Affairs of Counterparts

According to the staff at the Heilongjiang Livestock Department, although their financial condition allows the employment of human resources in relation to technological dissemination, they have been able to secure only a minimum amount of training budget for dissemination activities and improvement of personnel skills from the government budget. They have explained that they are unable to implement sufficient dissemination activities for production improvement needed by dairy farmers.

On the other hand, there was no problem in the financial sustainability of Youyi Ranch and Longdan Milk Industry Company, which were the project executing agencies, and interviews with persons concerned have revealed that their business is expanding.

(1) Dairy Farming Field

In order to maintain the financial sustainability for technological dissemination, it is necessary to improve personnel skills and secure activity costs such as transportation expenses and allowances. Although the number of extension workers and the size of the budget are increasing in the province as a whole, they are still not sufficient. Furthermore, despite the sufficient number of extension workers secured at the city/county and township/town levels, the skill development of each worker is a challenge, with the training budget for them not sufficient.

The subsidies provided by the national, provincial and city governments are on the increase compared to at the time of the project completion (see Table 11 for details).

Meanwhile, the financial sustainability of the project model areas is as follows: The expenditures related to technological dissemination and public relations by the Xianyuan Township Government have been unchanged at 200,000 Yuan annually for the past five years, but have increased from 100,000 Yuan during the project period. Although Youyi Ranch is being run on a self-financing basis, it does not seem to have any financial issues, with its business

growing as evidenced by the addition of new milking plants and cattle sheds after the end of the project.

(2) Dairy Industry Field

The total annual sales of Longdan Milk Industry Company, an executing agency in the dairy industry field, grew from approximately 500 million Yuan in 2005 to approximately 800 million Yuan in 2010. The company continues to be in the black, thus posing no problems for securing operation and maintenance fees for the equipment and facilities.

3.4.5 Sustainability Status of Effects

(1) Sustainability of Effects

In the section "3.2.2 Impacts," the status of the project achievements and goals after project completion was mentioned. Besides this, the effects on the following research fields have been observed.

The annual production and land area of alfalfa seeds in the Heilongjiang Province Livestock Research Institute have been expanding since the end of the project, indicating the effects of the technological transfer. This research institute contacts the Anda City Livestock Department of the dairy farming site a few times a year as necessary to offer support services such as embryo transfer and provision of excellent alfalfa seeds.

Table 22 Changes in Alfalfa Seed Production in Provincial Livestock Research Institute

Year	Annual Production (Catty)	Production Land Area (Mu)
2006	183	12
2007	450	30
2008	675	45
2009	900	90

Source: Heilongjiang Province Livestock Research Institute

(2) Promoting Factors

Since October 2009, JICA has been dispatching senior volunteers in the field of dairy farming, and they have been addressing challenges such as improvement of alkaline soil, cattle manure treatment, and reproductive difficulties of dairy cattle. The daily duties of these dispatched volunteers include instructing farmers on how to apply the technologies transferred in the project to limited conditions. According to interviews with the staff at Youyi Ranch and the volunteers, these activities have not only ensured that the technologies are assimilated but also contributed to changing the mindset and attitude of the workers toward the utilization and application of the technologies.

As above, some problems have been observed in terms of the technical and financial conditions of the project; therefore the sustainability of the project effects is fair.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

Heilongjiang Province in China, ranking high in dairy production, had been making efforts to develop and promote dairy farming and the dairy industry but had issues in the quality/quantity of cattle forage and the productivity of raw milk, as well as problems such as delays in the development of dairy products. This project was intended to address such development needs while aiming for improvement of the technologies for forage production, feeding management and dairy processing. Therefore, its relevance was high. The goal of this project was to establish a model for dairy farming and dairy industry in the province, and this was achieved through the improvement of technologies for forage production and feeding management in the dairy farming sector, and through the diversification and quality improvement of dairy products in the dairy industry. Since the completion of the project, the established model, that is to say the systematized technological methodology, has been promulgated by the authorities concerned to the entire province, and its effects have been manifested in the improvement of raw milk production and the increase in dairy farmers' earnings, thus substantiating its positive impact. Furthermore, since the project has been implemented in accordance with the schedule and the results have been proportionate to the inputs, the implementation can be considered to have been efficient. With regard to the sustainability of the project, although some challenges remain in the technological and financial aspects concerning the technical advancement of the extension workers, no problems have been observed in terms of the project policy and structure.

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

4.2 Recommendations

4.2.1 Recommendations to Counterparts

(1) Soil Improvement for Increased Forage Production

In order to increase the income of dairy farming households, forage production has proved to be important in curtailing production costs, especially forage purchasing expenses. In Anda City, where the project area was located, the arable land area where forage can be produced is limited due to the abundance of alkaline soil. Consequently, the farmers can only produce insufficient volume of forage on their own, forcing them to buy commercial forage. In turn, the added costs are undermining the profitability of each dairy farmer. In order to increase the forage production in such an environment, one cannot count solely on the efforts of individual dairy farmers to improve their forage production technologies. Therefore, large-scale support efforts must be made by dedicating an entire project to certain undertakings such as alkaline soil improvement.

(2) Enhanced Training for Extension Workers

In order to enhance the skill levels of extension workers in the field of dairy farming, it will be necessary to increase the frequency and quality of the training. Although the number of extension workers is sufficient, they are unable to provide dairy farmers with satisfactory services regarding technological dissemination just by undergoing training once annually under the auspices of the Livestock Department of the province. The Chinese Government has been promoting financial support for dairy farmers nationwide to reinforce the agricultural sector including dairy farming and animal husbandry, and it has been confirmed that budget can be secured at a local municipality level. It is desirable that the financial resources be secured and the structure and quality of the training be improved.

4.2.2 Recommendations to JICA

None in particular

4.3 Lessons Leaned

None in particular