Ex-Post Project Evaluation 2015:Package I-1 (China)

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JAPAN INTERNATIONAL COOPERATION AGENCY

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INTERNATIONAL DEVELOPMENT CENTER OF JAPAN INC.

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People's Republic of China

FY2015 Ex-Post Evaluation of Japanese ODA Loan

"Hubei Urban Flood Control Project"

External Evaluator: Shima Hayase, IC Net Limited

0. Summary

This project aims to carry out construction and repairs of dikes, culvert gates, pumping stations, and diversion canals for 18 areas in total including 14 cities and four counties on the Jianghan Plain in Hubei Province in order to improve the flood control capacity of each city.

Consistency of this project with China's development policies and development needs on the national, provincial, and city levels at the time of the appraisal and the ex-post evaluation as well as with Japan's ODA policy toward China at the time of the appraisal is fully ensured, and thus, this project is highly relevant. Although a substantial change in the scope was made in the middle of this project since a flood control project by domestic funds advanced, the change was made in accordance with the project purpose and the actual outputs in total increased to more than the plan. Although the project costs were within the range of the plan, efficiency is fair due to considerable delay in the project period.

Through this project, flood control facilities with a design to meet the planned highest safe water level at the reference points were constructed in all subprojects[1], and urban drainage facilities ensured planned drainage capacity.

During the comparison range, rainfall has been within the planned level, and the annual maximum water level and annual maximum were respectively below the highest safe water level and the flood drainage capacity, thus it can be said that predetermined flood safety has been secured[2]. Inundation area and duration, human damages, as well as the amount of maximum damages by levee breach or overflow have decreased sharply accompanying the completion of subprojects and have reduced to almost zero after the completion of all subprojects since 2014. Therefore, the effects yielded by this project can be evaluated as very high. Moreover, it is assumed that the decrease in flood damages has an effect of preventing economic loss of about 3.8 billion yen (about 265 million Chinese yuan[3]) per year on average occurred before the project started, and the impact on the promotion of urban development, promotion of tourism industry, and the improvement of living environment of residents can also be recognized. Accordingly, effectiveness and impact of this project are high.

In general, no major problems have been observed in the institutional, technical, and financial aspects as to the sustainability of the effects yielded through this project, and thus the

[1] Individual project of each city and county carrying out construction, operation, and maintenance of dikes and other facilities under the guidance of provincial government which are included in this project.

[2] However, verification of the effect of the project is based on the confirmation of only the secular change of annual rainfall, and it is not comparable up to the occurrence trend of rainfall.

[3] Conversion was made based on the average exchange rate during a period from 2000 to 2004 at 1 Chinese yuan=14.3 yen.

sustainability is high.

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

1. Project Description

Project Location

Dike Constructed (in Chibi City)

1.1 Background

The Yangtze River basin is a flood-prone area and serious damages were incurred by large-scale floods in 1931, 1954, and 1998. In the basin development plan *Yangtze River Integrated Flood Prevention Facilities System (approved by the State Council in June 1999)* which was revised reflecting such situations, (1) repairs and strengthening of dikes, (2) improvement of the flood prevention capacity through the construction of the Three Gorges Dam and dams in branches of the Yangtze River, (3) improvement of the mainstream and branches of the Yangtze River and branches of Dongting Lake and Poyang Lake, and (4) prohibition of felling of natural forests, reforestation, and prohibition of slope cultivation were included. Although Hubei Province has been developed as agricultural and heavy industrial areas as well as an transportation hub, the province has historically suffered from floods of the Yangtze River and the Han River, and damages were magnified by such factors as insufficient structure of existing dikes against water leakage and low urban drainage capacity caused by inadequate drainage channels and pumping stations.

1.2 Project Outline

The objective of this project is to improve flood control capacity of each city by carrying out the construction and repairs of dikes, culvert gates, pumping stations, and diversion canals of 18 areas in total including 14 cities and four counties on the Jianghan Plain in Hubei Province, thereby preventing flood damages and contributing to stabilization of society and economy of the areas and to improvement of living conditions of local residents.

Figure 1:Yangtze River, Han River and the Subproject Sites

Loan Approved Amount/ Disbursed Amount	13,000 million yen / 12,509 million yen	
Exchange of Notes Date/ Loan Agreement Signing Date	March 2000 / March 2000	
Terms and Conditions	Interest Rate	0.75%
	Repayment Period (Grace Period	40 years 10 years)
	Conditions for Procurement:	Bilateral Tied
Borrower / Executing Agency	The Government of People's Republic of China/ Hubei Provincial People's Government	
Final Disbursement Date	April 2011	
Main Contractor (Over 1 billion yen)	・China Gezhouba Water & Power (Group) CO. ・China Water Resources & Hydropower Min River CONST. & ENG. Bureau ・Daye City's Hydraulic Engineering Company ・Hubei Huaxia Water Conservation & Hydro-Power CO., LTD. ・Hubei International Trade Investment & Development CO., LTD. ・Xiangfan City's Hydraulic & Hydroelectric Engineering Group (all companies are Chinese)	
Main Consultant (Over 100 million yen)	None	

Feasibility Studies, etc.	・F/S (Hubei Province Investigation Design & Research Institute of Water Conservancy and Hydropower June1999） ・F/S Final version(Hubei Province Investigation Design & Research Institute of Water Conservancy and Hydropower December 2001) ・SAPROF (JICA June – September 1999)
Related Projects	【ODA Loan】 ・Hunan Urban Flood Control Project (L/A March 2000) ・Jiangxi Urban Flood Control Project (L/A March 2000) 【Grant Aid】 ・The Project for Improvement of Dikes in Yangtze River (1999 - 2000) 【Other International Donors】 ・Yangtze Flood Emergency Rehabilitation Project (World Bank 1999) ・Yangtze Dike Strengthening Project (World Bank 2000) ・Implementing the National Flood Management Strategy (Asian Development Bank 2007)

2. Outline of the Evaluation Study

2.1 External Evaluator

Shima HAYASE, IC Net Limited

2.2 Duration of Evaluation Study

The ex-post evaluation study was carried out as follows:

Duration of the Study: May 2015 – January 2017

Duration of the Field Study:

December 14, 2015 – December 24, 2015

April 15, 2016 – April 19, 2016

2.3 Constraints during the Evaluation Study

Since this project was implemented in wide areas of 18 cities and counties along the Yangtze River basin, in the ex-post evaluation, the whole picture of the project was grasped by collecting operation and effect indicators of all subprojects through the Ministry of Water Resources and implementing field survey through the survey on major subprojects (six cities[4]). Although local information was collected through interviews and questionnaire survey to subprojects as much as possible, judgment of local operation and maintenance are based on the observation of the situations in the cities for which the field survey was carried out, and therefore, situations of all cities are not reflected.

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

3.1 Relevance (Rating ③[6])

3.1.1 Relevance to the Development Plan of China

(1) Relevance to the Development Plan at the Time of the Appraisal

In the *10th Five-Year Plan for the National Economic and Social Development (2001-2005)*, which was the national development plan of the People's Republic of China at the time of the appraisal, improvement of the systems for flood prevention and disaster mitigation against floods and flood damages in major areas were the priority issues regarding the development of flood control projects, and it was aimed that flood prevention facilities along seven major rivers[7] including the Yangtze River would reach the standards specified by the nation during the period of the five-year plan.

[4] After discussion with the executing agency, six cities representing regional characteristics, such as cities surrounded by mountains (Xiaogan City, Qianjiang City, Xianning City) and flat lands (Jingzhou City, Chibi City, Huangshi City), were selected from among subprojects whose scale of output was large.

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

[6] ③ High, ② Fair, ① Low

[7] Haihe River, Liaohe River, Huaihe River, Yellow River, Songhuajiang River, Yangtze River, and Zhujiang River

The basin development plan *Yangtze River Integrated Flood Prevention Facilities System (approved by the State Council in 1999)* placed the highest priority on repairs and strengthening of dikes as the project for preventing and mitigating flood damages of the Yangtze River, reflecting the heavy flood that occurred in 1998. In light of the above, it is fair to say that repairs and strengthening of the flood control infrastructures through this project were fully relevant to the China's National Development Plan at the time of the appraisal.

(2) Relevance with the Development Plan at the Time of the Ex-post Evaluation

The *12th Five-Year Plan for the National Economic and Social Development (2011-2015)*, which is the National Development Plan of People's Republic of China at the time of the ex-post evaluation, shows a policy to continue strengthening the construction of flood control infrastructure and developing large rivers including the Yangtze River in order to strengthen the flood control, disaster prevention, and disaster deterrence systems. In the *National Water Resources Development Plan (2011–2015)* that was formulated to realize the objective, it was planned: (1) to develop large-scale rivers and lakes including the Yangtze River and construct important hollows and reservoirs that temporarily store flood waters outside the dikes; (2) to construct dikes for branches and improve river roads; and (3) to repair and reinforce dangerous dams and culvert gates, and to construct breakwater and to make comprehensive improvement of river estuaries.

In the *12th Five-Year Plan for the Hubei Province Economic and Social Development (2011-2015)*, which is the Development Plan of the Hubei Province and was formulated reflecting the above, six flood control projects[8] at 12.22 billion Chinese yuan in total were deployed for strengthening the construction of flood control, disaster prevention, and disaster deterrence systems.

In light of the above, the strengthening of the flood control / flood prevention capacity continues to be a priority area of both the national and provincial development plans also at the time of ex-post evaluation, and thus, this project has been highly relevant.

[8] Six projects were implemented during the *12th Five-Year Plan for the Hubei Province Economic and Social Development (2011-2015)* which included: Han River Short-Term Priority Project (6,980 million Chinese yuan); Dan River Improvement Project (510 million Chinese yuan), Tangbai River Improvement Project (190 million Chineseyuan); Jingnan Four Rivers Improvement Project (4,270 million Chinese yuan); Yuan River Improvement Project (210 million Chinese yuan); and Lishui River Improvement Project (60 million Chinese yuan).

3.1.2 Relevance to the Development Needs of China

(1) Relevance to the Development Needs at the Time of the Appraisal

In Hubei Province, large-scale rivers, such as the Yangtze River and the Han River, are adjacent to large cities, and those cities usually suffered from flood damages during the rainy season because rainfalls are concentrated in the summer season. Meanwhile, existing urban drainage facilities, such as dikes, drainage channels, and pumping stations, failed to satisfy flood prevention standards (recurrence interval[9]) in 90% or more of the cities, which became a factor of expanding flood damages.

In the large-scale flood that occurred in 1998, the Yangtze River recorded the highest ever water level at 32.09 m, causing damages along the basin to extend to about 223 million afflicted people and damages of about 3 trillion yen (approximately 200 billion Chinese yuan[10]) in total[11]. As can be seen, safety of local residents was threatened and severe economic losses were incurred, and thus the need for flood control measures was very high.

(2) Relevance to the Development Needs at the Time of the Ex-post Evaluation

In 2010, the second highest water level following 1998 was recorded at 31.94 m at the Yangtze River due to heavy rain, causing damages including: 18.21 million afflicted population; 100,000 collapsed houses; about 100 fatalities; and economic loss at 27.35 million yen[12] (2.11 million Chinese yuan) in the province[13]. Threats of seasonal rise of river waters and concentrated heavy rains still exist on the Yangtze River and other large rivers, and thus, at the time of ex-post evaluation, this project has been highly relevant to the country's and the province's development needs of expanding dikes and urban drainage facilities into wide areas of the entire large-scale river basin.

3.1.3 Relevance to Japan's ODA Policy

At the time of the appraisal, in the *Second Country Study for Japan's Official Development Assistance to the People's Republic of China (1998), the Japan International Cooperation Agency* (hereinafter referred as to JICA), in which an economic cooperation program for China was studied, a proposal was made to shift the focus area of economic cooperation for China from conventional assistance such as economic infrastructures to "reduction of poverty and interregional disparities," "environmental conservation," "agricultural development and food

[9] Prevention standards or capacities to be achieved by the dikes. It is expressed as the probability that a flood that exceeds a certain size will occur.
[10] Conversion was made based on the exchange rate according to materials at the time of the appraisal at 1 Chinese yuan=15 yen.
[11] Materials provided by JICA
[12] Conversion was made based on the average exchange rate in 2010 at 1 Chinese yuan=12.96 yen.
[13] Statistic value by Hubei Provincial Water Resources Bureau

supply," and "establishment of a systematized market economy" where China's self-efforts are difficult to reach. In addition, the "Fourth Round of Loan Assistance (1996 – 2000)" placed its focus on the environment, food, and poverty measures, in addition to conventional economic infrastructures, targeting inland China. Furthermore, the *Medium-Term Strategy for Overseas Economic Cooperation Operations (1999-2002)* designated its focus areas on (1) support for poverty reduction and economic and social development, (2) efforts for working on global problems, and (3) support for economic structural reform.

In light of the above, this project corresponds to measures toward environmental conservation and reduction of poverty and interregional disparities in inland China, and thus this project was confirmed to be consistent with Japan's ODA policy and JICA's assistance policy at the time of the appraisal.

3.1.4 Relevance to Appropriateness of Project Planning and Approach

At the time of the appraisal, subprojects of this project were selected under the following selection criteria and 18 cities and counties were finally determined through field survey by flood control experts. The selection, in which socio economic criteria were taken into account, was appropriate in accordance with needs of flood control measures.

Selection criteria of subproject
(1) Importance: From population and other social indicators, important areas in terms of safety of citizens and economic stability
(2) Threat of floods: the areas where serious damages were inflicted by floods of 1996 and 1998 in particular
(3) Economic rationality : areas where social and economic benefits in line with infrastructure improvements are expected
(4) Financial feasibility: existence of capability to repay loan and procure funds

Source: Hubei Provincial ODA Loan Urban Flood Control Project Managing Office

A substantial change in the scope occurred in the middle of project implementation (for details of the change, please refer to outputs in 3.2 Efficiency). The largest change was made due to the reason that the Feasibility Study (hereinafter referred as to F/S) was replaced from a preliminary version of F/S at the time of the appraisal (June 1999) to a revised version of F/Y (December 2001) that was formally approved by the National Development and Reform Commission (NDRC) in 2002. This change occurred since facilities with high priority had been constructed by domestic funds in advance immediately after the appraisal[14].

[14] In November 1999, the Ministry of Water Resources of the People's Republic of China added 690 million Chinese yuan of budget for the construction of dikes at priority area of the Yangtze River basin. By using the budget, a project at Wuhan City, construction of dikes at Huangshi City, and construction of flood prevention walls

Although this change was substantial, including the withdrawal of Wuhan City that accounted for almost a half of the new construction and repairs of dikes, the construction moved forward without obtaining a formal prior consent of JICA. It seems that closer communication and coordination were necessary between the executing agency of the Hubei Province and JICA. However, the problem is not taken into consideration for the relevance rating, because the final scope was in accordance with the project purpose and the change was made in such a manner as not to substantially damage the project's effects.

In light of the above, the improvement of infrastructures for strengthening flood prevention and flood control capacity is a priority area of the development plans and development needs of China, the Yangtze River basin, and the Hubei Province at the time of the appraisal and the ex-post evaluation and is also highly relevant with Japan's ODA policy at the time of the appraisal. Therefore, the relevance of the project is high

3.2 Efficiency (Rating ②)

3.2.1 Project Outputs

(1) Plan and Actual of the Project Outputs

At the time of the appraisal (1999), it was planned to construct and repair dikes, culvert gates, and pumping stations in 18 areas in total including 14 cities and four counties on the Jianghan Plain. Actually, flood prevention facilities including dikes, flood prevention walls[15], and dike roads, and urban drainage facilities including culvert gates and sluiceways, pumping stations, diversion canals, and sewers were constructed in 17 areas except Wuhan City that was excluded from the scope at the initial stage of the project.

When comparing the plan at the time of the appraisal with the actual achievement, a total extension of flood prevention facilities[16]increased to 453.7 km (112% over the plan). In case of urban drainage facilities, although the distance of renovation work of diversion canals was shortened to 53% of the plan to 40.5 km, the distance of newly constructed diversion canals[17] was 15.7 km (462% over the plan). The number of new construction and renovation of culvert gates and sluiceways was 106 locations (663% over the plan), the number of pumping stations was added one location to 15 locations, and other facilities which were not included in the plan were constructed actually at 23 locations. Although a substantial reduction of scope occurred

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at Xiangfan City that had been planned in this project were carried out in advance. Accordingly, these were excluded from the scope of this project.

[15] Measures to prevent floods by constructing buffer walls or wave preventive walls at rapid streams of rivers or lowlands which are more likely to be damaged by floods by heavy rains and during flood seasons.

[16] Since classification method of each item differed between the time of the appraisal and ex-post evaluation, the comparison between the plan and actual result is made based on the total extension of culvert gates.

[17] New construction of diversion canals created the water flow leading to rivers or lakes from moats where waters were present in cities, which not only improved the flood control capacity but also contributed to environmental improvements such as water quality improvement and elimination of bad odor of rivers.

due to the withdrawal of the largest subproject (Wuhan City) immediately after starting the project, subprojects of five cities were added into the scope, and project outputs have increased as a whole.

Table 1: Plan and Actual of the Flood Prevention Facilities (Unit: km)

		Plan at Appraisal (1999)				Actual (2015)						Plan/ Actual Ratio
		Dikes		Others	Subtotal	Dikes		Flood Prevention Walls		Others[18]	Subtotal	
		New	Renovation	Renovation		New	Renovation	New	Renovation	Renovation		
1	Wuhan City	0	59.5	0	59.5	0	0	0	0	0	0	0%
2	ingzhou City	0	48.0	6.6	54.6	0.1	34.1	11.5	0	27.0	72.7	133%
3	Huangshi City	0	28.2	0	28.2	0	0	0	0	0	0	0%
4	Huanggang City											—
5	Xiangfan City	0	26.1	18.5	44.6	0	26.1	0	0	4.5	30.6	69%
6	Xiaogan city	0	56.9	0	56.9	0	56.9	0	0	16.0	72.9	128%
7	Xianning City	5.3	12.5	6.5	24.2	2.1	8.8	6.6	0	7.3	24.9	103%
8	Xiantao City	0	13.0	0	13.0	0	13.0	0	0	7.5	20.5	158%
9	Qianjiang City	0	9.4	0	9.4	0	20.6	3.7	0	9.5	33.8	360%
10	Zhongxiang City	0	24.2	0	24.2	0	24.2	0	0	24.2	48.4	200%
11	Shayang County	0	14.9	0	14.9	0	7.5	5.0	0	23.1	35.6	239%
12	Chibi City	6.7	1.0	0	7.7	0.1	7.8	7.1	1.2	8.1	24.3	315%
13	Yuanan County	4.0	0.4	0	4.4	2.3	0	1.8	0.4	0	4.4	100%
14	Anlu City	3.9	2.8	1.5	8.2	3.0	2.5	4.6	0	8.1	18.2	222%
15	Xiaochang County	4.5	14.1	0	18.6	0	12.7	0.4	2.3	25.8	41.2	221%
16	Daye City	2.1	0.4	0	2.5	0	7.0	0.6	0	7.7	15.3	612 %
17	Yunmeng County	0	25.6	0	25.6	0	1.5	0	0	0	1.5	6%
18	Danjiangkou City	0	7.0	0	7.0	0	0	4.5	0	5.0	9.5	136%
	Total	26.5	344.0	33.1	403.5	7.5	222.8	45.8	3.8	173.8	453.7	**112%**

Source: Materials provided by Hubei Provincial ODA Loan Urban Flood Control Project Managing Office
Note: Since the figures are rounded off to the first decimal place, there are some part which does not agree with the total on the number.

[18] Including evacuation routes at the time of flood and pathways created in the middle section of dikes, etc.

Table 2: Plan and Actual of the Urban Flood Control Facilities

		Plan at Appraisal (1999)				Actual (2015)				
		Culvert Gates	Pumping Station	Drainage Channels		Culvert Gates / Sluiceways	Pumping Station	Sewers and Drainage		Others
		New / Renovation	New/ Renovation	New	Renovation	New / Renovation	New /Renovation	New	Renovation	
	Unit	locations	locations	km	km	locations	locations	km	km	locations
1	Wuhan City	0	1	0	0	0	0	0	0	0
2	Jingzhou City	0	2	0	0	22	2	0	11.8	5
3	Huangshi City	0	2	3.4	9.0	0	3	9.3	0	0
4	Huanggang City	0	2	0	0	1	2	1.8	0	0
5	Xiangfan City	11	0	0	0	11	0	0	0	0
6	Xiaogan city	0	2	0	0	32	2	3.0	0	0
7	Xianning City	0	0	0	0	5	0	0	0	0
8	Xiantao City	1	0	0	14.6	3	0	0	0	1
9	Qianjiang City	0	1	0	12.3	1	1	0	18.3	0
10	Zhongxiang City	0	2	0	0	1	2	0	0	0
11	Shayang County	2	0	0	15.8	2	0	0	2.0	1
12	Chibi City	0	1	0	0	8	1	0	0.9	0
13	Yuanan County	0	0	0	0	1	0	1.6	5.1	4
14	Anlu City	0	0	0	1.5	4	0	0	0	2
15	Xiaochang County	0	0	0	23.5	14	0	0	2.3	0
16	Daye City	0	1	0	0	1	2	0	0	0
17	Yunmeng County	2	0	0	0	0	0	0	0	0
18	Danjiangkou City	0	0	0	0	0	0	0	0	10
	Total	16	14	3.4	76.7	106	15	15.7	40.5	23
	Appraisal/Actual Ratio					**663%**	**107%**	**462%**	**53%**	**—**

Source: Materials provided by Hubei Provincial ODA Loan Urban Flood Control Project Managing Office
Note: Although the names of classification differ between the time of the appraisal and the ex-post evaluation, names in the actual values are described more precisely and the same facilities are indicated virtually according to the explanation of the executing agency. However, there were no item of "Others" at the time of the appraisal and they were added by the change during the project implementation. Specifically, bridge and other facilities are included.

During the project implementation, a substantial change of the scope was made as follows.

(2) Change of F/S

The contents of the change of F/S replaced in 2001 are summarized as shown in Table 3. Replacement was made because high priority facilities were constructed by domestic funds

after the appraisal. Renovation of 59.5 km of dikes and construction of pumping stations planned in Wuhan City, construction of dikes at Huangshi City etc. were excluded from this project.

Table 3: Change in Replaced F/S

Items	F/S at Appraisal (1999)	Replaced F/S (2001)	difference
Number of the Target Cities and Counties	18 cities/counties	17 cities/counties	- 1 city
Total Length of the New Dikes	26.5 km	7.5 km	- 19 km
Total Length of the Renovated Dikes	344 km	235.35 km	- 108.65 km
New/Renovate Pumping Stations	14 locations	15 locations	＋1 locations

Source: Materials provided by Hubei Provincial ODA Loan Urban Flood Control Project Managing Office

(3) Cancellation of Outputs

In April 2005, the executing agency determined the cancellation of the plan of constructing 14 km of dike and culvert gates at two locations in Yunmeng County at the stage when 1.5 km of dike had already been constructed, and the plan was excluded from the scope of this project[19]. The reason for the cancellation was that although resettlement of 48 households was planned at the planned construction site of flood prevention facilities, the compensation costs exceeded the financial capacity of the county and the payment became impossible. In 2011 when financial resources and funds of the county were secured, the dikes and culvert gates originally planned in this project were constructed by domestic funds, and the flood prevention standards which Yunmeng County targeted were attained.

(4) Addition of Project Outputs

As an alternative to the cancelled subproject of Wuhan City, outputs of five cities were added in 2009 (Table 4). This addition was made because the necessity of improving flood protection capacity arose accompanying the creation of a new development district[20], and construction needs of dikes and protection walls arose to cope with the new protection standards of Jingzhou City, Chibi City, and Daye City that became higher than the time of appraisal in 2009. Therefore, this change was in accordance with the objective of this project and it was the change that heightened the effects of the project further.

[19] This change proceeded without receiving prior approval of JICA, and the fact was found out at the time of the ex-post evaluation.

[20] In China, according to the local development plan, barren lands are appointed in the new development area, and are developed. Output of the Project was added because higher flood prevention standards were adopted to the newly developed areas in the cities.

Table 4: Contents of Addition of Outputs at Five Cities and Reasons for Addition

Name of City (approval date) Amount applied for additional budget	Flood prevention facilities	Urban drainage facilities	Reasons for addition
Jingzhou City (July 2009) 511 million yen	0.1 km of dike, 4.6 km of revetment road	Culvert gates at four locations	New construction of culvert gates and dikes is necessary at upstream areas to adjust water amount through separate sewer systems and to reduce flood risks. Repairs of drainage channels of the areas not satisfying the standards are necessary.
Qianjiang City (July 2009) 725 million yen	11.2 km of dike, 3.7 km of flood wall, 2.1 km of emergency evacuation road	12.2 km of sewers and drainage	Dikes that do not satisfy drainage capacity and do not have emergency evacuation roads exist in the newly developed district.
Chibi City (February 2009) 761 million yen	2.3 km of dike, 2.8 km of flood wall	Culvert gates at four locations	Districts where dikes are not constructed exist in the City. Also, the flood prevention capacity of the newly developed district does not meet the probability of 50 years of floodprevention standards. Culvert gates are necessary because a problem of deposition of sediments exists.
Anlu City (July 2009) 498 million yen	2.8 km of dike, 0.9 km of flood wall	Culvert gates at two locations	Construction of dikes and flood walls is necessary because the newly developed district that was constructed does not meet flood prevention standards. Culvert gates for drainage are necessary at these intersections.
Daye City (February 2009) 723 million yen	5 km of dike, 5.7 km of emergency evacuation road	Pumping station at one location	Dikes that are lower than the design water level exist, and they are required to be strengthened. There are also dikes whose emergency evacuation roads are not constructed.

Source: Materials provided by JICA

3.2.2 Project Inputs

3.2.2.1 Project Cost

The planned project cost at the time of the appraisal was 23,920 million yen (3,133 million Japanese yen in foreign currency; 20,787 million Chinese yuan in domestic currency). The actual project cost was 18,660 million yen (1,538 million Japanese yen in foreign currency; 17,122 million Chinese yuan in domestic currency), which was within the budget (78% of the planned amount) despite the increase in project outputs. The reasons are because: the amount of material unit prices, etc. was estimated higher when formulating the budget; and efforts were made to save costs through implementation of international bidding and bulk purchase of materials, if possible.

3.2.2.2 Project Period

The actual project period was from April 2000 to April 2015 (181 months), which substantially exceeded the project period from April 2000 to December 2005 (69 months) planned at the time of the appraisal (262% over the plan). The main reasons were: start of civil engineering work was delayed because it took 152 months for the resettlement which had been planned to be completed in six months; and the period of civil engineering work was extended accompanying the addition of project outputs of five cities in 2009.

3.2.3 Results of Calculations of Internal Rates of Return (Reference only)

The economic internal rate of return (EIRR) was re-calculated[21] based on the construction cost, operation and maintenance costs, and actual amount of damage, etc.[22] provided by the executing agency, which resulted in 9.88% at the time of ex-post evaluation against 7.84% at the time of the appraisal (Table 5). Before completing this project, average loss of about 3.8 billion yen (271.47 million Chinese yuan)[23] was incurred per year as a total for the 17 cities; however, damages were mitigated and the amount of loss was reduced to almost zero at the time of the ex-post evaluation. It is almost at the same level of the social discount rate used by most international organizations (10% to 12%), and it also indicates that the project generates higher benefits than the general EIRR of projects against floods in China, which is 6% to 7%. Since damages by levee breach or overflow were serious in Hubei Province, it explains that the project to mitigate such damages was highly significant from the social point of view also.

Table 5: Comparison of EIRR at the Appraisal and the Ex-post Evaluation

Plan at Appraisal (1999)	Result at Ex-post Evaluation (2015)
EIRR 7.84%	**EIRR 9.88%**
Prerequisite ・Cost : Construction, Operation and Maintenance ・Benefit: Damage Amount Assumption ・Project Life : 50 years	Prerequisite ・Cost : Construction, Operation and Maintenance ・Benefit: Damage Amount ・Project Life : 50 years

Source: The evaluator re-calculated according to the data provided by Hubei Provincial ODA Loan Urban Flood Control Project Managing Office

In light of the above, although the project costs were within the plan, the project period substantially exceeded the plan, and therefore, efficiency of the project is fair.

[21] Although the EIRR values at the time of the appraisal and the ex-post evaluation were presented from the executing agency, numerical ground and calculation method of benefits and operation and maintenance costs were unknown. Therefore, re-calculation was made by using the plan and the actual for the construction costs and by using the actual value of benefits up to the time of the ex-post evaluation.

[22] Based on data provided by 17 cities and counties, average value of annual flood damages from 2000 to 2004 before the completion of the project was used for the benefits, and the total value of costs that were actually incurred in 17 cities and counties was used for operation and maintenance costs.

[23] The average amount of flood damages per year based on data provided from 17 cities and counties.

3.3 Effectiveness[24] (Rating:③)

3.3.1 Quantitative Effects (Operation and Effect Indicators)

Although no indicators were set at the time of the appraisal, upon agreement with the executing agency, operation indicators for this evaluation are set to measure how project outputs contribute to the improvement of the flood control capacity at the subproject implementation areas. Specifically it was checked whether the annual highest water level and annual maximum flow volume at the reference point[25] of each subproject fall within the range of planned highest safe water level and flood drainage capacity, provided that external factors (such as rainfalls) is within the range of the planned scale. In addition, flood prevention standards (recurrence interval) and prevention of damages by levee breach or overflow are positioned as effect indicators.

(1) Operation Indicators

1) The Planned Highest Safe Water Level[26] and the Annual Highest Water Level at a Reference Point

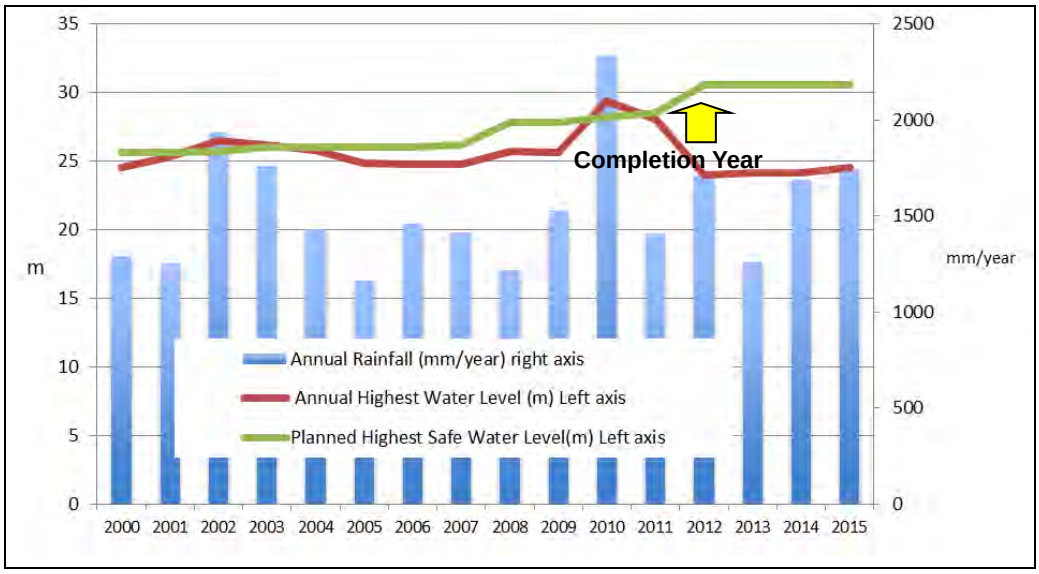
If the annual highest water level at a reference point is lower than the planned highest safe water level, this means that if rainfall is within the range of the post records, the safe water level is being maintained. Out of 15 subprojects excluding cancelled Wuhan City, and Yunmeng City and Huanggang City whose construction of flood prevention facilities was not included in the scope, seven subprojects[27] had a design where the planned highest safe level exceeded the highest water level before the start of the project. Eight other projects[28] were in a dangerous situation where the annual highest water level exceeded the planned highest safe level. After the project implementation, the annual highest water level is within the planned highest safe water level in seven subprojects except Anlu City[29].

[24] Rating for Effectiveness is to be put with consideration of Impact.
[25] Observed values at the reference points set in the areas where rivers were improved and in which the relevant project areas are included.
[26] The highest water level considered flood prevention facilities can endure. Dikes are designed to drain the water under the water level safely. In China, the standards are changed in accordance to the modification of the city development plan. For reasons such as the farm land being developed to a residential area, or the area has a record breaking scale of rain fall and flood, etc., the standards are strengthened progressively. In the areas of the subprojects other than that of figure 2, the standards were strengthened progressively, too.
[27] Seven cities and counties of Jingzhou City, Huangshi City, Xiangfan City, Xiaogan City, Zhongxiang City, Shayang County, and Chibi City fall under this category.
[28] Eight cities and counties of Xianning City, Xiantao City, Qianjiang City, Yuanan County, Anlu City, Xiaochang County, Daye City, and Danjiangkou City fall under this category.
[29] In Anlu City, the annual highest water level at the reference point exceeded the planned highest safe water level by 0.1 – 0.3 m from 2013 to 2015, but damages by levee breach or overflow did not occur since urban drainage functions were strengthened under this project.

Wave-dissipating concrete blocks (Qianjiang City)

Dike and culvert gate (Xiaogan City)

Looking at Xianning City as an example, the annual highest water level exceeded the planned highest safe water level before the project completion in 2002, 2003, and 2010 when outstanding precipitation was recorded. After the project completion, the highest water level of 2012 and 2015, when precipitation recorded almost at the same level with 2003, was substantially lower than the planned highest safe water level and the threat of flood could be avoided by a difference of 5 m or over.



Source: Materials provided by Hubei Provincial ODA Loan Urban Flood Control Project Managing Office

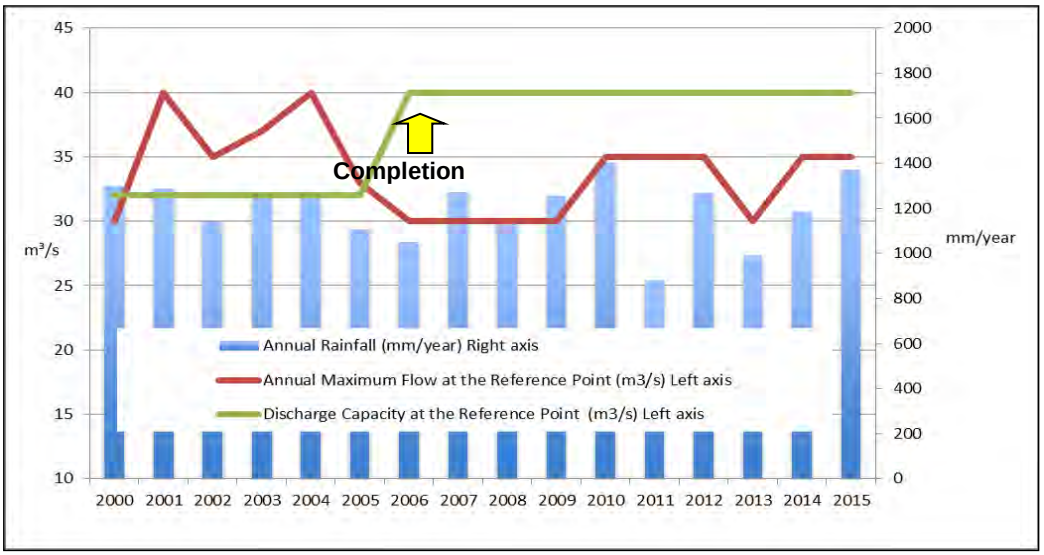
Figure 2: Transitions of Planned Highest Safe Water Level and Annual Highest Water Level of Xianning City

According to interviews with subprojects, concerning seven subprojects which already had a design where the planned highest safe level exceeded the highest water level before the start of the project, flood control measures other than the method of raising the planned highest safe water level at a reference point were implemented, such as construction of a protection wall as flood preventive measures at rapid streams of rivers and installation of wave-dissipating concrete blocks at river junctions, etc.

2) Comparison between the Discharge Capacity and the Annual Maximum Flow at a Reference Point

The discharge capacity (m^3/s) at a reference point is the maximum volume of water that can flow down safely at the reference point. In the comparison of the discharge capacity between the time of the ex-post evaluation (2015) and the time of the appraisal (1999), the discharge capacity increased at 12 subprojects[30] and the original discharge capacity was maintained at four subprojects[31].

Moreover, when the discharge capacity is compared with the annual maximum flow (m^3/s), if the annual maximum flow is less than the discharge capacity, this means that water increased by heavy rains, etc. can flow down safely. Looking at Huanggang City as an example, it shows that the discharge capacity improved with the project completion and for the duration analyzed the annual maximum flow maintained a level lower than the discharge capacity (Figure 3).



Source: Materials provided by Hubei Provincial ODA Loan Urban Flood Control Project Managing Office

Figure 3: Transitions of the Maximum Flow and the Discharge Capacity at a Reference Point in Huanggang City

(2)Effect Indicators

1) Flood Prevention Standards (Recurrence Interval)

Out of 17 cities, flood prevention standards of flood prevention facilities have improved in 15 cities and counties, and flood prevention standards of urban drainage facilities have

[30] 12 cities and counties of Jingzhou City, Huanggang City, Xiaogan City, Xianning City, Xiantao City, Qianjiang City, Shayang County, Chibi City, Yuanan City, Anlu City, Xiaochang County and Daye City fall under this category.

[31] Four cities and counties of Xiangfan City, Zhongxiang City, Yunmeng County and Danjiangkou City fall under this category.

improved in 13 cities and counties by implementing this project.

Concerning four cities and counties in which the standards were already satisfied at the time of the appraisal, the project was not targeted for the entire basin including reference points but targeted for narrow areas, such as partial repairs of dikes and rapid stream portions or river junctions, and so, it is not possible to confirm the effects of this project based on the flood control capacity at reference points. Accordingly, the effects will be judged based on damage situations of individual cities and counties in the section "2) Damage Situations by Levee Breach or Overflow" shown below.

2) Damage Situations by Levee Breach or Overflow

The annual damage area, inundated time (Figure 4), human damages, and the loss amount (Figure 5) by levee breach or overflow after 2000 in 17 cities and counties where subprojects were implemented started to decline substantially from around 2005 when some of the subprojects were completed and approached almost zero at the time of the ex-post evaluation[32].

In four cities and counties of Huanggang City, Xiangfan City, Xiaochang County, and Danjiangkou City in which flood prevention standards were satisfied at the time of the appraisal, damages are almost gone after 2006, which indicates that this project had the planned effects.

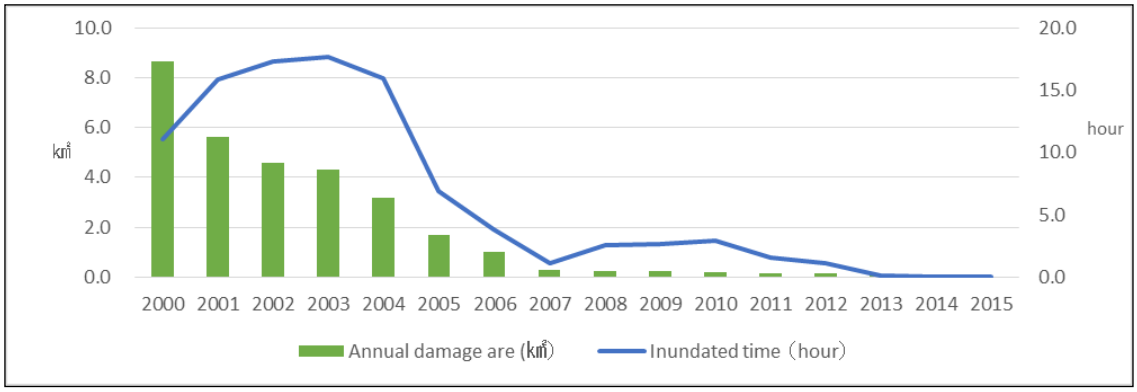


Figure 4: Transitions of the Annual Damage Area and Inundated Time by Levee Breach or Overflow

[32] Completion year of each city and county is as follows. Completion in 2005: Xiantao City, Qianjiang City, Chibi City, and Daye City/completion in 2006: Zhongxiang City, Anlu City, Xiaochang County, Yunmeng County, and Danjiangkou City/completion in 2008: Huanggang City, Xiangfan City, Xiaogan City, and Shayang County/completion in 2009: Huangshi City and Yuanan County/completion in 2011: Jingzhou City, additional work in Qianjiang City and additional work in Chibi City/completion in 2012: Xianning City and additional work in Anlu City/completion in 2013: additional work in Daye City/completion in 2014: additional work in Jingzhou City.

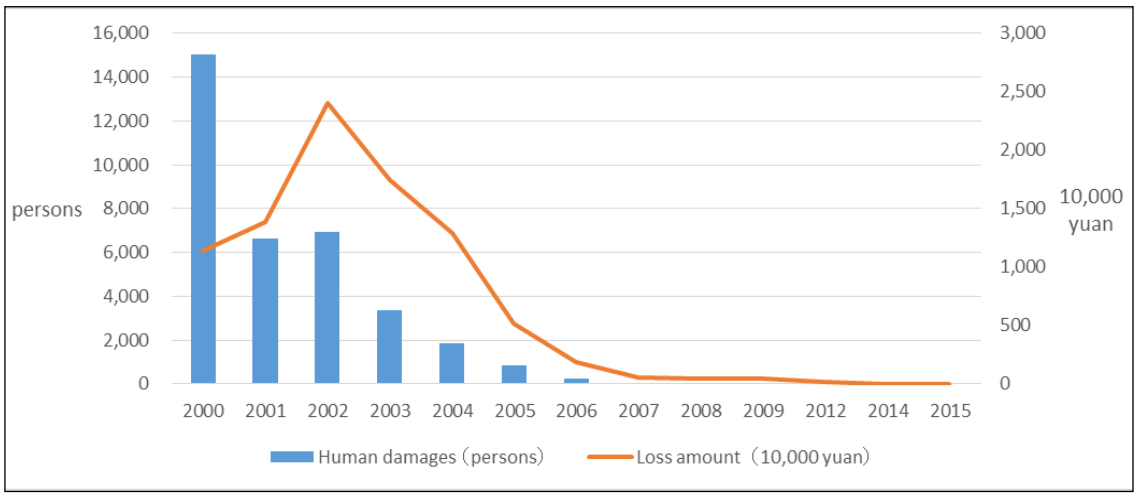


Figure 5: Transitions of the Human Damages and the Annual Maximum Loss Amount by Levee Breach or Overflow

3.3.2 Qualitative Effects (Other Effects)

Because no specific qualitative effects were set at the time of the appraisal, for the ex-post evaluation, the qualitative effects were integrated and evaluated together with the effects of the project at the impact level as shown in the section "3.4 Impacts."

3.4 Impacts

3.4.1 Intended Impacts

The objective of this project is to "stabilize society and economy of the area and to improve living conditions of local residents" by preventing flood damages. Concerning "stabilization of society and economy," economic effects by the prevention of floods are considered from situations of damage mitigation, while individual cases are looked at concerning the impact on local society and economy. In addition, concerning the impact of floods to be given to social and economic activities and living environment, confirmation will be made by a beneficiary survey for residents and a company survey.

(1) Economic Effect by Prevention of Floods

A total of annual maximum loss by levee breach or overflow of 17 subprojects from the start of this project until the year before 2005, when project outputs started completion, stood at about 3.8 billion yen (271.47 million Chinese yuan)[33] on average during a period from 2000 to 2004. From this value, it can be inferred that the project had the effect of preventing economic loss by preventing flood damages at the subprojects sites. The total value of loss decreased sharply after 2005 and economic loss has been prevented along with the progress of this

[33] Estimation was made based on the average exchange rate during the period at 1 Chinese yuan = 13.9862 yen that was used for the calculation of project costs.

project. It is fair to say that economic effects are attained in the subproject sites.

(2) Impact on Local Society and Economy

Although comparison was made between transitions of house prices of 17 subproject cities and counties and house prices of Hubei Province as a whole, such prices are influenced by many factors including commodity prices and railroad and other infrastructure improvements, and therefore, it was not possible to extract only the relationship with this project quantitatively.

On the other hand, positive impacts are reported, which include: the development around rivers was promoted due to mitigation of flood damages; and the development of cities and tourism industry was promoted accompanying the improved river environment at the time of construction of facilities under this project. As individual cases, the following are the cases of Xianning City and Jingzhou City.

Impact Case 1) Effect of building the foundation for the urban development: Xianning City

Although Xianning City was close to Wuhan City, the capital city of Hubei Province, and was also an area with high potential of the development accompanying the expansion of urban area of Wuhan City, the population of Xianning City remained around 100,000 persons before starting the project, since the development of the City had been hampered by repeated inundation damages because the flow of the Gan River that curves and runs through the City is rapid and causes flood damage in a short time.

Since the inundation threat was gone as the result of construction of dikes and related facilities under this project, the area around the Gan River has become a new development district, and the City population grew sharply to 450,000 persons by 2015. Also, the development of hot spring resort located upstream of the river progressed due to the strengthening of dikes. The number of tourists recorded 4.84 million persons in 2015, which is four times the number of tourists in 2008, and tourism revenues reached 2.7 billion Chinese yuan.

The Gan River before the project implementation (provided by Xianning City Water Bureau)
Dike of rapid flow of the Gan River constructed by this project

Impact Case 2) Impact on the promotion of tourism industry: Jingzhou City

Under this project, dredging work of the moat around the old castle and castle wall built 2000 years ago was carried out and the strengthening of protection walls around the moat and new construction of diversion canals were also carried out. Through this work, the moat where turbid water was present could be linked to a branch of the Yangtze River or a lake. Although the work was targeted to enhance the urban drainage functions, the landscape of the castle and castle walls, and water flow and water quality of the moat were also improved.

Moat around improved castle walls (Jingzhou City)

Moreover, since the water depth became 10 m from 1.5 m resulting from the removal of sludge, it became possible to hold a dragon boat race as a centerpiece of the City's tourism. The recognition as a tourist site was enhanced, resulting in the increase in the number of tourists by 4.3-folds and tourism revenues of the City grew by 2-folds in 2015.

(3) Beneficiary Survey

Concerning "stabilization of local society and economy" and "improvement of living environment of residents," a beneficiary survey[34] (60 samples) was implemented for residents of Jingzhou City and Xianning City, and confirmation was made on the change of flood damages, living environments, and psychological change toward the threat for floods before the implementation of the project (2000 – 2010) and after the project (after 2011).

In Jingzhou City, 83% of respondents feel that flood damages were mitigated. Concerning living environment, more than 70% of respondents answered that the living environment was improved. In particular, the improvement effects of the environment of rivers, such as trash, bad odor, and landscape, were strongly recognized, and 80% said that the frequencies of using[35] rivers, dikes, and areas around them increased. A total of 77% recognized the

[34] A beneficiary survey was carried out through a site-visit for 60 residents around the project sites of Jingzhou City and Xianning City (30 residents each) at places where facilities covered by this project are concentrated and where benefit areas are easy to identify. Since the survey was carried out for households which agreed on the survey, random sampling has not been made. Since the answers are only from residents who are cooperative with the survey and are more likely to be overvalued and a sample size is small against the number of beneficiaries, they cannot be said to represent the entire beneficiaries under this projects. Therefore, it represents the expressions of only some of the beneficiaries for the change of their surrounding environments.

[35] As methods of using the river, walking, jogging, fishing, nature exploration, and dancing were cited.

improvements of psychological effects, such as reduction of anxiety toward floods. Concerning economic effects, more than 70% recognized improvements such as the opening of retail shops and the growth of tourists. On the other hand, half of respondents answered that real estate prices have increased, those who answered that loss caused by flood damages was mitigated were less than a half of the respondents, and 6% of respondents answered that inundation damages to houses or lands were not mitigated or not improved much.

In Xianning City, however, since flood damages became zero after the project, all respondents recognized the improvements compared to years before 2010 in all items, including: inundation damages caused by floods; change of living environment; frequencies of visiting dike; anxiety toward floods; and economic impacts. In the case of Jingzhou City, although damages were mitigated by the project implementation, the speed was slow, and thus it is assumed the result as mentioned above was induced.

(4) Company Survey

A company survey[36] was conducted for 20 companies around the project sites to confirm situations of flood damages and change of company activities before (2000 – 2010) and after (2011 and thereafter) the project implementation.

Almost all companies that responded in Jingzhou City and Xianning City recognized the mitigation of inundation damages by floods on companies. Concerning earnings of companies, seven companies in Jingzhou City and all companies in Xianning City responded that their earnings improved and they cited the reasons that distribution (move-in/move-out) was no longer hampered by inundation and commuting of employees was no longer hindered by floods.

3.4.2 Other Impacts

(1) Impact on the Natural Environment[37]

At the time of the appraisal, no negative impacts on the natural environment were anticipated. During the project implementation, the executing agency of Hubei Province was in charge of the natural environment monitoring (water quality, air, and noise) under each dedicated section of the Environmental Protection Department. Environmental protection groups were established in each city and county of Subproject Management Offices (SMO), and the groups were in charge of submitting reports on environmental activities of the respective city and county, thoroughly implementing environmental management and

[36] A corporate survey was carried out through a site-visit survey for 20 companies (10 companies in each city) around the project sites of Jingzhou City and Xianning City at places where facilities covered by this project are concentrated and where benefit areas are easy to identify.

[37] The Environmental Impact Assessment Report of this project was approved by the State Environmental Protection Administration in March 2000.

monitoring plans pertaining to the project and carrying out internal and external coordination and supervision and management activities. The categories of the environmental monitoring by the subprojects and the results are shown in the below Table 6.

Table 6: Categories, Method and Result of Environmental Monitoring Implemented by the Subprojects

Items	Monitoring Method and Result
Water Quality	The subprojects were to monitor at 12 points at the inlet of lakes in Jingzhou, Huangshi, Huanggang, Xiaogan, and Xiangfan cities, one section of upper and lower stream each in the cities and counties including Xiantao City, Qianjiang City, Zhongxiang City, Chibi City, Daye City, Anlu City, Yuanan County, Shayang County, Xiaochang,City Danjiangkou City, and Xianning City. Duration of the monitoring was from the beginning and the end of construction, and frequency was divided into three periods (flood period, dry period, normal period). Environmental stations in the cities and the counties were the organization responsible for the duty. If any problem found in water quality, necessary measurement such as improving waste water processing etc. was taken.
Air Pollution	Each subproject selected 3 to 5 observation points in the representative construction sites where construction was mainly carried out. Monitoring items were selected according to the source of pollutant. The environmental monitoring stations conducted quarterly monitoring in every year. The result was within the standard.
Noise	Each subproject selected 4 to 6 sample points from the representative construction area in the city, and monitored them once every two months. Counties set 2 sample locations, and monitored them quarterly. The monitoring result was within the standard.

Source: Materials provided by Hubei Provincial ODA Loan Urban Flood Control Project Managing Office

In the aforementioned beneficiary survey implemented for residents, six items of environmental pollution (waste disposal, gas emissions, dust, turbid water, noise, and vibration) during the implementation of this project were confirmed. In Jingzhou City, more than 90% of respondents answered that 'they were not bothered at all' or 'they were not bothered very much' and there were none that answered that 'they were extremely bothered' or 'they were somewhat bothered'. On the other hand, according to the survey in Xianning City, 30%, 33%, 20%, 23%, 43% and 30% responded that 'they were extremely bothered' or 'they were somewhat bothered' respectively by gas emissions, waste disposal, dust, turbid water, noise, and vibration, which exceeded the answers of 'they were not bothered at all' or 'they were not bothered very much'. For these questions, more than a half of the respondents in Xianning City selected the answer of 'they are not sure' or 'no reply'. Because the construction of buildings such as the high-rise housings or office buildings and railroads were carried out around the river in the city for the same time period, it is assumed that the respondents did not notice about these types of environmental pollution or they could not respond by extracting the impacts by the work of this project only.

In the above-mentioned company survey, among the nine companies in Jingzhou City replied to the questionnaire, seven companies answered that 'they were not bothered at all' or 'they were not bothered very much' regarding all the items about the impacts on natural environment. On the other hand, in the column where to write contents if negative impacts on

environment occurred, among the two companies responded that 'they were somewhat bothered', one said 'the improvement of environment around the company', and the other wrote that 'there was no pollution'. All the four companies in Xianning answered they were not bothered at all. Only four companies answered to each items, and the answer rate was low. However, all the 10 companies filled their answer in the column as they did not worry about pollution, 'there was no pollution'. About the companies of the cities, it may be said that they consider that approximately no negative impact to the natural environment were caused during the construction.

(2) Resettlement and Land Acquisition

Comparing the total value of 16 subprojects except Xiaogan City in which land acquisition did not take place (Table 7), 65.09 million Chinese yuan were expected to be needed for the land acquisition of the construction site of flood prevention facilities and urban drainage facilities (471 hectares) in the plan at the time of the appraisal, but 74.60 million Chinese yuan (115% over the plan) were needed actually to acquire 413 hectares (88% of the plan). The acquisition cost increased by 31% to 181,000 Chinese yuan/hectare against the plan at 138,000 Chinese yuan/hectare because of the soaring land prices[38].

Table 7: Plan and the Actual of Resettlement and Land Acquisition

	Plan at Appraisal (1999)		Actual (2015)	
	Area (ha)	Cost (10,000 Chinese yuan)	Area (ha)	Cost (10,000 Chinese yuan)
Total (Plan/Actual Ratio)	471	6,509	413 (88%)	7,460 (115%)

Source: Materials provided by Hubei Provincial ODA Loan Urban Flood Control Project Managing Office

Comparing the plan and actual of resettlement of 12 subprojects except five cities in which resettlement did not take place (Table 7), the actual land area acquired was about 60% of the plan and the number of residents and households resettled was 50% or less than the plan, whereas compensation costs increased by 145% to 118.91 million Chinese yuan from the plan of 81.88 million Chinese yuan. Actual costs required for the resettlement increased by 2.4-fold to 390,000 Chinese yuan/hectare against the plan of 160,000 Chinese yuan/hectare.

In the plan at the time of the appraisal, a period required for the resettlement was expected to be around six months; however, it actually took 152 months. During the extended period, land prices or house prices that required the compensation increased. Also, since the compensation cost of the land acquisition and resettlement accompanying the construction of electric power

[38] According to the Hubei Province Statistical Yearbook, house prices and the consumer price index between 2001 and 2014 rose respectively 11% and 17% per year on average. Since the project completion extended substantially to 2015 from 2005, 31% increase seems to be within a reasonable scope in the light of price increase during the period.

facilities and railroads that was carried out at the same time with this project were set relatively high because they are profit-earning businesses[39], the compensation amount for this project was also forced to be raised near those costs during the land price negotiations. These are the factors of increasing the compensation costs.

Table 8: Plan and the Actual of Resettlement

	Plan at Appraisal (1999)				Actual (2015)			
	Area (ha)	Number of Residents (persons)	Number of Households (households)	Amount of Compensation (10,000 Chinese yuan)	Area (ha)	Number of Residents (persons)	Number of Households (households)	Amount of Compensation (10,000 Chinese yuan)
Total	512	15,847	3,225	8,188	304	7,259	1,544	11,891
Plan/Actual Ratio					**59%**	**46%**	**48%**	**145%**

Source: Materials provided by Hubei Provincial ODA Loan Urban Flood Control Project Managing Office

Although resettlement and land acquisition were implemented by each subproject, negotiations of land acquisition prices, compensation contents of resettlement, and resettlement arrangement were proceeded with in accordance with policies and ordinances including the *Land Administration Law of the People's Republic of China*, *Regulations on Compensation for Land Expropriation and Resettlement for Large- and Medium-scale Water Resources and Hydropower Generation (March 2001)* by the State Council and the *Ordinance on the Settlement for the Improvement Project of the Three Gorges on the Yangtze River (enforcement in March 2001)*, etc. According to interviews with the subprojects, it was reported that although the public interest in the flood control project is high, unit prices of resettlement compensation were set lower than those of railroad or electricity projects because earnings from the flood control project, such as fee revenues, are not directly expected, which made resettlement negotiations with residents difficult. In addition, since unified compensation unit price standards were not set in the province, each SMO at city/county level had to negotiate compensation details and the monetary amount individually, which also served as a factor for the difficulty in obtaining agreement from residents. In some cases, the work was delayed and the contents of project and construction site were reconsidered because resettlement negotiations faced difficulties. Among others, the reason that the subproject of Yunmeng County was cancelled in the middle was because the costs required for the resettlement increased.

According to a survey implemented for resettled residents[40] concerning the impacts to their

[39] Price for resettlement compensation was not unified, the businesses such as railroad that have income from fees set higher unit price for resettlement compensation than this project that has no fee collection from the users.

[40] A survey for resettled residents was carried out through a site-visit survey for 20 residents who resettled from areas close to rivers to different areas of Jingzhou City and Xianning City (10 residents each). The survey was carried out for residents whose former locations and resettled locations can be specified instead of selecting samples at random from a list of resettled residents.

lives accompanying the resettlement and the degree of satisfaction for compensation, all respondents answered that their lives improved quite well or well after the resettlement compared to pre-settlement concerning the living environment, accessibility to life infrastructures, damage situation to houses or lands due to heavy rains, and livelihood. If the space of houses before and after the resettlement is compared, respondents resettled to larger houses than pre-resettlement houses: respondents of Jingzhou City resettled from houses with a size of about 85 m^2 on average to houses of 104 m^2 (increased by 22%); and respondents of Xianning City resettled from houses with a size of 113.4 m^2 on average to houses of 137.8 m^2 (increased by 21%). Respondents were satisfied with compensation and life at resettled places. According to interviews with subprojects, the reason is that: although their former houses were located in the flood risk area and suffered from inundation damages every year during the rainy season, damages were mitigated resulting from resettlement or the place of resettlement was selected in a location several hundred meters away from the former houses.

(3) Other Impacts

When dikes and diversion canals were newly constructed under this project in Xianning City, cleaning and dredging of rivers were also carried out. By doing so, not only was water drained properly at the time of floods, but also water flowed smoothly from upper reaches. Turbid water in rivers was eliminated and water quality[41] that had been classified as Classification V before the project implementation improved to Classification III fit for drinking and swimming after the completion of the project (2012). Although the main purpose of this project is to improve the living environment, this is a case where the impact was extended to the natural environment, such as the improvement of water quality.

In light of the above, this project has largely yielded its planned effects. Therefore, effectiveness and impact of this project are high.

3.5 Sustainability (Rating ③)

3.5.1 Institutional Aspects of Operation and Maintenance

(1) Institutional Aspects of Operation during Project Implementation

Hubei Provincial ODA Loan Urban Flood Control Project Managing Office (PMO) established in the Ministry of Water Resources of Hubei Province was in charge of specific

[41] Water quality of river is classified from I to V under the Environmental Quality Standards for Surface Water. I.: mainly applicable to the water from sources, and the national nature reserves/II.: mainly applicable to first class of protected areas for centralized sources of drinking water, the protected areas for rare fishes, and the spawning fields of fishes and shrimps/III.: mainly applicable to second class of protected areas for centralized sources of drinking water, protected areas for the common fishes and swimming areas/IV.: mainly applicable to the water areas for industrial use and entertainment which is not directly touched by human bodies/V: mainly applicable to the water bodies for agricultural use and landscape requirement.

operation of the project during the project implementation, and carried out oversight of the subprojects and communication and coordination with JICA and other related organizations. The PMO comprised the General Affairs Department, Financial Department, Procurement Department, Engineering Department, and Environment and Resettlement Department. Sections in charge of the project operation were also established in each subproject, which were in charge of construction, operation, and management of this project.

(2) Institutional Aspects of Operation and Maintenance after the Project Completion

Hubei Provincial ODA Loan Urban Flood Control Project Managing Office (PMO) is carrying out operation and maintenance after the project completion under the same system as that during project implementation. Upon the completion of this ex-post evaluation, PMO will be dissolved and repayment and other work will be taken over by the Foreign Capital and Foreign Affair Office of the Hubei Provincial Ministry of Water Resources which is the PMO's supervising organization. Although the organization of the office will change, the same persons will be in charge, and therefore, no special changes are foreseeable concerning actual operation and management.

Operation of subprojects and supervision of maintenance of facilities are continuously carried out by the PMO of each city and county. Since the scope of inspection expanded due to increase in project outputs, the number of staff members increased more than the plan with increase in technical personnel. According to interviews with subprojects, all subprojects responded that the current number of staff members is sufficient.

Since the flood control project is a project with high public interest, operation and maintenance of facilities constructed are carried out by local governments or state-owned companies (100% invested by the state). Each subproject has a specific organizational chart and chain of command, and sections responsible for operation and maintenance and their duties are clarified, and therefore, there are no problems identified.

To sum up, no major problems have been observed in the institutional aspects of the operation and maintenance during or after the project implementation.

3.5.2 Technical Aspects of Operation and Maintenance

(1) Technical Level of Operation and Maintenance

The Provincial Water Resources Department periodically confirms the level of maintenance personnel and engineers of operation and maintenance organizations of flood prevention and urban drainage facilities of each city and county, and implements training on flood control facility maintenance, flood control specialized techniques, and dike maintenance targeting engineers.

(2) Preparation of Operation and Maintenance Manuals and Inspection Situation

According to interviews with all 17 subprojects except Wuhan City, they responded that operation and maintenance manuals, patrol records, inspection records, and maintenance logbooks have been prepared. At facilities of six cities visited by the field survey, manuals, patrol records, inspection records, and maintenance logbooks have also been prepared and records according to determined frequencies have been kept in the logbooks.

The mechanism of confirming the technical levels and of succeeding techniques is in place and appropriate maintenance methods are applied at the site. Therefore, no major problems have been observed in technical aspects of operation and maintenance.

3.5.3 Financial Aspects of Operation and Maintenance

Budget for operation and maintenance of facilities at the Hubei Provincial Ministry of Water Resources is allocated on a priority basis because it falls under the priority project of the state. Moreover, according to interviews with subprojects, it is fair to say that operation and maintenance costs allocated from the budget mentioned above are sufficient, since revenues exceed expenditures in all cities and counties when comparing year-to-year expenditures (operation and maintenance costs) and revenues (total of National Subsidies, Flood Prevention and Security Funds[42] and Water Resource Funds[43]). Since flood prevention and urban drainage projects are the ones with high public interest, national subsidies that are allocated to the national priority projects, such as the Yangtze River Basin Development Plan, are to be supplemented, and thus there is no probability of the situation occurring where problems arise on the sustainability of operation and maintenance costs.

Table 9: Hubei Province Operation and Maintenance Cost Flood Prevention and Urban Flood Control Facilities

(unit: 10,000 Chinese yuan/year)

Item/Fiscal Year	2004	2005	2006	2007	2008	2009
Expenditure	**2,193**	**2,720**	**2,887**	**3,244**	**3,544**	**3,719**
Revenue	**2,932**	**3,546**	**3,829**	**4,178**	**5,404**	**4,787**
National Subsidies	2,864	2,986	3,220	3,448	3,578	3,784
Flood Prevention and Security Funds	38	43	50	86	90	90
Water Resource Funds	30	517	559	644	1,736	913
Balance	**739**	**826**	**942**	**934**	**1,860**	**1,068**
Item/Fiscal Year	2010	2011	2012	2013	2014	Ground

[42] Funds are collected from companies in Hubei Province and are used for flood prevention and security works and maintenance of flood-control related infrastructures.

[43] Funds are a special fund used for the construction of flood control infrastructures. The sources of the funds are: the Central Water Resource Construction Funds used for the national policy and for the construction and maintenance of priority projects on the national level; and Local Water Resource Construction Funds used for local priority projects.

Expenditure	**3,866**	**4,131**	**4,696**	**5,068**	**5,499**	Total Ratio
Revenue	**5,050**	**5,510**	**6,423**	**6,745**	**7,937**	
National Subsidies	3,971	4,319	4,904	5,284	6,170	79%
Flood Prevention and Security Funds	98	91	159	121	162	2%
Water Resource Funds	981	1,100	1,360	1,340	1,605	19%
Balance	**1,184**	**1,379**	**1,727**	**1,677**	**2,438**	-

Source: Materials provided by Hubei Provincial Ministry of Water Resources
Note: The percentage of cumulative total is computed based on the percentage of cumulative total amount of revenue total from 2004 to 2014.

3.5.4 Current Status of Operation and Maintenance

According to answers to questionnaire and interviews for the project executing agency as well as the subprojects' implementation agency that are responsible for construction, operation and maintenance of flood prevention facilities and urban drainage facilities of each city and county, there have been no particular problems with operation and maintenance situations. In the field survey, it was confirmed that infrastructures and facilities have been maintained in a manner that they can demonstrate their functions as planned. In addition, facilities are well and neatly organized, and manuals and maintenance, inspection, and patrol records have been completely prepared. Maintenance logs have been appropriately recorded, and according to the records, if any problem was found in facilities, such problem was responded to promptly such as reporting, repair, or replacement of parts. At the time of the ex-post evaluation, all subprojects had the plan of periodical inspection and the plan of equipment replacement and repairs. As for the maintenance, such as spare parts, although pumps and some other parts are manufactured in foreign countries, no special problems have been observed on their availability or repairs, because agencies exist in neighboring cities. Through questionnaire and interviews survey for the province and subprojects and site-visit survey to six cities, it was confirmed that operation and maintenance of facilities have been carried out properly and there have been no particular problems in the situation.

In light of the above, no major problems have been observed in the institutional, technical, and financial aspects of the maintenance system of this project. Therefore, sustainability of the project effects is high.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

This project aims to carry out construction and repairs of dikes, culvert gates, pumping stations, and diversion canals for 18 areas in total including 14 cities and four counties on the Jianghan Plain in Hubei Province in order to improve the flood control capacity of each city.

Consistency of this project with China's development policies and development needs on the national, provincial, and city levels at the time of the appraisal and the ex-post evaluation as well as with Japan's ODA policy toward China at the time of the appraisal is fully ensured, and thus, this project is highly relevant. Although a substantial change in the scope was made in the middle of this project since a flood control project by domestic funds advanced, the change was made in accordance with the project purpose and the actual outputs in total increased to more than the plan. Although the project costs were within the range of the plan, efficiency is fair due to considerable delay in the project period.

Through this project, flood control facilities with a design to meet the planned highest safe water level at the reference points were constructed in all subprojects, and urban drainage facilities ensured planned drainage capacity.

During the comparison range, rainfall has been within the planned level, and the annual maximum water level and annual maximum were respectively below the highest safe water level and the flood drainage capacity, thus it can be said that predetermined flood safety has been secured. Inundation area and duration, human damages, as well as the amount of maximum damages by levee breach or overflow have decreased sharply accompanying the completion of subprojects and have reduced to almost zero after the completion of all subprojects since 2014. Therefore, the effects yielded by this project can be evaluated as very high. Moreover, it is assumed that the decrease in flood damages has an effect of preventing economic loss of about 3.8 billion yen (about 265 million Chinese yuan) per year on average occurred before the project started, and the impact on the promotion of urban development, promotion of tourism industry, and the improvement of living environment of residents can also be recognized. Accordingly, effectiveness and impact of this project are high.

In general, no major problems have been observed in the institutional, technical, and financial aspects as to the sustainability of the effects yielded through this project, and thus the sustainability is high.

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

4.2 Recommendations

None in particular

4.3 Lessons Learned

(1) Unified management method from start to completion of the project for subproject-type project management

This project was a large-scale project which required 15 years until the completion and in which 18 cities and counties participated. The executing agency, as the control tower, carried out detailed operation and management including: monitoring of all subprojects once each year during the implementation period; and if any difficulty arose in the subprojects such as

resettlement negotiations and procurement of domestic currency, visiting the implementation site and supporting the settlement of problems. Although an issue of delay in communication and coordination with JICA occurred in the middle, generally the agency appropriately responded with complicated adjustments such as the change of F/S and substantial change of the scope.

The management of subprojects has been unified from project management and operation to material filing methods, videos/photos/media coverage have been kept as PR materials, and a review of the project has been also carried out by organizing an ex-post evaluation workshop[44] in each province, city and county after the completion of the project (in May 2015). This is a good example where an executing agency demonstrated its leadership in the project whose management was difficult due to a long-term project with participation by many subprojects. Fine-tuned monitoring carried out by the executing agency of this project from its start to the completion, support for problem solution, unified material management throughout all subprojects, and publicity methods can be utilized in other similar projects.

(2) The necessity of monitoring during project implementation in a country where domestic procedures are complicated

Since the construction of flood prevention facilities on the Yangtze River basin had been carried out by domestic funds in advance immediately after the start of this project, a substantial change occurred, including the cancellation of project at Wuhan City that was the largest subproject of this project. Also, Yunmeng County withdrew from the scope of this project in the middle due to the budget shortage of the county. These changes were proceeded before JICA's approval. Substantial change in the project contents requires procedures for each Development and Reform Commission, Finance Department, and other organizations at multiple levels including implementation city, county, provice, and state, and it may take several years until formal approval is obtained from organizations in China. Because of the above reason, consent of JICA was left behind during such processes. Although the final scope change was in line with the contents of the objectives of this project and the change was made in such a manner as not to negatively affect the project effects greatly, it seems that more close communication and coordination were necessary between the executing agency and JICA.

In the project management in a country where domestic procedures are complicated as stated above, JICA should support an executing agency so that procedures for JICA and the central government are observed without delay by using progress reports and interim supervision, etc. and carrying out monitoring on the possibility of the change of project contents and in the situation of procedures for changes.

[44] Meetings for reporting on the situation of project implementation and completion as well as media coverage in which subproject of each city and county were introduced, and were held on the level of each subproject implementation city and county and on the provincial level.

Comparison of the Original and Actual Scope of the Project

Item	Plan	Actual
(1) Project Outputs	**Flood Prevention Facilities:** Construction of Dikes 26.5 km Renovation of Dikes 344 km Other Renovation 33.1 km **Total 403.5 km** **Urban Drainage Facilities:** Construction/Renovation of Culvert Gates 16 locations Construction/Renovation of Pumping Stations 14 locations Construction/Renovation of Diversion Canals 80.1 km	**Flood Prevention Facilities:** Construction of Dikes 7.5 km Renovation of Dikes 222.8 km Construction of Flood Prevention Walls 45.8 km Renovation of Flood Prevention Walls 3.8 km Other Renovation 5.0km **Total 403.5 km** **Urban Drainage Facilities:** Construction/Renovation of Culvert Gates and Sluiceways 106 locations Construction/Renovation of Pumping Stations 15 locations Construction of Sewers and Drainage 15.7 km Renovation of Sewers and Drainage 40.5 km Other 24 locations
(2) Project Period	April 2000-December 2005 (69 months)	April 2000-April 2015 (181 months)
(3) Project Cost Amount Paid in Foreign Currency Amount Paid in Local Currency Total Japanese ODA Loan Portion Exchange Rate	 3,133 million Japanese yen 20,787 million Japanese yen (139 million Chinese yuan) 23,920 million Japanese yen 13,000 million Japanese yen 1 Chinese yuan =15 yen(as of October 1999)	 1,538 million Japanese yen 17,122 million Japanese yen (122 million Chinese yuan) 18,660 million Japanese yen 12,496 million Japanese yen 1 Chinese yuan =13.99 yen (average of January 2002-December 2011)

People's Republic of China

FY2015 Ex-Post Evaluation of Japanese ODA Loan Project

"Inland Higher Education Project (Regional Vitalization, Market Economy Reform Support, and Environmental Conservation) (Guangxi Autonomous Region, Jiangxi Province, Hubei Province and Shanxi Province)"

External Evaluator: Toshihiro Nishino, International Development Center of Japan Inc.

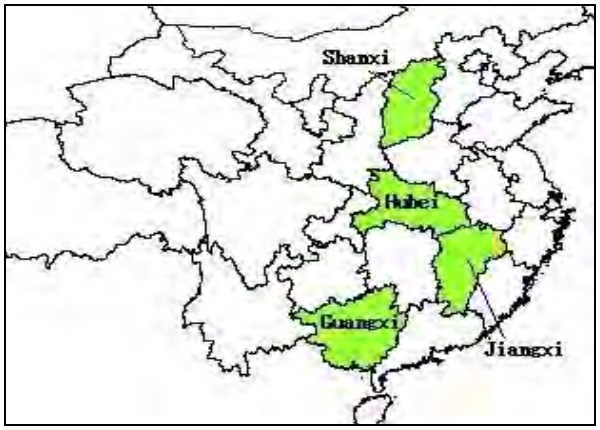
0. Summary

The Project[1] was implemented for the purpose of improving education and research at a total of 38 universities in Guangxi, Jiangxi, Hubei and Shanxi Provinces (hereinafter referred to as "the subject provinces") in China through the improvement of relevant facilities and equipment and the training of teachers. Relevance of the Project was evaluated to be high, as it was consistent with (i) the higher education policies of China and the subject provinces, (ii) the development needs for quantitative and qualitative enhancement of the universities, and (iii) Japan's assistance policies. While the actual effects of the Project were somewhat hampered by the delayed installment of some educational and research equipment, the tangible (hard component) and intangible (soft component) needs were met. Quantitative and qualitative improvements of the higher education at the targeted universities were achieved, as evidenced by the significant increases in the various indicators for education. The high level of effectiveness and the impacts of the Project were also substantiated by the improved outcomes of educational and research activities, making the best use of the advanced equipment and training; and the advancements in the various initiatives designed to achieve regional vitalization, environmental conservation, etc. Efficiency of the Project was evaluated to be fair on the whole: although the Project cost was within the plan, the Project period exceeded the planned period due to delays in procurement. Sustainability was evaluated to be high, with no issues observed in institutional, technical and financial aspects, and the operation and maintenance of the facilities and equipment developed by the Project were in good status.

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

[1] Although this evaluation deals with four separate projects implemented in four different provinces under the Inland Higher Education Project, they are collectively referred to as "the Project" in this report.

1. Project Description



Project Locations

Teaching in progress using equipment procured under the Project
(Huanggang Normal College: Hubei)

1.1 Background

In China, together with the remarkable economic development, several development challenges have arisen such as the narrowing internal disparity between coastal and inland areas, reducing poverty, preparing to join the World Trade Organization (WTO) and taking part in global issues. To deal with these challenges, the Chinese government put a high priority on the development of human resources that were essential for the accelerated efforts towards developing a market economy and narrowing economic gaps under the policy to strengthen reform and promote openness. Accordingly, the government set out a target to increase the higher education enrollment ratio to 15% and to adopt a policy to strengthen higher education institutions in inland areas. The basic indicators for the subject provinces are shown in Table 1 below.

Table 1: Basic indicators for the subject provinces

	Guangxi(2001)	Jiangxi(2002)	Hubei(2002)	Shanxi (2002)
Population	47.88 million	42.22 million	59.87 million	32.95 million
GDP per capita	4,668 yuan	5,828 yuan	8,309 yuan	5,571 yuan
Higher education enrollment rate	8%	14%	18%	15%
Number of higher education institutions	41	48	75	39

Sources: JICA appraisal documents.

Apart from Hubei Province, GDP per capita in the other three subject provinces is significantly lower than the national average (8,670 yuan in 2001 and 9,465 yuan in 2002).

The higher education enrollment rate in the subject provinces—except for Guangxi Province—was higher than the national average (13.3%) but there was still a need to strengthen higher education in all of the subject provinces. The 10th Five Year Plan (2001 – 2005) for each province called for the promotion of a market economy and further economic growth while the 10th Five Year Plan for Education (2001 – 2005) called for improvement of the higher education enrollment rate and an increase of the number of students in higher education to reach human development targets. There was recognition of the need to improve the hard aspect (new teaching facilities and equipment) as well as the soft aspect (teacher training) in addition to breaking free from the financial constraints.

Under these circumstances, the Project identified the development themes for Guangxi, Jiangxi, Hubei and Shanxi Provinces to be (i) regional vitalization, (ii) strengthening of the market rules and (iii) environmental conservation. The Project aimed to improve the quality and quantity of higher education at major universities in the subject provinces to contribute to the fostering of human resources capable of dealing with the identified development themes.[2]

1.2 Project Outline

The objective of the Project was to quantitatively and qualitatively enhance higher education at major universities in the subject provinces by developing educational infrastructures such as buildings and equipment (improvement of the hard aspects) and training teachers (strengthening of the soft aspects), thereby contributing to regional vitalization, strengthening of market economy reform, and environmental conservation of the subject provinces.

The targeted universities in the subject provinces are listed in the following table.

[2] This ex-post evaluation features the work conducted in Guangxi, Jiangxi, Hubei and Shanxi Provinces as part of the Japanese ODA loan project entitled "Inland Higher Education Project" targeting 22 inland provinces, municipalities and autonomous regions in China.

Table 2: Targeted universities of the Project

	Universities
Guangxi	Guangxi Normal University, Guilin University of Electronic Technology, Guangxi University of Chinese Medicine, Guangxi Teachers Education University, Guilin Medical University, Guilin University of Technology, Youjiang Medical University for Nationalities, Yulin Normal University, Guangxi University of Science and Technology and Guangxi Open University (10 Universities)
Jiangxi	Nanchang University, Jiangxi Normal University, Jiangxi Agricultural University, Jiangxi University of Finance and Economics, East China Jiaotong University, Gannan Normal University, Shangrao Normal University, Yichun University and Jiangxi University of Traditional Chinese Medicine (9 Universities)
Hubei	Hubei University, Wuhan University of Science and Technology, China Tree Gorges University, Hubei University of Technology, Yangtze University, Wuhan Textile University, Wuhan Polytechnic University, Huanggang Normal College, Wuhan Institute Of Technology, Hubei University For Nationalities, Hubei University of Arts and Science and Hubei University of Traditional Chinese Medicine (12 Universities)
Shanxi	Taiyuan University of Technology, Shanxi University, Shanxidatong University, Shanxi Normal University, Shanxi Medical University, ShanXi Agricultural University and Shanxi Vocational College of Tourism (7 Universities)

Sources: Responses to the questionnaire from the executing agency.

Note: The university names are those at the time of the ex-post evaluation. The Shanxi Vocational College of Tourism (targeted college for the ODA Loan Project) became an independent college from Shangxi University of Finance and Economics.

Province	Guangxi	Jiangxi	Hubei	Shanxi
Loan Approved Amount/Disbursed Amount	4,606million yen / 4,093million yen	4,872million yen / 4,517million yen	5,097million yen / 4,017million yen	5,093million yen / 5,000million yen
Exchange of Notes Date/Loan Agreement Signing Date	March 2003 / March 2003	March 2004 / March 2004	March 2004 / March 2004	March 2004 / March 2004
Terms and Conditions	Interest Rate 0.75% (2.2% for training component) Repayment Period (Grace Period) 30 years (40 years for training component) (10 years) Conditions for Procurement: General untied	Interest Rate 0.75% (1.5% for training component) Repayment Period (Grace Period) 30 years (40 years for training component) (10 years) Conditions for Procurement: General untied	Interest Rate 0.75% (1.5% for training component) Repayment Period (Grace Period) 30 years (40 years for training component) (10 years) Conditions for Procurement: General untied	Interest Rate 0.75% (1.5% for training component) Repayment Period (Grace Period) 30 years (40 years for training component) (10 years) Conditions for Procurement: General untied
Borrower /Executing Agency	The government of People's Republic of China / Guangxi Autonomous Region People's Government	The government of People's Republic of China /Jiangxi Provincial People's Government	The government of People's Republic of China /Hubei Provincial People's Government	The government of People's Republic of China /Shanxi Provincial People's Government
Final Disbursement Date	July 2013	August 2013	August 2013	August 2013
Main Contract	-	-	-	-
Main Consultant	-	-	-	-
Feasibility Studies, etc.	F/S by the School of Design and Research, Guangxi University (May,2002)	F/S by the Nanchang Engineering and Research Institute of Nonferrous Metals (July, 2003)	F/S by Hubei Province Engineering Consulting Company (May, 2003)	F/S by Shanxi Province Engineering Consulting Company (May, 2003)
	- "Special Assistance for Project Implementation (SAPI) for Higher Education Project in China", Japan International Cooperation Agency (JICA), 2003, 2004 and 2005. - "The Supervision Survey Report on JICA Loaned Higher Education Project", JICA, 2010.			
Related Projects	-	-	-	-

2. Outline of the Evaluation Study

2.1 External Evaluator

Toshihiro Nishino, International Development Center of Japan Inc.

2.2 Duration of Evaluation Study

Duration of the Study: August 2015 – January 2017

Duration of the Field Study: November 15 – December 12, 2015 and March 6 - 19, 2016

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

3.1 Relevance (Rating: ③[4])

3.1.1 Relevance to the Development Plan of China

The objective of the Project is consistent with the five-year plans for economic and social development and the five-year plans for the education sector at both the national and provincial levels, as well as with other education-related development strategies, which all aim for quantitative and qualitative development of higher education both at the times of appraisal and ex-post evaluations of the Project. At the national level, there has been continuous emphasis to foster and expand core universities in the Midwestern part of China, and the relevant projects, such as "the Project for the Promotion of Higher Education in the Midwestern Part (2012–2015)," have been implemented. Although there have not been major policy changes between the appraisal stage and the ex-post evaluation stage, the 13th Five Year Plan (2016–2020) includes the policy of "steadily maintaining the scale of higher education while seeking substantial development". There appears to be an emphasis on the qualitative improvement of higher education in the coming years from the viewpoint of "seeking to develop highly capable human resources to match the social needs".

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

[4] ③: High, ② Fair, ① Low

Table 3: Main objectives of development plans related to the Project

Type of document	At the time of appraisal	At the time of ex-post evaluation
National level development plan	The 10th 5-year Plan for National Economic and Social Development (2001–2005): To increase higher education enrollment ratio to around 15% by 2005.	The 12th 5-year Plan for National Economic and Social Development (2011-2015): To emphasize higher education for promoting industrial advances (quantitative targets include 87% of junior secondary graduates to go on to senior secondary school)
National level education sector plan	The 10th National 5-year Plan for Education (2001-2005): To increase student enrollment in HEIs (higher education institutions) to 16,000,000 by 2005; to develop human resources that have high skills in high technology, biotechnologies, manufacturing technologies etc. that are necessary for industrial structural adjustment; to strengthen support to HEIs that are relatively at a high level in western area; to strengthen support to fostering of teachers.	The 12th National 5-year Plan for Education (2011-2015) and National Mid- and Long-term Reform and Development Plan for Education Sector"(2010–2020): To increase higher education enrollment ratio from 26.5% in 2010 to 40% in 2020; to increase student enrollment in HEIs from 29,790,000 in 2009 to 33,500,000 by 2015; to develop HEIs in Midwestern area with special focus on development of departments that are competitive and fostering of teachers.
Provincial Level Education Development Plan	Provincial 10th Five Year Plan for Education (2001 – 2005) (Guangxi) • Higher education enrollment rate: 12% • Number of students in higher education: some 550,000 (Jiangxi) • Higher education enrollment rate: 18.5% • Number of students in higher education: some 450,000 (Hubei) • Higher education enrollment rate: 23% • Number of students in higher education: some 1.4 million (Shanxi) • Higher education enrollment rate: 20% • Number of students in higher education: some 300,000	Provincial 12th Five Year Plan for Education (2011 – 2015) (Guangxi) • Higher education enrollment rate: 28% • Number of students in higher education: some 900,000 (Jiangxi) • Higher education enrollment rate: 36% • Number of students in higher education: some 1.25 million (Hubei) • Higher education enrollment rate: 40% • Number of students in higher education: some 1.84 million (Shanxi) • Higher education enrollment rate: 38% • Number of students in higher education: some 690,000

Sources: JICA appraisal documents; respective documents of the mentioned development plans.

3.1.2 Relevance to the Development Needs of China

Development needs were observed for the quantitative and qualitative enhancement of education at the thirty eight targeted universities during both the appraisal and ex-post evaluation.

At the appraisal stage, the future need for the quantitative expansion of higher education was predicted (i) in line with the further expansion of primary and secondary education and (ii) to narrow the economic disparity between coastal and inland areas as mentioned in 1.1 – Background. The projected demand suggests an approximate double the number of students in higher education in five years (Table 4), and the central government made a request to local higher education institutions to make hard, (expansion of classroom

facilities and equipment) as well as soft (teacher training) improvements. However, the universities targeted by the Project and controlled by each provincial government were experiencing a complete lack of funds, as evidenced by the fact that all of the universities responded to an interview survey with the statement that "at the start of the Project, financial assistance was quite limited and the introduction or renewal of educational equipment was especially low".[5]

Table 4: Projected demand for higher education

	Guangxi	Jiangxi	Hubei	Shanxi	Total
Actual number of students in higher education	288,000 (2001)	409,000 (2002)	1,040,000 (2002)	208,000 (2002)	1,945,000
Projected demand	555,000 (2006)	1,207,000 (2007)	1,600,000 (2007)	400,000 (2007)	3,762,000

Sources: JICA appraisal documents.

At the time of the ex-post evaluation, GDP per capita was still below the national average (49,754 yuan) in all of the subject provinces. According to the findings of an interview survey with the education bureaus of the subject provinces and senior staff members as well as those in charge of project implementation at the targeted universities, it is still necessary to further promote "the strengthening of market rules" and to maintain economic growth and eradicate the economic disparity with coastal regions through "vitalization of regional economy". Meanwhile, "environmental conservation" has become the primary target for human resources development and enhancement at each university in the face of increasing need. The number of students in higher education has steadily increased in each of the subject provinces, and there is a strong need for quantitative and qualitative improvement of higher education institutions. In the coming years, the simple expansion of the scale of higher education will likely become less important in some provinces because of (i) the successful quantitative expansion of higher education in the 12th Five Year Plan period and (ii) the growing demand for highly capable human resources at the post-graduate level due to the enhancement of China's economic and industrial level. However, in Guangxi and other provinces, there is still an emphasis on the quantitative expansion in light of the lower higher education enrollment rate compared to the national average.

Although the contents of the Project during its request stage were limited to the improvement of facilities and equipment (i.e. the hard aspect), the soft component (teacher training) was subsequently added following consultations between Japan and China. The

[5] Funding sources for universities in China consist of grants from the central and provincial governments and self-funding sources, including tuition fees.

findings of the interview survey with senior staff members and those in charge of project implementation at the targeted universities reveal that all of the targeted universities were initially interested in improving the facilities and equipment because of their insufficient availability. Subsequently, however, they were aware of the essential need for the qualitative improvement of higher education through human resources development, etc. from the viewpoint of (i) improving the education and research level and (ii) promoting the structural reform of the university. By the time of the ex-post evaluation stage, the need to improve the soft aspect was further increased. Accordingly, the inclusion of the soft component in the Project to facilitate human resources development was highly appropriate as it reflected the long-term need for further development of higher education institutions in China.[6]

3.1.3 Relevance to Japan's ODA Policy

At the time of the appraisal, Japan's Country Assistance Policy for China, the Medium-term Strategy for Overseas Economic Cooperation Operations (JICA 2002) and the Country Assistance Strategy (JICA 2002) put priorities on human resources development from the viewpoint of supporting openness and reform and post-WTO economic reform, and on assistance in inland China from the perspective of narrowing the economic gap. The Project objective was consistent with these aid policies of Japan. The Country Assistance Strategy upholds "regional vitalization and exchange", "strengthening of market economy reform", and "environmental conservation" as key areas of human resource development.

The Project has been highly relevant to China's development plans, development needs, as well as to Japan's ODA policies. Therefore, its relevance is high.

3.2 Efficiency (Rating: ②)

3.2.1 Project Outputs

The actual production of the outputs is summarized in "Comparison of the Original and Actual Scope of the Project" of the final page of this report. In regard to the hard component, the original plan to use Japanese ODA loan for the construction of facilities in Hubei Province was changed and constructed through the domestic funds. As the saved amount of ODA loan was then used for the procurement of educational and research equipment, the actual number of procured educational and research equipment increased from the original plan despite the partial cancellation of the equipment procurement. The

[6] However, it was not necessarily easy for some provinces to secure host higher education institutions for the long-term dispatch of their teachers for training in Japan, which will be in greater detail in the section dealing with the efficiency of the Project. This situation suggests that it was necessary to accurately grasp the actual local needs for training.

procurement of these equipment under the Project was conducted in several product specific packages. Because of the prolonged procurement period, there were frequent (i) changes in equipment specifications (including discontinued production of some products)[7] and (ii) cancellation, minor changes and adjustments of the equipment reflecting the changing needs of individual universities.[8] Regarding facility construction, there were no major changes from the original plan even though some minor changes were made to the contents of the work and building areas based on the needs of individual universities. In short, it is safe to conclude that the hard outputs were generally achieved as planned.

[7] In regard to updating the specifications necessitated by the lengthening of the project period, the specifications were adjusted or changed prior to the tender. In some cases, it took a long time for the actual delivery, and senior staff members and those in charge of project implementation of several universities pointed out that some of the procured equipment was not necessary of the latest model.Nevertheless, all of the procured equipment has been actively used for research and education, and no problems with their use have occurred.

[8] Funds saved as a result of the tender for early packages under the Project and funds for cancelled packages were subsequently passed on to later packages after undergoing the official procedure within the approved loan amount.

Table 5: Changes of the Outputs (Hard Component)

	Construction of Facilities	Educational and Research Equipment
Ghangxi	• The department to use the new facility was changed at one university. • The construction site was changed for one university (a new campus). • The overall building area was increased in nine universities and decreased in one university.	• Following the extension of the procurement period, minor changes were made to the specifications and types of equipment to be procured. (The procurement method was changed to university-specific packaged procurement).
Jiangxi	• The overall building area was increased in five universities and decreased in two universities	• Following the extension of the procurement period, minor changes were made to the specifications and types of equipment to be procured. • One package was cancelled.
Hubei	• The construction work was cancelled in two universities because of a change in required facilities • The contents and purpose of the construction were changed in one university. • The overall building area was increased in five universities and decreased in three universities. • (The funding source was changed to domestic funds.)	• Following the extension of the procurement period, minor changes were made to the specifications and types of equipment to be procured. • Three packages were cancelled (the funds for the cancelled packages were used for other packages) (Phase 1 procurement). • The diversion of part of the ODA loan for construction work to the Phase 2 procurement meant an increased scale of procurement of educational and research equipment (Phase 2 procurement). • During the Phase 2 procurement period, the delivery of some of the planned equipment (worth ¥707 million) was cancelled after signing of the contract due to a strong yen and other factors. (For the Phase 2 procurement, the procurement method was changed to university-specific packaged procurement).
Shanxi	• The contents and purpose of construction were changed in two universities. • The overall building area was increased in four universities and decreased in one university. • (The civil engineering work procurement method was changed to domestic competitive bidding.)	• Following the extension of the procurement period, minor changes were made to the specifications and types of equipment to be procured. • Two packages were cancelled while three new packages were added.

Sources: Responses to the questionnaire from the executing agency.

Piano procured under the Project
(Gannan Normal University : Jiangxi)

Microscope procured under the Project
(Wuhan University of Science and Technology : Hubei)

Classroom building constructed under the Project
(Shanxi University)

Library building constructed under the Project
(Guilin Medical University : Guangxi)

As part of the Project, the training of teachers of the targeted universities in Japan (in principle, individual universities and teachers hoping to undergo such training select the host universities and tutors (professors) and make individual arrangements for their training) was conducted under the soft component. The actual outputs of this training are shown in Table 6.

Table 6: Actual training outputs

	Planned (persons)	Actual output			Actual-Planned ratio	
		Total	Long-term specialist training	Short-term manager training	Total	Long-term specialist training
Guangxi	149	195	114	81	131%	77%
Jiangxi	150	349	64	285	233%	43%
Hubei	158	162	74	88	103%	47%
Shanxi	216	345	210	135	160%	97%

Sources: Responses to the questionnaire from the executing agency.

Note: "Long-term specialist training" is training where teachers in specialist fields are individually dispatched to host universities in Japan for a long period of time (long-term training of more than one year in a specialist field), while "short-term manager training" usually lasts for less than one month.

The actual output in terms of the number of trainees exceeded the planned number in all four provinces. However, regarding "the long-term dispatch of individual teachers with specialist knowledge of the relevant disciplines to Japanese universities (long-term training of one year or longer in their own specialist fields)" as planned at the appraisal stage, the planned output was almost achieved only in Shanxi Province. In the other three provinces, however, the achievement rate was 77% for Ghangxi Province and was below 50% for Jiangxi and Hubei Provinces. These low achievement rates can be attributed to the large number of participants enrolled in short-term training courses (normally less than one month) where manager training (to learn how to manage a university) is the dominant course. Several factors have contributed to the failure of many provinces to achieve the target for long-term specialist training, as listed below.

Factors applicable to almost all of the target universities

- As teachers hoping to undergo training searched for suitable Japanese universities on the Internet or through an introduction by an acquaintance, there were cases of mismatching, especially for universities with little experience of exchange with foreign universities (see Box 1).
- Some of the targeted universities were in the midst of expansion and had no leeway to dispatch their teachers abroad for a long period of time (especially universities in Jiangxi Province).

Factors applicable to some of the targeted universities

- In Jiangxi Province, the Provincial Education Bureau emphasizes and utilizes manager training, and the targeted universities also showed the same tendency to emphasize such training. (At some universities, the opportunity to train in Japan was not fully publicized.)
- The number of eligible Chinese teachers was limited due to language problems (lack of English proficiency).
- At the initial stage of recruitment, there was a misconception that Japanese proficiency was essential, impairing the application prospects.
- Training in Japan was less attractive because of "a noticeable preference for training in Europe or the United States", "existence of numerous options for study abroad or overseas training," amongst other reasons.
- The Great East Japan Earthquake in 2011 fostered a mood of staying away from Japan in the subsequent years.

Meanwhile, universities and their teachers in Guangxi and Shanxi Provinces expressed a strong desire for overseas training for human resources development under the Project, and local universities adopted measures such as "the active assistance of departments for teachers to find suitable universities in Japan for training" and "provision of language

training for teachers hoping to apply for training in Japan". In Guangxi Province, the Provincial Education Bureau actively assisted the matching of local universities with few overseas networks, and this proactive stance bore fruit.

Short-term training courses that predominantly feature manager training were promoted through consultations and agreement between JICA and the Chinese side, taking into account the difficulty of matching and other factors hindering the full achievement of the long-term training objectives. As the contents of these short-term training courses were important for universities facing the needs to proceed with scale expansion and structural reform, their implementation was justified. Nevertheless, the manager training course should serve to complement long-term specialist training, and the actual outputs of the implemented manager training were not realized necessarily as planned.[9]

Box 1: JICA's assistance for training applicants to secure places for training and outcomes

The importance of matching to ensure the number of trainees as planned was recognized at a relatively early stage of the Inland Higher Education Project, and JICA made various efforts to ensure good matching.[10] As a result of these efforts, the necessary foundations to ensure smooth matching were established. The beneficiaries survey[11] for the ex-post evaluation found that 31% and 64% of the respondents selected the answers "very appropriate" and "appropriate" respectively to the question of "Was the matching to find a place for training conducted appropriately?" This indicates that the matching process was highly evaluated by an overwhelming majority. However, according to the interview survey with senior staff members and persons in charge of project implementation at the targeted universities, there were some teachers that abandoned their training applications because they could not find locations for training. This indicates that some applicants did not experience smooth matching of programs.

From the viewpoint of training applicants, it was important to find a place (tutor) for

[9] There were universities, especially in Jiangxi Province, which sent dozens of staff members to manager training. It can now be observed at some of these universities that many of those that underwent manager training had already left their positions by the time of the ex-post evaluation.

[10] To be more precise, these efforts included ① convening of a briefing targeting Japanese universities to accept trainees and Chinese universities to participate in the Project, ② preparation of a pamphlet explaining the Project, ③ convening of a meeting for Japanese and Chinese universities to facilitate matching, ④ simplification of the procedure for trainees to enter Japan through consultations with Japan's Immigration Bureau, ⑤ construction of a website for the Project, formulation of guidelines regarding how to find accepting Japanese universities, a template for e-mails to be sent to Japanese universities and other relevant matters and the preparation as well as distribution of information materials on Japanese universities and ⑥ assistance for matching using the SAPI (Special Assistance for Project Implementation) facility.

[11] The beneficiaries survey conducted as part of the ex-post evaluation is outlined here. (Target) Participants for training in Japan; (Method) Request to each university via the provincial education bureau to make former trainees reply to the questionnaire (the selection of subject former trainees to reply to the questionnaire was left to each province and university because of the difficulty of conducting random sampling using a list); (Number of questionnaires sent) 201; (Number of valid responses) 201 (by province, 50 each for Guangxi, Jiangxi and Hubei Provinces and 51 for Shanxi Province) (by subject, 64 for humanities courses, 84 for science courses and 53 for the manager course) (by duration (for only humanities and science courses), 60 for long-term (one year or longer) and 88 for short term (less than one year); (by gender, 85 females and 116 males); (Principal questions) ① How was a training place found, ② Adequacy of matching, ③ Degree of satisfaction with training and ④ Degree of deepened knowledge of Japan.

training that matched his/her specialist discipline. In many of the targeted universities, the search for a matching place was left to the applicants themselves,[12] and it was particularly difficult for applicants without an overseas network or vital information due to their little experience of international exchange or activities abroad. Information provided by JICA on Japanese universities must have been effective to a certain extent but was not necessarily sufficient, especially for teachers in scientific disciplines of which their specialist fields tend to be highly segmented. JICA's assistance was primarily directed towards individual universities. The interview survey found a strong need for JICA to provide more detailed assistance, including focused advice, for individual applicants. Meanwhile, the beneficiaries survey found that only 9% of applicants used "information provided by JICA" to find a possible place for training in Japan.

3.2.2 Project Inputs

3.2.2.1 Project Cost

The total project cost by province was 5,407 million yen (90% of the planned cost) for Guangxi Province, 7,807 million yen (92% of the planned cost) for Jiangxi Province, 8,843 million yen (102% of the planned cost) for Hubei Province and 7,617 million yen (93% of the planned cost) for Shanxi Province as shown in Table 7. The actual cost was, therefore, lower than planned for three of the provinces. The reason for the actual cost exceeding the planned cost in Hubei Province was the expansion of the project scale due to an increase in educational and research equipment. All of the planned buildings were funded by the Government of Hubei Province, and the ODA loan originally earmarked for these buildings was totally diverted to the procurement of additional educational and research equipment to increase the project scale. As such, the over-run of the project cost is deemed to have been appropriate for the increased project scale.

[12] The most common responses to the question "How did you find a place for training?" in the beneficiaries survey conducted among the participants of the specialist training courses were ① "the Internet" (46%) and ② "introduction by a friend or acquaintance" (39%) (multiple answers permitted). This result suggests that the applicants were generally expected to find training places by themselves.

Table 7: Planned and actual project costs

Unit: million yen

		Plan (appraisal)			Actual		
		Foreign currency	Local currency	Total	Foreign currency	Local currency	Total
Guangxi	1.Building construction	1,854	1,349	3,202	1,870	1,314	3,184
	2. Equipment	2,283	0	2,283	2,051	0	2,051
	3. Training	172	0	172	172	0	172
	4.Price contingency	78	3	81	0	0	0
	5.Physical contingency	219	67	287	0	0	0
	Total	4,606	1,419	6,025	4,093	1,314	5,407
Jiangxi	1.Building construction	0	3,432	3,424	0	3,290	3,290
	2. Equipment	4,301	0	4,301	4,334	0	4,334
	3. Training	244	0	244	183	0	183
	4.Price contingency	94	0	94	0	0	0
	5.Physical contingency	233	172	405	0	0	0
	Total	4,872	3,604	8,476	4,517	3,290	7,807
Hubei	1.Building construction	1,709	2,471	4,180	0	3,902	3,902
	2. Equipment	2,824	924	3,748	3,849	924	4,773
	3. Training	243	0	243	168	0	168
	4.Price contingency	78	1	79	0	0	0
	5.Physical contingency	243	171	413	0	0	0
	Total	5,097	3,566	8,663	4,017	4,826	8,843
Shanxi	1.Building construction	1,430	2,341	3,771	1,430	2,617	4,047
	2. Equipment	3,118	551	3,669	3,386	0	3,386
	3. Training	215	17	232	184	0	184
	4.Price contingency	87	3	90	0	0	0
	5.Physical contingency	243	145	389	0	0	0
	Total	5,093	3,057	8,151	5,000	2,617	7,617

Sources: JICA appraisal documents, responses to the questionnaire from the executing agency.

Notes

1) At the time of this ex-post evaluation, while no contractual settlement has officially been made in regard to the refund of the unused ODA loan of 707 million yen in the Phase 2 funding for educational and research equipment in Hubei Province, this amount is subtracted here from the actual cost because this refund is likely to be made in the near future based on the signing of the relevant L/A.
2) The exchange rate (yen to yuan) used was 15 yen for the planned cost for Guangxi Province and 14.3 yen for the planned cost for Jiangxi, Hubei and Shanxi Provinces. In comparison, the exchange rate used for the actual cost was 13.9 yen for Jiangxi Province (average exchange rate during the project period from 2003 to 2013), 14.3 yen for Jiangxi Province (between 2002 and 2014), 14.9 yen for Hubei Province (between 2004 and 2015) and 14.1 yen for Shanxi Province (between 2004 and 2013).

3.2.2.2 Project Period

As shown below in Table 8, the actual project period was significantly longer than the planned period at the time of appraisal in all of the provinces (ratio against plan: 315% for Guangxi Province, 182% for Jiangxi Province, 231% for Hubei Province and 185% for Shanxi Province).

Table 8: Planned and actual project periods

		Plan (appraisal)	Actual
Guangxi	Signing of Loan Agreement	March 2003	March 31, 2003
	Project period	January 2003 - March 2006 (39 months)	April 2003 - June 2013 (123 months)
	Building construction	January 2003 - March 2005	August 2005 - April 2011
	Procurement of equipment	April 2003 - December 2005	August 2005 - June 2013
	Training	October 2003 - March 2006	September 2004 - December 2011
Jiangxi	Signing of Loan Agreement	March 2004	March 31, 2004
	Project period	May 2002 - March 2009 (83 months)	May 2002 - November 2014 (151 months)
	Building construction	May 2002 - May 2005	May 2002 - May 2005
	Procurement of equipment	May 2004 - October 2006	November 2006 - November 2014
	Training	July 2004 - March 2009	July 2005 - November 2009
Hubei	Signing of Loan Agreement	March 2004	March 31, 2004
	Project period	April 2004 - March 2009 (61 months)	April 2004 - December 2015 (141 months)
	Building construction	April 2004 - December 2005	April 2004 December 2015
	Procurement of equipment	April 2004 - March 2007	January 2009 - December 2015
	Training	April 2004 - March 2009	January 2007 - December 2012
Shanxi	Signing of Loan Agreement	March 2004	March 31, 2004
	Project period	April 2004 - March 2009 (61 months)	April 2004 - August 2013 (113 months)
	Building construction	April 2004 - December 2006	December 2006 - August 2013
	Procurement of equipment	April 2004 - March 2007	December 2006 - August 2013
	Training	April 2004 - March 2009	December 2006 - August 2013

Sources: JICA appraisal documents, responses to the questionnaire from the executing agency.
Note: In cases where part of the Project commenced using local funds prior to the signing of the loan agreement, the time of project commencement was before the date of signing.

The main cause of the massive over-run of the project period was the delayed procurement of educational and research equipment. This delay was observed in almost all of the provinces and universities. The principal reasons for the delay are listed below.

Delay prior to tender	Central level	• The approval and modification procedures relating to procurement under an international cooperation project were strictly monitored at the central government level, and these procedures took much longer to complete than originally planned.
	Provincial and university levels	• The Chinese organizations and universities were unaccustomed to procurement work under an international cooperation project, especially at the initial stage of the Project. • Because educational and research equipment was packaged by product type, etc. for all of the universities, the delay in procurement procedure at some universities affected the entire procurement procedure (Contrary to the original plan, some universities expressed the desire to procure equipment after facility construction; the necessary work to complete the procurement was delayed at these universities.). • As a result of the delay described above, it became necessary to make additional adjustments, such as (i) the procurement of some equipment by the recipient's own funds and (ii) the specifications of the equipment to be procured as a package became obsolete during the delay. Such situation further delayed the procurement completion. • Although efforts were made to change to the university-specific packages for easier adjustment, the agencies responsible for procurement in some provinces were reluctant to change the procurement method: they aimed to follow the original procurement plan and to preserve the original packages.
Delay after tender		• Because the contents of each package were diverse, it took a long time for the successful bidder to procure all equipment from various suppliers for final delivery. In the case of some equipment, it was discovered after the tender that production had been terminated, necessitating extra time to adjust to the situation. • In the international competitive tender held, the lowest bidder was the successful bidder. However, some successful bidders demanded a lower contract price and a change in some of the specifications after the closure of the tender, and some time was required to persuade them to keep to their bids. (These problems were especially evident in the Phase 2 tender in Hubei Province where the opening of the tender occurred when the yen was weak, and the profit margin of the successful bidder was badly hit by the subsequent change of the exchange rate.)

The construction of facilities was also delayed at some universities because of ① the delayed commencement of procurement in some provinces, as the implementing organization was unfamiliar with Japan's ODA loan projects, ② change in the procurement method, including the change to local procurement, ③ adverse impacts of flooding and other natural disasters and ④ lengthy process of approval and adjustment by a provincial government regarding a new campus construction plan. Compared to the procurement of educational and research equipment, the actual delay of the construction work was much shorter.

3.2.3 Results of Calculations of Internal Rates of Return

Due to the nature of the Project, a quantitative analysis of the internal rate of return was not conducted.

Although the Project cost was within the plan, the Project period exceeded the plan. Therefore, the efficiency of the Project is fair.

3.3 Effectiveness[13] (Rating: ③)

The effectiveness of the Project was analyzed from two aspects: the quantitative aspect, including the performance of indicators for operational effectiveness as determined at the appraisal stage; and the qualitative aspect regarding the qualitative improvement of education and research.

3.3.1 Quantitative Effects (Operation and Effect Indicators)

The target year for the achievement of the quantitative indicators was set as the planned completion year of the Project. Yet, because the latest data obtainable for this ex-post evaluation was that of 2014 for all provinces, the 2014 data is used as the actual performance in the target year in the present analysis.

(1) Quantitative expansion of teaching and research

At the appraisal stage, “the number of students”, “the total building area of the school buildings” and “the total monetary value of the educational and research equipment” were set as indicators for the improvement of education and research. As shown in the following tables, all provinces demonstrated substantial improvements for each indicator. The facilities and equipment developed under the Project were mostly utilized, and it can be said that they played an important role in the quantitative expansion of teaching and research.

Firstly, there was a substantial increase in the number of students at each of the targeted universities. Although the actual number at the original target year for completion did not reach the target number in all provinces (56,000 short of the target altogether in four provinces), this figure was compiled at a time when the construction work to accommodate incoming students was still incomplete. The total number of students in the four provinces increased by 189,000 in approximately five years from the year of appraisal to the original target year (the actual number of students in the original target year for the four provinces was 623,000, an increase of some 44% from the year of appraisal). By province, the rate of increase was 44% for Guangxi, 68% for Jiangxi, 35% for Hubei and 27% for Shanxi. This upward trend in the number of students continued, reaching 879,000 (total for four

[13] Sub-rating for Effectiveness was given with consideration of Impact.

provinces) in 2014 after the completion of the Project, which was 2.03 times the number of students (434,000) in the year of appraisal, achieving the target. However, because the initial projected demand was set high, the actual number of students in 2014 in Jiangxi Province reached only 97% of the target number of the year of project completion.

Table 9: Number of students (Total number of graduate, undergraduate and single department college students)

	Actual	Target	Actual	Actual
	Appraisal year	Project completion year	Original target year	2014
Guangxi	63,000	112,000	91,000	247,000
Jiangxi	117,000	208,000	197,000	202,000
Hubei	162,000	228,000	218,000	284,000
Shanxi	92,000	131,000	117,000	146,000
Total	434,000	679,000	623,000	879,000

Sources: JICA appraisal documents, responses to the questionnaire from the executing agency

Notes

1) The year of appraisal was 2001 for Guangxi Province and 2002 for Jiangxi, Hubei and Shanxi Provinces. The target year for project completion (original target year) was 2006 for Guangxi Province and 2007 for Jiangxi, Hubei and Shanxi Provinces while the year of project completion was 2013 for Guangxi and Shanxi Provinces, 2014 for Jiangxi Province and 2015 for Hubei Province.
2) Single-department college students are equivalent to junior college students in Japan.

There was also a substantial increase in the building area, as in the case of the number of students. The actual figure for the original target year almost reached the target (total building area in the original target year: 10.99 million m^2). The total building area in the four provinces increased by 6.38 million m^2 (138% of the original figure in the year of appraisal) in approximately five years from the year of appraisal to the original target year. The rate of increase was especially high in Guangxi Province and Shanxi Province. The building area showed a noticeable upward trend during the post-project period, reaching a total of 17.06 million m^2 for the four provinces in 2014. This was 3.7 times the initial building area of 4.61 million m^2 in the year of appraisal. The target for the project completion year was achieved by 2014 in all provinces. At some universities, the added building area under the Project was greater than those proposed in the original plan. As a result, the actual increase under the Project exceeded the plan in Guangxi and Jiangxi Provinces.

Table 10: School building area
(Classrooms, laboratories, libraries, gymnasiums and auditoriums)

Unit: m2

	Actual	Target (Project completion year)		Actual (Original target year)		Actual (2014)	
	Appraisal year	Total	Portion under the Project	Total	Portion under the Project	Total	Portion under the Project
Guangxi	656,325	1,391,143	146,000	1,737,700	28,257	3,474,653	183,335
Jiangxi	1,201,262	2,992,852	152,800	2,881,762	168,208	4,873,971	168,208
Hubei	1,901,304	3,739,502	169,000	4,002,266	113,513	5,376,094	159,313
Shanxi	855,890	1,682,774	130,000	2,372,537	0	3,333,301	97,718
Total	4,614,781	9,806,271	597,800	10,994,265	309,978	17,058,019	608,574

Sources: JICA appraisal documents, responses to the questionnaire from the executing agency.

The total monetary value of the educational and research equipment at each targeted university also increased substantially. Although no target was set at the time of appraisal for the monetary value of the educational and research equipment, the total value in the project completion year was 4.63 billion yuan for the four provinces, indicating that the total value of such equipment owned by the targeted universities more than doubled in approximately five years. In 2014, the total value for the four provinces was 10.92 billion yuan, which is approximately five times the amount in the year of appraisal (2.16 billion yuan). The rate of increase was much higher than that of the number of students and the building area.

The actual monetary value of the added equipment under the Project was slightly below the planned value in all of the provinces except Hubei Province due to the cancellation and adjustment of some of the planned equipment. In Hubei Province, the actual value exceeded the planned value: the ODA loan originally earmarked for subsequently cancelled construction work was diverted to the procurement of additional educational and research equipment.

Table 11: Total monetary values of educational and research equipment

Unit: thousand yuan

	University total			Portion under the Project		
	Actual (Appraisal year)	Actual (Original target year)	Actual (2014)	Target (Project completion year)	Actual (Original target year)	Actual (2014)
Guangxi	266,760	670,930	2,227,610	152,930	0	148,070
Jiangxi	961,570	1,890,160	3,700,500	300,740	100,340	291,680
Hubei	453,330	1,261,560	2,842,850	251,440	0	320,340
Shanxi	477,050	809,170	2,146,830	260,130	208,480	237,550
Total	2,158,710	4,631,820	10,917,790	965,240	308,820	997,640

Sources: JICA appraisal documents, responses to the questionnaire from the executing agency.

The findings of the questionnaire survey and interview survey conducted at each university indicate that the utilization rate is high for both the buildings constructed and equipment procured under the Project. The utilization rate of major equipment appears to be higher than 90% in most universities. There are many advance bookings for transmission microscopes and other equipment of which the utilization rate is particularly high; prospective users often have to wait for one or two weeks. Some of the equipment procured under the Project, such as the gene analysis apparatus, is very valuable, and only one of such apparatus is available at a university or even in a wider area.

(2) Qualitative enhancement of teaching and research

At the time of appraisal, "the school building area per student" and "the monetary value of equipment per student" were set as indicators for the qualitative improvement (enhancement) of teaching and research. The actual performance of these indicators is shown in Table 12. Because the increase in the building area and monetary value of the educational and research equipment was greater than the increase in the number of students in all four provinces, the actual performance of these indicators is very high. The building area per student already exceeded the target in the original target year. In 2014, both the school building area per student and the monetary value of equipment per student were double or treble those in the year of approval in all four provinces. It was found that the average school building area and the monetary value of equipment per student satisfied the national standard at most targeted universities, implying that the quality of teaching/research environment was ensured to a certain degree.

Table 12: School building area (teaching, research and administration) per student and monetary value of educational equipment per student

	School building area per student (m^2)							Value of educational equipment per student (yuan)	
	Actual (Appraisal year)	Target (Project completion year)		Actual (Original target year)		Actual (2014)		Actual (Appraisal year)	Actual (2014)
		Area per student	Increment through this project	Area per student	Increment through this project	Area per student	Increment through this project		
Guangxi	10.1	11.3	1.58	23.5	0.31	32.7	1.01	3,760	10,230
Jiangxi	12.9	14.2	0.76	17.2	0.88	24.2	0.81	3,326	10,975
Hubei	11.1	14.5	0.98	21.4	0.77	20.8	0.73	3,338	9,964
Shanxi	7.4	9.7	1.25	16.4	0.00	16.1	1.13	5,391	13,321

Sources: JICA appraisal documents, responses to the questionnaire from the executing agency.
Notes
1) The value for each province is the simple average of the corresponding values for individual universities.

2) The national standard (for ordinary university departments) varies from one department to another. For example, the standard school building area per student ranges from 9 m^2 for a medical department to 22 m^2 for a social science department while the standard monetary value of equipment per student ranges from 3,000 yuan for a social science department to 5,000 yuan for such science departments as engineering, agro-science and medicine.

Table 13 outlines the performance (outcome) of indicators for the quantitative and qualitative enhancement of higher education that can be recognized externally when measured against relevant permits or designations by the Ministry of Education (equivalent to Japan's Ministry of Education, Culture, Sports, Science and Technology). While each indicator shows progress, a particularly noticeable improvement is made in the number of key disciplines (provincial/ministerial level[14]), number of key laboratories (state level as well as provincial/ministerial level), number of master's degree and doctorate programs and number of research projects (state level as well as provincial/ministerial level). The actual figures for 2014 more than trebled those for the year of appraisal. Some improvements were made in the number of key disciplines (state level) and number of key laboratories (state level) for which the target figures are strictly set because of the very high criteria to be met. For those indicators for which the target value in the project completion year was set in the year of appraisal, very few reached the target by the original target year. However, three indicators apart from the number of key disciplines (state level) achieved the target by 2014. The interview survey with senior staff members and those in charge of project implementation at the targeted universities found that the Project, especially in the provision of educational and research equipment, had greatly contributed to achieving the set targets. Much of the equipment procured under the Project are currently used for key disciplines, laboratories and research projects while some of the teachers who underwent training in Japan are participating in research projects.

Since the commencement of the Project, 10 colleges have been upgraded to universities, eight universities have commenced master's degree programs and 10 universities have installed doctorate programs. In order for these new programs to be officially approved, it is crucial that the hard components of school infrastructure meet and surpass a certain level. It is evident that the enhanced level of these hard components under the Project at these universities significantly contributed to this educational upgrade.

[14] Those designated by a provincial government or ministry are classified as "provincial/ministerial level" while those designated by the state are classified as "state level".

Table 13: Trend of major teaching/research outcome indicators (total of the targeted universities)

		Actual (Appraisal year)	Target (Project completion year)	Actual (Original target year)	Actual (2014)
Guangxi	Number of key disciplines (state level)	0	0	0	0
	Number of key disciplines (provincial/ministerial)	23	41	34	139
	Number of key laboratories (state level)	0	-	-	2
	Number of key laboratories (provincial/ministerial)	0	-	-	50
	Number of undergraduate faculties/departments	82	-	-	208
	Number of master's degree programs	70	178	203	386
	Number of doctorate degree programs	0	26	4	28
	Number of research projects (state level)	19	-	-	289
	Number of research projects (provincial/ministerial)	77	-	-	424
Jiangxi	Number of key disciplines (state level)	2	23	4	6
	Number of key disciplines (provincial/ministerial)	51	110	85	139
	Number of key laboratories (state level)	2	-	-	7
	Number of key laboratories (provincial/ministerial)	5	-	-	135
	Number of undergraduate faculties/departments	266	-	-	543
	Number of master's degree programs	158	352	443	758
	Number of doctorate degree programs	13	45	33	130
	Number of research projects (state level)	24	-	-	450
	Number of research projects (provincial/ministerial)	225	-	-	1,156
Hubei	Number of key disciplines (state level)	0	26	0	1
	Number of key disciplines (provincial/ministerial)	84	168	102	169
	Number of key laboratories (state level)	0	-	-	6
	Number of key laboratories (provincial/ministerial)	15	-	-	96
	Number of undergraduate faculties/departments	349	-	-	681
	Number of master's degree programs	107	269	308	548
	Number of doctorate degree programs	9	40	29	85
	Number of research projects (state level)	107	-	-	477
	Number of research projects (provincial/ministerial)	384	-	-	2,048
Shanxi	Number of key disciplines (state level)	5	34	11	7
	Number of key disciplines	35	84	89	103

	(provincial/ministerial)				
	Number of key laboratories (state level)	2	-	-	3
	Number of key laboratories (provincial/ministerial)	24	-	-	69
	Number of undergraduate faculties/departments	156	-	-	234
	Number of master's degree programs	195	339	342	414
	Number of doctorate degree programs	30	85	57	136
	Number of research projects (state level)	119	-	-	913
	Number of research projects (provincial/ministerial)	564	-	-	1,136

Sources: JICA appraisal documents, responses to the questionnaire from the executing agency
Note: An indicator for which the target value was not set at the time of appraisal is given a value of 0 (-). As the reference values at the time of appraisal were verified by the reference materials used at the time, they are included in this table.

3.3.2 Qualitative Effects

(1) Effects of the hard components

The principal effect of the hard component is "improvement of teaching and research conditions and the environment". There are many concrete cases where improvements have been achieved: ① new research and experiments have become possible by the latest equipment which were not available prior to the implementation of the Project (for example, cell level bio-chemical analysis), ② opportunities for practical training and research have significantly increased due to an increased number of equipment per student (For example, the Project contributed particularly to faculties/departments prioritized by the Project for the procurement of equipment, and testing and analysis centers with expensive equipment. The monetary value of the equipment procured under the Project exceeds 30-50% of the total monetary value of the equipment), ③ integral research has become possible through the combination of a variety of research equipment and ④ foundations for teaching and research have been consolidated as a result of the increased number of books and advancements in digitalization through the improvement of libraries and related systems.[15]

Next is "the contribution towards better assessments of universities by the Ministry of Education". Universities in China undergo periodic assessments by the Ministry of Education, and higher assessment scores lead to the admission of excellent human

[15] In those universities where libraries have been improved under the Project, the number of books in stock and the number of users both increased after improvement.

		Number of books	Number of users (per day)
Guangxi	Guangxi University of Chinese Medicine	580,000 → 870,000	17,977 → 21,455
	Guangxi Normal University	580,000 → 1,200,000	2,000 → 8,000
	Guilin Medical University	500,000 → 890,000	3,000 → 8,000
	Guangxi University of Science and Technology	1,590,000 → 1,790,000	18,089 → 20,277
Jiangxi	Shangrao Normal University	580,000 → 870,000	8,200 → 9,300

Source: Responses to the questionnaire from the executing agency

resources, an increase in financial support and the accelerated designation of key disciplines and laboratories. Therefore, these assessment results are highly significant for universities. In this university assessment by the Ministry of Education, the level of existing facilities and educational/research equipment serve as an important criterion. There are many cases where improvements in the hard component under the Project have contributed to universities passing or even obtaining high assessment marks from the Ministry of Education. The introduction of new educational and research equipment under the Project was delayed at many universities; yet, despite the lack of actual equipment delivery, the Project contributed to positive assessment scores because the eventual introduction of new equipment was ensured under the Project. However, there were also other cases where the Project did not contribute to high assessments by the Ministry of Education because the planned improvement of university equipment could not be achieved in time for the assessment. Cases of non-contribution are particularly evident in Jiangxi Province, where the construction of facilities with ODA loan was not planned (for example, Shangrao Normal University assessed in 2005, Nanchang University assessed in 2006 and East China Jiaotong University assessed in 2005).

(2) Effects of the soft components

The findings of the interview survey with senior staff members and those in charge of project implementation at the targeted universities and the beneficiaries survey with the training participants indicated that many of the participants, excluding some universities, found the training that was part of the soft component of the Project to be a useful opportunity to learn about the contents of advanced research and education, as it was rare to have the opportunity for long-term overseas training to obtain advanced specialist knowledge.[16] Many participants also mentioned that the training provided an opportunity to obtain proper knowledge of Japanese society.[17] As mentioned earlier, long-term training in specialist fields was not conducted as planned in some provinces, and the expected effects of the training were not likely to have been fully achieved. Nevertheless, there was a general tendency among universities to send trainees in prioritized departments or disciplines that were expected to contribute to their developments. As a result, there have been many cases where the training outcomes have been actively utilized. Concrete

[16] The beneficiaries survey with the training participants found that almost all of the participants positively valued their training (37% said that the training was very useful, 51% said it was useful and no respondents selected the answer of "it was not very useful" or "not useful at all". The remaining 12% did not reply to the question. When the scope of respondents was narrowed to those undergoing long-term training of one year or more in specialist fields, more than half (53%) said that the training was "very useful", indicating the higher level of appreciation of the training in this group.

[17] The same beneficiaries survey found that 44% of the respondents said that their understanding of Japan "had very much deepened" while 53% said that it "had deepened", indicating the contribution of the training to understanding of Japan on the part of the trainees. One noticeable feature is that there was little difference in the selected answers between long-term trainees and short-term trainees, suggesting that even short-term training can contribute to a deeper understanding of Japan among trainees.

examples of such use are listed below.

1) Fostering of key university persons

Many of the training participants are considered to be key persons at their own universities. Many of them were promoted on their return to China and currently hold important positions, such as professors responsible for key laboratories at a university or department. Most training participants have written academic papers since their return to China, utilizing the new knowledge obtained through their training.

2)Boosting of the research level and development of research in advanced or new fields previously unexplored

There are many cases where the research level has been enhanced (increase in the production of high-quality academic papers, among other aspects) and research in new fields, etc. has been initiated due to contact with the most advanced research fields and equipment in Japan. Some of these research initiatives have been authorized as national research projects. At some universities, a number of advanced equipment (such as those that the trainees used in Japan during their training) have been newly installed to boost their research level.

3)Improvements in the teaching method

Many of the training participants gained the impression that the relationship between professors and students is much closer in Japan than in China and that guidance is given by professors who fully understand the needs of individual students through efficient communication. Because of this, many became conscious of providing careful guidance to their students since their return to China. More precisely, there have been many cases where the Japanese teaching method of “regularly holding seminars and allowing students to present papers on set themes for discussion” has been adopted. Another improvement in the teaching method is encouraging undergraduates to participate in advanced research work much sooner than before.

4)Launching new courses and strengthening departments

There have been many cases where the training outcomes were fully utilized from the viewpoint of effectively promoting new initiatives such as the enhancement of many newly established departments and courses (for example, Japanese language course) as well as key disciplines (for example, environmental science). Many universities have combined the improvements in hard and soft components under the Project to ensure effective strengthening of their departments. In several universities, training participants whose English proficiency was significantly improved through the training now play a key role in the newly introduced English course for foreign students.

5)Improvements in university management

The short-term training course on university management was introduced in response to

the changes in the business environment for Chinese universities. These changes include the expansion of the scale and institutional reform. The interview survey with senior staff members and those in charge of project implementation at the targeted universities and with former trainees found that the course is in line with "the actual needs faced by universities for the promotion of modernization and improvement of the management level". While the actual achievements of this course vary greatly from one university to another, there are many cases where the positive outcomes of such course are utilized (see Box 2).

Box 2: Examples of improved university management utilizing the outcomes of university management training

- Promotion of cooperation with companies (Establishment of courses linked to companies: companies not only provide funding but also arrange study visits for students and the dispatch of lecturers to assist students) (Jiangxi Province)
- Improvement of the fund raising method (Establishment of "an education fund" to strengthen fundraising activities that target the alumni. A total of approximately 20 million yuan was collected to commemorate the anniversary of the foundation, contributing to better financial health of the university.) (Jiangxi Province)
- Utilization of IT for management work (Development of a management software to centralize student information, referring to examples of Japanese universities) (Jiangxi, Shanxi and Hubei Provinces)
- Improvement of the teaching method utilizing ICT (Reinforcing lecture contents by "chatting" with students during lectures to understand their questions and opinions to further identify the level of understanding of the lecture) (Jiangxi Province)
- Enhanced support for student life (Establishing a support center for sexual harassment, etc., providing support to find part-time employment, and daily life and mental health guidance) (Jiangxi and Guangxi Provinces)
- Improvement of new facilities (Introducing an exchange space for teachers and students, barrier-free floor plan and guiding signs for directions)
- Establishment of a system that enables teachers to become actively involved in university management (Jiangxi, Hubei and Shanxi Provinces)

3.4 Impact

3.4.1 Intended Impacts

(1) Enhancement of teaching and research results at the targeted universities

Table 14 outlines the performance of indicators that are believed to represent enhancement in teaching and research results (impact indicators) among the teaching and research-related indicators.

While every indicator showed improvements, the number of published research papers, number of awards and number of granted patents in 2014 were three times or more the corresponding numbers in the year of appraisal. In particular, the number of academic papers listed in the SCI (Social Science Citation Index), EI (Engineering Index) and ISTP (Index to Scientific and Technical Proceedings)[18] increased by 31 times, while the number

[18] As SSCI and SCI/EI/ISTP are international databases for the social science field and the science,

of patents granted increased by 30 times during this period. These massive improvements of indicators points to a substantial enhancement of the teaching and research levels and their outcomes at the targeted universities. The graduation rate exceeded 96% in each province in the year of appraisal. Although only Jiangxi Province achieved the target graduation rate in the original target year, all provinces maintained high graduation rates despite massive increases in the number of students. Meanwhile, both the graduate employment rate and the post-graduate enrollment rate increased in every province. The employment prospects for graduates in China are not necessarily favorable (see Table 15) but graduates of the targeted universities enjoy a relatively high employment rate. The increased post-graduate enrollment rate is likely attributable to ① the increasing demand for highly educated personnel in China and ② the expansion of post-graduate education at the targeted universities in addition to improved teaching and research outcomes.

Table 14: Trends in major teaching/research impact indicators (total of the targeted universities)

		Actual (Appraisal year)	Target (Project completion year)	Actual (Original target year)	Actual (2014)
Guangxi	Number of award-winning research (state level)	3	-	-	27
	Number of award-winning research (provincial/ministerial)	20	-	-	127
	Number of patented research outcomes	5	-	-	569
	Number of research papers (SSCI)	2	-	-	5
	Number of research papers (SCI・EI・ISTP)	108	-	-	918
	Graduation rate	96%	97%	95%	95%
	Graduate employment rate	89%	-	-	93%
	Post-graduate enrollment rate	2%	-	-	6%
Jiangxi	Number of award-winning research (state level)	0	-	-	2
	Number of award-winning research (provincial/ministerial)	26	-	-	163
	Number of patented research outcomes	18	-	-	604
	Number of research papers (SSCI)	0	-	-	25
	Number of research papers (SCI・EI・ISTP)	83	-	-	2,593
	Graduation rate	97%	98%	98%	99%
	Graduate employment rate	84%	-	-	87%
	Post-graduate enrollment	6%	-	-	10%

technology and engineering fields, respectively, they are used as indicators for the production of high-level academic papers.

	rate				
Hubei	Number of award-winning research (state level)	8	-	-	21
	Number of award-winning research (provincial/ministerial)	62	-	-	125
	Number of patented research outcomes	10	-	-	853
	Number of research papers (SSCI)	2	-	-	87
	Number of research papers (SCI・EI・ISTP)	162	-	-	3,429
	Graduation rate	97%	99%	98%	98%
	Graduate employment rate	89%	-	-	91%
	Post-graduate enrollment rate	15%	-	-	21%
Shanxi	Number of award-winning research (state level)	5	-	-	2
	Number of award-winning research (provincial/ministerial)	77	-	-	106
	Number of patented research outcomes	43	-	-	371
	Number of research papers (SSCI)	163			1,121
	Number of research papers (SCI・EI・ISTP)	293			13,482
	Graduation rate	99.6%	99.6%	96.8%	98.6%
	Graduate employment rate	83%			85%
	Post-graduate enrollment rate	10%			11%

Sources: JICA appraisal documents, responses to the questionnaire from the executing agency.
Note: An indicator for which the target value was not set at the time of appraisal is given a value of 0 (-). As the reference values at the time of appraisal were verified by the reference materials used at the time, they are included in this table.

(2)Enhancement of teaching and research at the provincial level

The performance of the higher education indicators in each province is shown in Table 15. Some indicators, noticeably the school building area per student, graduate employment rate and number of students per teacher, have failed to achieve the target values of 2014 in some provinces. However, most of the provincial-level quantitative indicators introduced at the time of appraisal have exceeded the target values of 2014. The targeted universities of the Project are highly ranked in terms of scale, etc. among provincial higher education institutions, and their improvement has played an important role in the improvement of the provincial-level higher education indicators.

Table 15: Higher education indicators of targeted provinces

		Actual (Appraisal year)	Target (Project completion year)	Actual (Original target year)	Actual (2014)
Guangxi	Number of regular HEIs	41	41	62	76
	Number of students enrolled in regular HEIs	288,355	555,000	400,738	727,801
	Enrollment rate in HEIs	8%	13%	15%	27%
	School building area per student (average of targeted universities) (m^2/person)	31.8 ㎡	36.0 ㎡	28.8 ㎡	27.1 ㎡
	Monetary value of education and research equipment per student	3,700yuan	5,200 yuan	6,198 yuan	8,902 yuan
	Number of students per teacher	22	18	17	18
	Graduation rate	95%	98%	96%	98%
	Graduate employment rate	86%	93%	87%	90%
	Post-graduate enrollment rate	3%	8%	9%	8%
Jiangxi	Number of regular HEIs	48	70	66	95
	Number of students enrolled in regular HEIs	266,300	600,000	795,374	944,075
	Enrollment rate in HEIs	27%	60%	35%	35%
	School building area per student (average of targeted universities) (m^2/person)	37 ㎡	40 ㎡	28 ㎡	32 ㎡
	Monetary value of education and research equipment per student	-.	-.	5,467 yuan	8,362 yuan
	Number of students per teacher	16	18	12	17
	Graduation rate	96%	98%	79%	79%
	Graduate employment rate	64%	80%	80%	86%
	Post-graduate enrollment rate	7%	7%	7%	9%
Hubei	Number of regular HEIs	75	85	86	123
	Number of students enrolled in regular HEIs	585,000	1,100,000	1,163,686	1,419,699
	Enrollment rate in HEIs	18%	25%	27%	47%
	School building area per student (average of targeted universities) (m^2/person)	11.6 ㎡	16.0 ㎡	11.8 ㎡	12.3 ㎡
	Monetary value of education and research equipment per student	6,226 yuan	-	7,890 yuan	11,734 yuan
	Number of students per teacher	15	14	15	16
	Graduation rate	99%	99%	Not available	Not available
	Graduate employment	80%	90%	Not	Not

	rate			available	available
	Post-graduate enrollment rate	11%	17%	Not available	Not available
Shanxi	Number of regular HEIs	39	41	59	71
	Number of students enrolled in regular HEIs	208,000	400,000	Not available	713,218
	Enrollment rate in HEIs	14%	20%	Not available	Not available
	School building area per student (average of targeted universities) (m^2/person)	7.0 ㎡	10.0 ㎡	30.9 ㎡	27.1 ㎡
	Monetary value of education and research equipment per student	4,498 yuan	-	6,189 yuan	8,558 yuan
	Number of students per teacher	18	22	15	18
	Graduation rate	97%	98%	99%	99%
	Graduate employment rate	80%	88%	83%	70%
	Post-graduate enrollment rate	1%	2%	12%	14%

Sources: JICA appraisal documents, responses to the questionnaire from the executing agency.

(3)Contribution to regional vitalization, strengthening of market economy reform, and environmental conservation

Regarding the three development issues expected to be addressed at appraisal, namely, (i) regional vitalization, (ii) strengthening of market economy reform and (iii) environmental conservation, sufficient quantitative data could not be obtained to show the overall trend for ex-post evaluation. Moreover, as large-scale universities tend to simultaneously implement a number of development projects, it made it difficult to discern the impact of the Project. Nonetheless, several cases of contribution have been identified, as described below.

1) Regional vitalization

In each province, leading universities that specialize in engineering, education, medical and social sciences were included in the targeted universities, and they have constantly produced graduates in these fields, which are essential for regional vitalization. The key industries in these provinces provide the main employment opportunities, and the number of graduates employed in these industries has been increasing, reflecting the increase in the number of graduates. The promotion of key industries and the vitalization of poor areas are leading policy issues of every provincial government. Each university is engaged in many projects commissioned by government organizations, notably provincial governments, contributing to regional vitalization. There are many cases where universities become involved in local development by cooperating with local companies and organizations. The equipment procured under the Project is actively used in many of these projects. The

expensive equipment procured under the Project is now registered under the public platform run by China's Ministry of Science and Technology and is often used by other universities, organizations and private companies.

Examples of projects for regional development commissioned to the targeted universities
- Training on farming techniques for farmers (project organized by a local government)
- "Development and practical use of teaching materials for English teachers in rural primary schools" and "training of young migrant workers from rural areas in cooperation with companies" using Internet education facilities
- Training of hospital personnel in rural areas
- Research on the treatment of local diseases
- General support for the promotion of local agriculture to become a sixth sector[19]
- Establishment of special classes for minority groups

Examples of cooperation between targeted universities and external organizations/companies
- Joint research or projects with external organizations and/or companies using research equipment owned by the university
- Technical support and technological development/research for agricultural/stock raising companies

2) Strengthening of market economy reform

In China, universities are moving to become comprehensive universities. As a result, the number of graduates from the targeted universities in fields relevant to the Project has shown an increasing trend. Specific examples of projects concerning the strengthening of market rules include (a) the training of managers of coal-producing companies (including financial training using equipment available at universities) and (b) promotion of the modernization of universities using the contents of the short-term manager training in Japan.

3) Environmental conservation

The environmental field has become a key discipline at many universities due to the increasing need in China, and conscious efforts have been made to bolster environment-related disciplines. There have been cases where new environmental courses and departments have been established, and environmental studies have been designated as a key discipline after the commencement of the Project. The number of graduates in the environmental field has also seen a rise. The environment has been one of the key fields for improvement of the educational and research equipment as well as training in Japan under the Project. There have been many cases of universities receiving grants for research projects or being commissioned to conduct studies (projects). In many cases, the equipment procured under the Project was actively utilized and/or former trainees were involved. Some specific examples include (a) research on environmental monitoring, analysis and

[19] The sixth sector points to the business expansion from agriculture (primary industry) to secondary (food processing) and tertiary (distribution and sales) industries.

treatment methods, (b) implementation of a JICA grassroots technical cooperation project in collaboration with the Saitama Prefectural Government (see Box 3) and (c) research on air pollutants (such as PM2.5).

Box 3: Development of international environmental research using exchange between local public bodies and JICA scheme (Shanxi Province)

Professor Xie Yinhe of the College of Resources and Environment, Shanxi Agricultural University had no personal experience of studying abroad prior to the Project. Yet, he underwent his first overseas training for six months at the Center for Environmental Science in Saitama (CESS) in Saitama Prefecture, which has a friendship exchange relationship with Shanxi Province, with the assistance of relevant organizations such as the Shanxi Provincial Foreign Affairs Section and his own university. This Center had previously accepted officials of the Shanxi Provincial Government, and the presence of a Chinese researcher at the time of the Project facilitated the acceptance of his training there. The Center has much experience accepting foreign trainees and offers accommodation for these trainees. As the proposed research theme (impact of heavy metals in the soil on the environment) suited the Center, Professor Xie was able to conduct productive research, which involved the daily checking of more than 100 samples.

Given the short training period, Professor Xie explored the possibility of research cooperation after his training with staff members of the Center during his stay. His enthusiasm and research ability were highly evaluated by the Japanese side, and a research cooperation agreement was signed in 2009 between the College of Resources and Environment, Shanxi Agricultural University and the CESS. Based on this agreement, a soil remediation project using plants, environmental studies, research exchanges and the dispatch of post-graduate students have been conducted, using the international exchange budget of the Saitama Prefectural Government. From 2011 to 2014, the Environmental Technology Support for Shanxi Province in China was implemented as a JICA grassroots technical cooperation project with the cooperation of these two organizations. For the implementation of these research cooperation projects, a number of equipment procured under the Project was actively used.

Professor Xie highly values the Project, saying that “my own experience of participating in an international research project under the Project has had positive impacts on both the university and myself in a number of aspects, including enhancement of the research level, widening of my own horizons as a researcher, development of new research and realization of domestic research projects”.

(4) Realization of a Virtuous Cycle, Including Recruitment of Excellent Human Resources through Improvement of the Environment and Conditions for Education and Research (Contribution of the Project)

The upgrading of facilities and equipment under the Project was conducted separately from the financial assistance of the government, and it was possible for the targeted universities to enjoy improvement (especially of the educational and research equipment) at a higher level than non-targeted universities. As a result, the environment and conditions for education and research improved to enable qualitative improvements in education and research and advanced research, which was not feasible in the past. What has been especially important from the viewpoint of improving education and research at the

targeted universities is the accelerated recruitment of excellent human resources. The targeted universities are now capable of providing favorable conditions such as “the installation of equipment for advanced research”, “designation of key disciplines and key laboratories”, “availability of doctorate courses” and “availability of research exchange facilities with leading universities overseas”. At one university, “the increase of the number of published academic papers is mainly attributed to newly recruited teachers”. As a result, the implementation of the Project has led to an efficient recruitment of enhanced human resources. In one university, it was found that the majority of the increase in published papers was attributable to the newly recruited professors. Through the implementation of the Project, the strengthening of human resources essential to conduct advanced education and research has been realized.

The quantitative and qualitative improvements in education at the targeted universities of the Project have resulted in concrete enhancements, such as increased number of research awards. Moreover, the actual performance in terms of human resources development for “regional vitalization”, “strengthening of market economy reform” and “environmental conservation” has improved, along with an increase in the number of contracted research and cooperative projects (income from contracted research). Consequently, university finance has been bolstered, resulting in further strengthening of the foundations for education and research, recruitment of excellent human resources and obtaining of commissioned work. It is, therefore, fair to say that the Project has enabled the smooth realization of a virtuous cycle through integrated assistance for both the hard and soft aspects, successfully fostering key universities in line with the policy objective of provincial education bureaus.

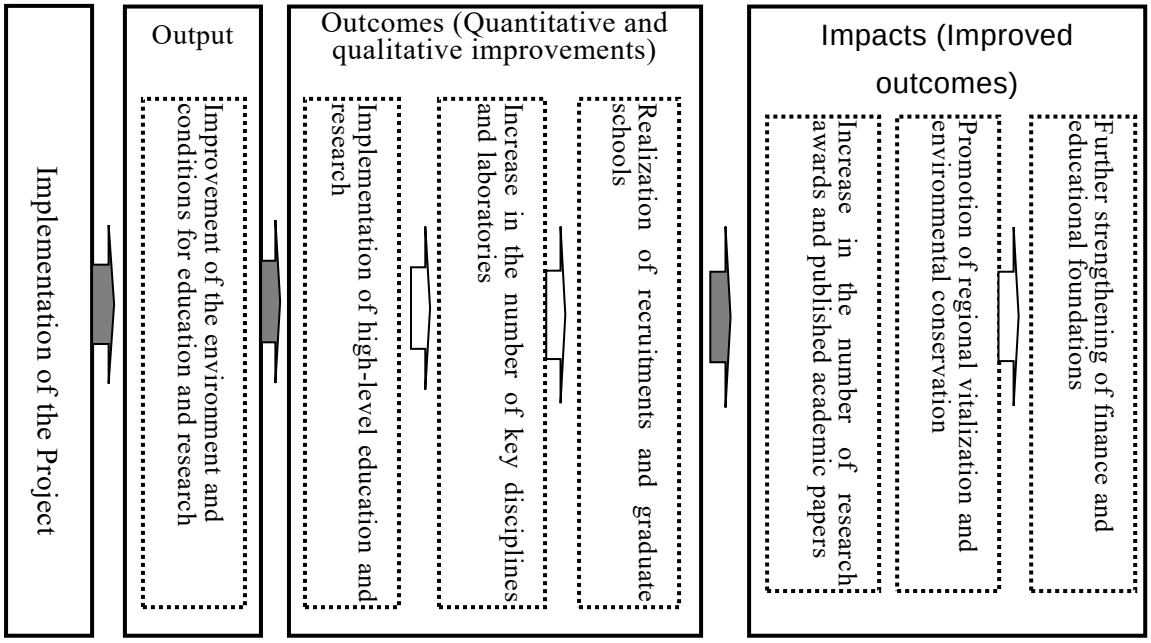


Figure 1: Contributions of the Project

Box 4: Impacts of the Project delay on the quantitative and qualitative improvement of education at the targeted universities

For the procurement of facilities and equipment under the Project, JICA provided constant assistance through collaboration with provincial education bureaus and the targeted universities. A series of procurement seminars were organized in collaboration with provincial education bureaus, based on the preconditions that ① procurement would be international procurement in line with the rules for procurement with Japan's ODA loan and ② domestic procurement would be encouraged in line with China's own procurement rules. Despite such assistance, delays occurred at the implementation stage. Initially, early realization at a higher level of the virtuous cycle shown in Fig. 1 was expected to take place at the targeted universities, where improvement of the facilities and equipment would be conducted prior to other universities. As a result of the delayed procurement, however, it cannot be denied that some of the expected positive results of the Project were curtailed.[20] For the introduction of educational and research equipment, more than 10 procurement packages were arranged for each province. When the length of time required for the signing of the contract and completion of delivery in each province is examined in terms of "the average length of time required to complete each package", the length of time required for the signing of the contract ranged from 45 months to 108 months and the length of time required for completion ranged from 68 months to 115 months (see Table 16). The length of time required to complete the delayed packages was much longer. Because of this, the actual performance in the original target year for completion was rather insufficient, as shown in Table 17. In particular, the shortage of the procured educational and research

[20] The fact that the actual performance of the long-term training in specialist disciplines was below the planned level suggests that the effect of the Project through the enhanced expertise of the teachers was adversely affected to some extent.

equipment was acute. As procurement or replacement by local funding would mean wasteful duplication, the scope of using local funds was limited. The impact of the delayed implementation of the Project was, therefore, very severe in terms of procurement. The Project was characterized by ① its implementation during the development stage of economy and universities, ② assistance for both the hard and soft aspects, especially assistance for the procurement of a large number of educational and research equipment, including advanced equipment, and ③ 10 or more independent universities as targets in each province. Effective implementation of the Project was particularly important to ensure excellent and enhanced outcomes. Because of the delay, however, the achievement of improved environment and conditions for education and research was delayed, somewhat hampering the virtuous cycle to achieve quantitative and qualitative improvement of education and research and to produce better outcomes of education and research.

Table 16: Average length of time to complete the Project after signing of the contract

(approximate number of months)

		Guangxi	Jiangxi	Hubei	Shanxi
Construction of buildings	Until the completion of construction work	70	10	35	70
Educational and research equipment	Until the signing of the contract	108	56	59 (Phase 1)	45
	Until the completion of delivery	115	68	96 (Phase 1)	95

Sources: JICA internal documents; responses to the questionnaire from the executing agency

Notes

1) The length of time for the construction work is the average of all universities. The length of time for the procurement of equipment is the average of individual packages.

2) In Hubei Province, procurement was conducted in two phases, as part of the ODA loan for the construction work was diverted to the procurement of equipment at the project implementation stage.

Table 17: Actual state of completion in the original target year for completion

	Guangxi	Jiangxi	Hubei	Shanxi
Construction of buildings (based on building area)	15%	100%	71%	0%
Procurement of equipment (based on monetary value)	0%	34%	0%	88%

Sources: JICA internal documents; responses to the questionnaire from the executing agency

Some examples of the impact of the delayed implementation of the Project are listed below. Without the delay, the intended development of the targeted universities would certainly have been achieved more effectively.

- The Project was not completed in time for assessment by the Ministry of Education.
- Some adverse impacts were observed in the approval of key disciplines, key laboratories and research projects, expansion of the master's degree and doctorate courses, and establishment of graduate schools.
- The continued shortage of educational and research equipment until their delivery made it unavoidable for many students to share limited equipment.
- The planned teaching and research sessions could not be conducted (some universities procured the minimum amount of the necessary equipment for their teaching using their own funds, while others endured prolonged lack of equipment due to their avoidance of duplicated procurement of the same equipment).
- Some universities procured the minimum amount of the necessary equipment with their own funds so that their newly constructed campuses will not remain idle because of the absence of equipment.
- Some universities introduced new disciplines and recruited new teachers based

on the expectation that the equipment will be delivered. Yet, they could not provide sufficient education because of the delayed equipment delivery (some of them dealt with the situation by procuring equipment with their own funds or conducting experiments, etc. at other universities).

- The strengthening of the practical capability for students to pass the enrollment examinations for graduate schools was not conducted as planned.

3.4.2 Other Impacts

(1)Impacts on the natural environment

No negative impacts were observed. The environmental impact assessment (EIA) for the Project was completed by the time of the appraisal and was approved by the Environmental Protection Bureau, and relevant procedures in China were all completed. Some noises, vibrations and dust from construction and sewage due to the use of the constructed facilities had been expected, but only on a small scale. Each university has been conducting necessary environmental monitoring during and after the Project, and no issues have been identified.

(2) Land acquisition and resettlement

Although issues such as land acquisition and resettlement of residents had arisen in universities where new campuses were constructed, compensation for resettled citizens was properly paid in accordance with relevant Chinese laws. According to the findings of the interview survey with senior staff members and those in charge of project implementation at the targeted universities, no problems in particular, including complaints by residents, have been reported.

(3)Strengthening of exchanges with universities in Japan

Many of the training participants have maintained contact with their Japanese tutors at a personal level. Although there were many cases where the participants visited their host universities for exchange purposes during subsequent visits to Japan or where the participants exchanged opinions and information on how to proceed with particular research and/or teaching via emails, there were also some cases where contact was lost due to the retirement of tutors. The ongoing exchanges have also not been restricted to the personal level but have also taken place at the university or department level. Table 18 summarizes the actual exchanges between the targeted universities and host universities in Japan (average number of exchanges per university). The types of exchange include short visits by teachers, dispatch of students, joint research and joint events.

Table 18: Exchanges with host universities in the post-training period
(Aggregate from the end of training to the present: average per university)

	Short visit to Japan (times)	Short visit to China (times)	Acceptance of foreign students (persons)	Dispatch of students to China (persons)	Joint research (projects)	Joint event (times)
Guangxi	6.5	14.9	5.7	7.5	3.7	1.0
Jiangxi	4.8	0.8	2.9	3.3	0.9	1.1
Hubei	6.5	2.8	3.3	3.8	0.6	1.5
Shanxi	10.0	1.4	6.9	7.1	3.7	9.1

Sources: Responses to the questionnaire from the executing agency.

By province, the number of exchange is high in Guangxi and Shanxi Provinces, where long-term training in specialist disciplines was more frequently conducted than in other provinces. In Shanxi Province, a project "to invite 100 people" was initiated in 2010 to encourage the recruitment of foreign personnel after the Lehman shock. Using this project and other schemes, Japanese professors from the host universities have been invited for short visits. This project and other schemes must have contributed to the high level of achievement of exchange.

One notable feature of the impact of exchanges with Japanese universities is that the level of impact greatly varies from one targeted university to another. Great outcomes have been achieved in universities that placed strategic importance on the Project as a means of internationalizing their universities and/or departments and strengthening exchanges with foreign universities (and strengthening the university as a result). Among these universities, there has been a successful case of a Chinese student studying in a doctorate course of a host university that was recruited to consolidate the staff strength and to enhance the foundations for exchange programs with Japanese universities. In contrast, the exchange level was often low at targeted universities that failed to implement systematic efforts during the post-project period.

Because the Project offered the first opportunity for overseas training and exchanges for many of the targeted universities and training participants, many senior staff members and those in charge of project implementation at the targeted universities pointed out in the interview that the Project provided an important opportunity for both universities and individual teachers to direct their attention overseas. There have been cases of the trainees interacting with students from other countries and even studying in other universities in Japan and abroad, using their own or university funds. In other cases, targeted universities have started overseas training of their teachers and other staff members.

The Project has largely achieved its objectives. Therefore, the effectiveness and impact of the Project are high.

Box 5: Improved research level and recruitment of excellent personnel through the expansion of international exchanges (Shanxi Province)

Taiyuan University of Engineering (TUE) is one of the leading engineering universities in China and has been designated as a key university under Project 211[21]. The TEU considered the training under the Project to be an important opportunity to expand its research exchanges with Japanese universities of high research levels and to develop capable human resources in a systematic manner and was actively involved in the Project. For example, its New Materials Research Center contacted the Institute for Material Research, Tohoku University regarding possible training based on past exchanges. It was agreed that the TUE would continually dispatch several young teachers for a period of one year each, developing a strong relationship at the organizational level instead of the personal level. The research exchanges between the two universities were continued in the post-project period. The fact that the TUE is a key university under Project 211 was a contributory factor to realize such exchanges. The use of advanced equipment not yet available in China has made it possible for TUE personnel to pursue high-level research, and the number of approved state level projects at the TUE has been increasing. One notable impact of the training at Japanese universities is "the strengthening of the teaching staff through the recruitment of Chinese doctorate students at host universities in Japan". While dispatching trainees to the Faculty of Engineering, Kyushu University, the TUE successfully recruited three Chinese doctorate students as professors, greatly contributing to the enhancement of the TUE's own staff level and the continuation and expansion of exchanges with Kyushu University. Recruitment following the training under the Project of Chinese post-graduate students studying at Japanese universities has not been limited to the TUE: similar situations have been confirmed for Guangxi Normal University and Hubei University of Technology. Those recruited as professors have been active as core teaching staff members at their universities. This is a positive impact that was not originally assumed for the Project.

3.5 Sustainability (Rating: ③)

3.5.1 Institutional Aspects of Operation and Maintenance

As planned during the appraisal, the facilities and equipment prepared under the Project are operated and maintained by each targeted university, and the Education Bureau of the subject provinces—the executing agency—oversee them. All targeted universities added the developed facilities and equipment to the universities' fixed assets and established the operation and maintenance system with clearly defined responsibilities and procedures by creating regulations such as the procedures for maintenance of large equipment and fund management, work regulations on experiment teaching, the procedures for fixed asset management, etc. In universities with a large number of important equipment, including those procured under the Project, are centrally managed by their own testing and analysis centers or similar facilities. The division of responsibilities among related organizations is clear, and no issues have been identified with respect to the number of staff in charge of

[21] Project 211 is a state project in China aimed at creating some 100 key universities in the 21st century (its implementation was decided in 1993 with the Ministry of Education acting as the responsible ministry).

operation and maintenance.

3.5.2 Technical Aspects of Operation and Maintenance

No issues were observed in the technical aspects, since all targeted universities regularly carried out maintenance and inspection of the facilities and equipment and outsourced repair works to contractors, such as suppliers, when necessary. To secure the skills necessary to operate and maintain large or sensitive laboratory equipment, the universities appoint full-time technical staff for each instrument or laboratory to manage the equipment in an integrated manner. At all targeted universities, the manuals and precautions are posted near individual instruments for easy reference. Moreover, professors in charge of sensitive equipment receive regular technical training from the manufacturers.

The utilization rate of the newly procured equipment has been high, and active research and educational activities using these equipment suggest that there are no issues regarding the technical capability of using the equipment.

3.5.3 Financial Aspects of Operation and Maintenance

The targeted universities are all affiliated with the provincial government. Their budgets consist of subsidies from the state or province and own income such as tuitions and fees. The interview survey with universities found that the financial support for universities by the government gradually increased under the 11th Five Year Plan (2006 – 2010), and this support was further consolidated under the 12th Five Year Plan (2011 – 2015). Although the actual figure varies from one university to another, each university receives a minimum of several million yuan a year. In the case of large universities, the financial support amounts to 20 – 30 million yuan, including those by the provincial government, to maintain and improve the facilities. According to available financial data, it can be said that the necessary budget for operation and maintenance is ensured in the university budget. None of the main facilities and equipment installed under the Project were found to be unused due to the lack of budget for operations and repairs.

Table 19: Financial expenditure of the subject provinces (2014)

	Guangxi	Jiangxi	Hubei	Shanxi
Total expenditure (million yuan)	347,979	388,270	493,415	308,528
Expenditure for education (million yuan)	66,053	71,172	98,745	50,728
Higher education budget (million yuan)	8,330	10,440	23,157	6,450
Education expenditure index (2006=100)	412	628	679	420

Sources: Each province statistics book and responses to the questionnaire from the executing agency.

3.5.4 Current Status of Operation and Maintenance

In all targeted universities, the equipment developed by this project are registered in the maintenance and management database. All expensive equipment are also registered and controlled by the public platform run by the provincial science and technology agency. Based on the observation and review of usage or inspection records, it was confirmed that the equipment were mostly in good condition. Some equipment, such as PCs, have short service lifespans. While the deterioration of such equipment is now causing some problems, it is still continuously used. In the case of important equipment, there is a system for users to record the equipment conditions and to note every time the equipment is used. All universities maintained that there is no problem in the purchase and stock of spare parts that are produced.

No major problems have been observed in the institutional, technical and financial aspects of the operation and maintenance system. Therefore, sustainability of the Project effects is high.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

The Project was implemented for the purpose of improving education and research at a total of 38 universities in Guangxi, Jiangxi, Hubei and Shanxi Provinces in China through the improvement of relevant facilities and equipment and the training of teachers. Relevance of the Project was evaluated to be high, as it was consistent with (i) the higher education policies of China and the subject provinces, (ii) the development needs for quantitative and qualitative enhancement of the universities, and (iii) Japan's assistance policies. While the actual effects of the Project were somewhat hampered by the delayed installment of some educational and research equipment, the tangible (hard component) and intangible (soft component) needs were met. Quantitative and qualitative improvements of the higher education at the targeted universities were achieved, as evidenced by the significant increases in the various indicators for education. The high level of effectiveness and the impacts of the Project were also substantiated by the improved outcomes of educational and research activities, making the best use of the advanced equipment and training; and the advancements in the various initiatives designed to achieve regional vitalization, environmental conservation, etc. Efficiency of the Project was evaluated to be fair on the whole: although the Project cost was within the plan, the Project period exceeded the planned period due to delays in procurement. Sustainability was evaluated to be high, with no issues observed in institutional, technical and financial aspects, and the operation and maintenance of the facilities and equipment developed by

the Project were in good status.

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

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

None

4.2.2 Recommendations to JICA

As a result of the implementation of the Project, a good relationship has been established between JICA/Japanese universities and leading universities in various parts of China. Academics with long-term or medium-term training experience in Japan are now teaching at these universities. The universities targeted by the Project are leading universities in the subject provinces/areas of the Project, and the former trainees demonstrate a high level of capability in their respective disciplines. Many of them show positive attitudes towards Japan because of their experience of living in Japan for some time. The number of former trainees is believed to exceed 4,000 for the Inland Higher Education Project as a whole. Although the effective utilization of these human resources is highly anticipated, the extent of their utilization has so far been insufficient.

It is imperative, not only for Japan's ODA, but for broader cooperation with China in the future to be implemented in a much more strategic and efficient manner, and this cooperation has reached a stage where new approaches are being sought, including a shift away from the public sector to the private sector. In the efforts to develop a new relationship of cooperation with China, the utilization of the "stock" nurtured by the Project—namely, the targeted universities and former trainee teachers—could prove to be an effective approach. For example, it would be highly significant to discuss and promote the inheritance of the Project run by other organizations such as the Japanese embassy in China, Ministry of Education, Culture, Sports, Science and Technology of Japan, Japan Foundation to maintain and further develop the relationship between Japanese and Chinese universities that was established under the Project. Needless to say, more detailed examination and analysis are essential for the full utilization of the "stock" developed by the Project. As the Inland Higher Education Project—the umbrella project for the project evaluated here—comes to an end, reassessment of the "stock" (human resources, good relationship between Japan and China, etc.) fostered by the Project[22] becomes essential, in addition to the planning and formulation of a viable strategy to effectively utilize this "stock" to advance Japan's cooperation for China.

[22] Reassessment of the "stock" is also believed to be essential from the viewpoint of disseminating the important outcomes of the Project.

4.3 Lessons Learned

(1) Appropriate selection of targets and methods to assist with the matching of universities, etc. in Japan as hosts for long-term training

There were cases in the Project of incomplete matching where some teachers could not receive any training because of their failure to find suitable hosts. In many targeted universities, the search for a host was left to individual applicants, and it was not easy for them to find hosts that met their training expectations. While the information provided by JICA was certainly useful, there was no official support at the individual level.

Considering the large number of trainees involved in the Project and the environment surrounding the Project at the time of project implementation, providing support at the individual level was not a realistic option. However, it is essential to recognize "the importance of support for individual hopefuls for training to ensure smooth and proper matching" in similar projects where training in Japan is provided on a smaller scale or where target universities have little experience with exchange with foreign universities. For these projects, it is essential to fully examine "whether the scope of assistance should remain at the university level or should extend to the individual level" while carefully considering the necessary costs of such extension. In recent years, it has become the standard practice in developing countries for former trainees and prospective trainees to form groups through SNS, etc. to exchange information and experiences, etc. Information and the experiences of former trainees and other training hopefuls are useful in the search for suitable hosts. The effective use of these tools should realize both efficient support for individuals and cost reduction.

(2) Implementation of appropriate procurement with full consideration of the balance between the actual procurement cost and work load required for adjustment, procurement contents and capacity of the executing agency

Much of the educational and research equipment procured under the Project was under a type of contract where each type of equipment was procured in bulk for distribution to multiple universities, and any change in the quantity or specifications affected the entire procurement schedule for the equipment in question. Because of this and other factors, the overall delivery of the equipment was considerably delayed from the planned delivery time. Under these circumstances, some provinces adopted flexible responses, including university-specific package instead of equipment-specific package. However, it took more than seven years from the commencement of the Project to fully change the original packages. In the end, the volume of work that was necessary to adjust the procurement of equipment to match the reality was much more than originally assumed: there were a large

number of targeted universities, and each university faced different circumstances. When an ODA loan project involving various bodies and equipment, especially precision equipment of which the specifications are frequently upgraded, is implemented, the procurement cost, including time and efforts, for smoothly procuring equipment without delay is likely to be extremely high. Necessary measures should be taken based on the recognition of this high cost. At the time of appraisal, it is essential to select an appropriate procurement method while considering the balance between the actual procurement cost and work load required for adjustment, and the procurement contents and capacity of the executing agency, in line with the basic principles put forth by the procurement guidelines. Examples of the necessary measures are listed below.

- For projects where adjustments between diverse bodies are necessary, the possibilities of product-based packages should be considered and fully analyzed. The relative advantages and disadvantages of product-based packages and individual entity-based packages must be analyzed at the implementation stage.
- It is expected that cases requiring major changes of the planned procurement contents and method may emerge at the implementation stage. Apart from a flexible response to such changes from the viewpoint of ensuring the realization of planned project effects, a proper understanding and consent to actively implement the necessary changes should be obtained in advance from the project executing agency and other stakeholder organizations in the recipient country through proper communication.

JICA's active engagement in gathering detailed information on the progress of procurement and strengthening of the monitoring between stakeholders, are especially necessary when (i) the executing agency is unfamiliar with international procurement, (ii) the executing authority has limited authority and insufficient capacity to make necessary adjustments with stakeholders, and/or (iii) the procurement procedure is likely to take a long time because of the relevant system, etc. of the recipient country.

(3) Sufficient preparation and arrangement to expand exchanges between host universities in Japan and the targeted universities (organizations)

The level of exchange with Japanese universities in the post-training period varies greatly from one targeted university to another, as well as from one former trainee to another. All cases of vigorous international exchanges can be attributed to the proactivity of a Chinese university or person, indicating a strong tendency of such exchanges to rely on the actions of individual universities or persons. The interview survey with the training participants found a strong desire for the expansion of exchange programs with Japanese universities and researchers at the time of this ex-post evaluation. There were cases where no preparations or arrangements to expand these exchange programs in the post-training period were made during the project implementation period. There have also been many

cases of individual persons experiencing the limits of expansion because of the lack of support by their own universities and other organizations.

From the viewpoint of facilitating the expansion of exchanges at many universities in the post-training period, it is important for JICA to raise awareness among the senior staff members and those in charge of project implementation at the targeted universities. To raise awareness, it is also essential for JICA to encourage universities at the project planning and implementation stages to systematically expand the scope of exchanges. Careful handling of the issue is required, especially in the case of universities and organizations with little experience of international exchange. Some examples of the careful handling required by JICA are outlined below.

- "① Capacity development" and "② expansion of inter-university exchanges" should be clearly set as the objectives of training at Japanese universities. A proper understanding of these two objectives on the part of the targeted universities is essential.
- The advantages of the expansion of inter-university exchanges should be actively publicized to the personnel of participating universities by introducing the outcomes of the Project and other similar cases.
- It is highly desirable to encourage the targeted universities (at the university level) to properly examine in advance the needs for the expansion of inter-university exchanges, as well as structuring the implementation system and securing budget. This should be followed by the formulation of an action plan (featuring the examination of reports submitted by former trainees on the exchange potential for the university, visits by senior staff members of the targeted universities to host universities with high exchange value at the training implementation stage and with a view to arranging post-training exchanges and other measures).
- It is essential to fully gather information from the project implementation stage on the state of implementation of exchanges and to implement coordination work so that JICA can conduct follow-up activities at an early stage of implementation and so that the cooperation of appropriate organizations other than JICA after the completion of the Project can be secured (consultations with the targeted universities (and host universities) on the implementation of concrete activities in cases where the targeted universities have not initiated any moves to expand their foreign exchanges).

Comparison of the Original and Actual Scope of the Project

Item	Original	Actual
① Project Outputs	Target： (Guangxi) 10universities (Jiangxi) 9 universities (Hubei)12 universities (Shanxi)7 universities	Target： same as planned
(a)Hard i) Building construction	(Guangxi) buildings such as libraries for 10 universities; total floor area of 146,0005㎡ (Jiangxi) buildings such as teaching buildings for 9 universities; total floor area of 152,800 ㎡ (Hubei) buildings such as experiment buildings for 10 universities; total floor area of 169,000 ㎡ (Shanxi) buildings such as experiment buildings for 5 universities; total floor area of 130,000 ㎡	(Guangxi) buildings such as libraries for 10 universities; total floor area of 183,335㎡ (Jiangxi) buildings such as teaching buildings for 9 universities; total floor area of 168,208 ㎡ (Hubei) buildings such as experiment buildings for 7 universities; total floor area of 129,313 ㎡ (Shanxi)buildings such as experiment buildings for 5 universities; total floor area of 97,718 ㎡
ii) Procurement of educational equipment	(Guangxi) 7,642 pieces, (Jiangxi) 14,223pieces, (Hubei) 5,843pieces, (Shanxi) 8,345pieces	(Guangxi) 7,160 pieces, (Jiangxi) 11,514pieces, (Hubei) 8,328pieces, (Shanxi) 7,882pieces
(b)Soft Teachers' training in Japan or acceptance of experts from Japan	(Guangxi) 149persons, (Jiangxi) 150persons, (Hubei) 158persons, (Shanxi) 216persons	(Guangxi) 195persons, (Jiangxi) 349persons, (Hubei) 162persons, (Shanxi) 345persons
② Project Period	(Guangxi) January 2003 - March 2006 (39months) (Jiangxi) May 2002 - March 2009 (83months) (Hubei) April 2004 - March 2009 (61months) (Shanxi) April 2004 - March 2009 (61months)	(Guangxi) April 2003 - June 2013 (123months) (Jiangxi) May 2002 - November 2014 (151months) (Hubei) April 2004 - December 2015 (141months) (Shanxi) April 2004 - August 2013 (113months)
③ Project Cost Amount Paid in Foreign Currency	(Guangxi) 4,606million yen (Jiangxi) 4,872 million yen (Hubei) 5,097 million yen (Shanxi) 5,093 million yen	(Guangxi) 4,093 million yen (Jiangxi) 4,517 million yen (Hubei) 4,017 million yen (Shanxi) 5,000 million yen
Amount Paid in Local Currency	(Guangxi)1,419 million yen（95 million yuan） (Jiangxi)3,604 million yen（252 million yuan） (Hubei)3,566 million yen（249million yuan） (Shanxi)3,057 million yen（214 million yuan）	(Guangxi)1,314 million yen（95 million yuan） (Jiangxi)3,290 million yen（230 million yuan） (Hubei) 4,826 million yen（324 million yuan） (Shanxi)2,617 million yen（186 million yuan）
Total	(Guangxi) 6,025 millon yen	(Guangxi) 5,407 millon yen

Item	Original	Actual
Japanese ODA Loan Portion	(Jiangxi) 8,476 millon yen (Hubei) 8,663 millon yen (Shanxi) 8,151 millon yen Same as foreign currency	(Jiangxi) 7,807 millon yen (Hubei)8,843 millon yen (Shanxi) 7,617 millon yen Same as foreign currency
Exchange Rate	(Guangxi)1yuan =15 yen (As of September 2002) (Jiangxi)1 yuan =14.3 yen (As of August 2003) (Hubei)(Shanxi)1 yuan =14.3 yen (As of July 2003)	（Guangxi） 1 yuan =13.9yen （Jiangxi） 1 yuan =14.3 yen （Hubei） 1 yuan =14.9 yen （Shanxi） 1 yuan =14.1 yen (Average of Project period)

People's Republic of China

FY2015 Ex-Post Evaluation of Japanese ODA Loan Project
"Inner Mongolia Afforestation and Vegetation Cover Project"

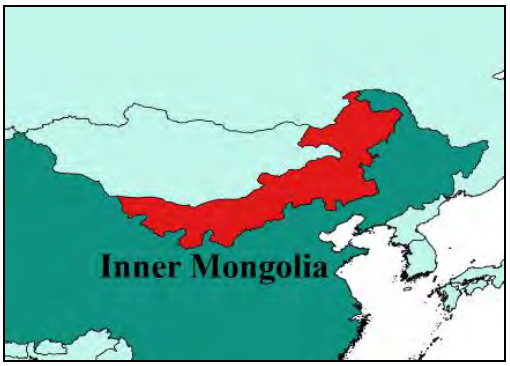
External Evaluator: Kenji Momota, IC Net Limited

0. Summary

This project carried out afforestation and planted vegetation cover in the Yellow River Basin of the southern part of Inner Mongolia Autonomous Region (hereafter "Inner Mongolia") located in northern China. Through this, it aimed to improve the living environment by improving the rate of forest cover and vegetation cover in the region, as well as preventing desertification in the region and the surrounding areas, thereby contributing to social and economic stability in the region. This project has remained relevant to the development plan and needs in China at the national and provincial levels from the time of the appraisal to the present, and it is therefore highly relevant. Both the forest land and production sites that were established through this project are showing favorable growth, and progress was made in establishing forest land. Because of the afforestation and vegetation cover initiatives including this project, the forested area in the autonomous region increased to nearly twice what it was before the implementation of the project, while there was a fall in the share of degraded land,[1] which is a contributor to desertification. As a result, the damage from yellow sand and other problems has been mitigated and this has led to improvements in the living environment for the local residents. Thus, the effectiveness and impact of the project are high. While the project cost fitted within the planned amount, the project period was longer than the planned period. Therefore, efficiency of the project is fair. Inner Mongolia has many years' experience with implementing afforestation projects using aid and funding from within the region and without, and so no major problems were observed with its institutional and technical aspects of operation. In terms of the project's financial aspect, the Inner Mongolia government continues to regard the afforestation projects to be important, so the expectation is that stable operations can be maintained for the time being. Thus, there are no major problems with the project's sustainability.

Given the above, this project can be evaluated to be highly satisfactory.

1. Project Description



Project Locations


Photo 1: A shelterbelt planted in order to anchor desert land in place (Horinger County)

[1] Land degradation refers to arid, semi-arid, and dry sub-humid zones in which the land has deteriorated as a result of climate change or human activity.

1.1 Background

Desertification continues to advance in China, with roughly 30% of its national territory categorized as either desert, land undergoing desertification, or land that is at risk of desertification. This has been caused by the exploitative abuse of natural resources following the rapid economic development in China that has come about through the country's reforms and liberalization, including excessive logging of forests, excessive land reclamation, and overgrazing. As a result, the rate at which its desert area has been expanding was about 1,500 km^2/year in the 1960s–1970s, but has averaged 2,460 km^2/year since the 1980s, reaching an average of 3,436 km^2/year in the latter half of the 1990s (1994–1999) (for reference, the geographical area of Tokyo is 2,102 km^2). The damage from violent sandstorms that arise from such land has been increasing year by year, and has recently begun to affect other East Asian countries such as Japan.

Given such conditions, the Chinese government enacted and promulgated the "National Ecological Environmental Construction Program" in 1999. Through this, it set in place a national framework pertaining to ecological and environmental conservation spanning 50 years in the four areas of forestry, irrigation, agriculture, and environmental protection. It established four priority areas, including Inner Mongolia, as well as priority issues that include planting shelterbelt and preventing desertification, through which it planned large-scale afforestation projects.

In Inner Mongolia, 63% of the autonomous region's total area[2] is desert or land undergoing desertification,[3] with 20% of the total amount of degraded land in China as a whole found within Inner Mongolia. Afforestation and planting vegetation cover have long been regarded as priority issues in Inner Mongolia, and from 1979 to 1998, a sum total of 7.75 million ha of land was afforested or covered in vegetation. Yet as of 1999 the rate of forest cover was only 14.8%. Inner Mongolia's "10th Five-year Plan for Forestry Development" (2001–2005), which is a medium-term plan for the forestry sector in Inner Mongolia, continues to regard afforestation and vegetation cover as priority issues. It set a goal of planting 6.67 million ha of land over a five-year period to raise the rate of forest cover up to 17%. The Yellow River Basin in the southwestern part of Inner Mongolia is one region with particularly low rainfall throughout the whole of China. The encroachment of desert upon farmland and human habitations poses a threat to daily life, and so preventing desertification by improving forests has come to pose a pressing issue.

1.2 Project Outline

The objective of this project is to improve the living environment by improving the rate of forest cover and vegetation cover in the region, as well as preventing desertification in the region and the surrounding areas by carrying out afforestation and planted vegetation cover in the Yellow River Basin of the southern part of Inner Mongolia, thereby contributing to social and economic stability in the region.

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[2] The area of the autonomous region comes to 118.3 million ha. It is an arid zone that primarily consists of desert land and degraded land, and is a central region for outbreaks of yellow sand. This project targeted five counties (banners) in Inner Mongolia, where it carried out afforestation or planted vegetation cover over a total of 181,973 ha. This area is of a scale that is roughly equivalent to the area of Kagawa Prefecture (186,200 ha).

[3] Desertification refers to arid zones where the earth's surface becomes entirely covered in sand, and where there is little rainfall and vegetation is scarce. It is incorporated in with the general notion of land degradation.

Loan Approved Amount/Disbursed Amount	15,000 million yen / 14,999 million yen
Exchange of Notes Date/Loan Agreement Signing Date	March, 2003 / March, 2003
Terms and Conditions	Interest rate: 0.75% Repayment Period: 40 years (Grace Period: 10 years) Conditions for Procurement: General untied
Borrower/Executing Agency	Government of the People's Republic of China/ Inner Mongolia Autonomous Regional People's Government (Finance Bureau)
Final Disbursement Date	October, 2013
Main Contractor	None
Main Consultant	None
Related Studies (Feasibility Studies: F/S), etc.	F/S (Inner Mongolia Forestry Investigation and Design Institute, July 2002) Environmental Impact Assessment Report (Inner Mongolia Environmental Sciences Academy, October 2002)
Related Projects	[Technical cooperation projects] Forest Protection Research Project in Ningxia (1994–2001) Watershed Management Training Project on the Loess Plateau Aftercare in the People's Republic of China (1990–1995) Project on Forestry Human Resource Development in Western Region of China (2003–2014) Dissemination of New Forestation Technology in Loess Plateau (yen-loaned-collateralized project) (2010–2015) Project on Forest Restoration after the Earthquake in Sichuan Province (2010–2015) [ODA Loan projects] Shaanxi Loess Plateau Afforestation Project (March, 2001) Shanxi Loess Plateau Afforestation Project (March, 2001) Inner-Mongolia Loess Plateau Afforestation Project (March, 2001) Gansu Water-Saving Irrigation Project (March, 2001) Xinjiang Water-Saving Irrigation Project (March, 2001) Ningxia Afforestation and Vegetation Cover Project (March, 2002) [Grant aid projects] Project for Improvement of Forestation Equipment for Conservation of Water and Soil in the Upper Stream of Hanjiang River (1998) Project for Afforestation for Conservation of Middle Stream of Huang He (2001–2002) [Projects by other international organizations, aid organizations, etc.] Loess Plateau Afforestation Project I-IIV (1990–2009, World Bank) Yangtze River Resource Protection Project (1995–2001, World Bank) Sustainable Forest Development Project (2002–2009,Global Environment Facility / World Bank) Regional Monitoring and Early Warning Network for Dust and Sandstorms (2003–2005, ADB) Children's Forest Program (1991, OISCA International)

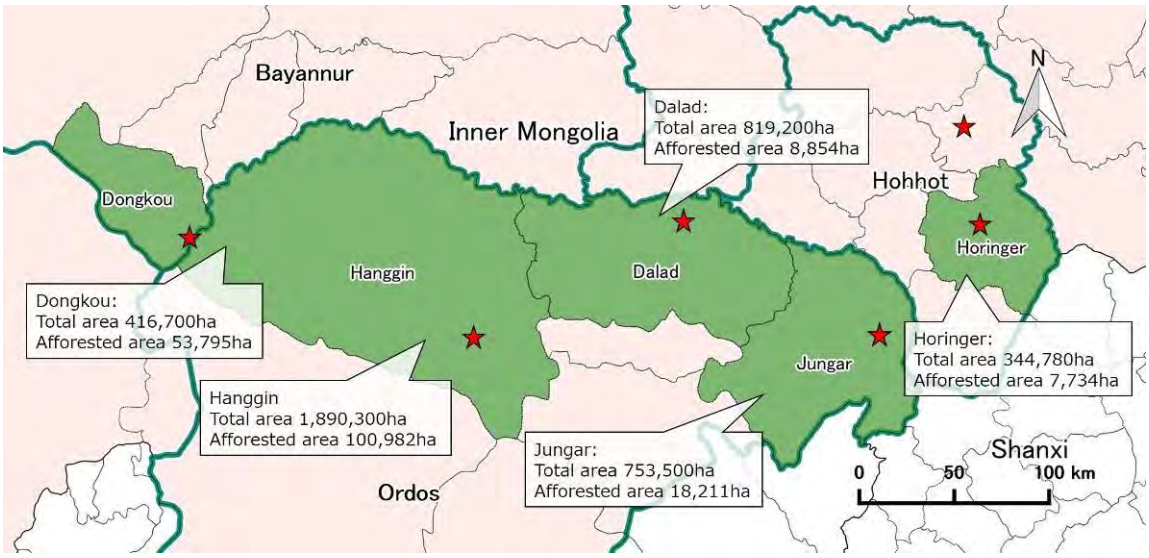
This project was implemented with a focus on five counties (banners)[4] located in southwestern Inner Mongolia. Overviews of the five counties (banners) targeted are listed below.

[4] Administrative divisions in China are categorized into four levels: provinces, cities, counties, and townships. In Inner Mongolia, some of the counties where the population consists primarily of nomadic peoples are called banners, and similarly some of the townships are called towns.

Table 1: Overviews of the Five Counties (Banners) Targeted

County (banner) name	Overview
Horinger County	Horinger County is located in the center of Hohhot City, Inner Mongolia. It has an area of 341,000 ha and a population of about 200,000 people. Its main industry is dairy farming (dairy industry). Of the county's total area, 50% is hills, 30% is mountains, and 20% is flat terrain. Its hills and mountains in particular are experiencing severe water and soil runoff, and so degraded land is expanding. According to statistics from 2014, it has 153,333 ha of forest land, 106,666 ha of forests, and a forest coverage rate of 31%. Its annual rainfall in 2014 fell below 400 mm to come in at 393.4 mm, and it is in a transition period from a steppe climate to a desert climate.
Jungar Banner	Jungar Banner is located in the Yellow River Basin in the northern part of Ordos City, which is an economically important city in Inner Mongolia. It has an area of 753,500 ha, and as of 2010 its population was approximately 360,000 people. Its main industry is mining, but aside from mining districts that produce petroleum and coal it also has stretches of agricultural villages and regions. Desert regions from the Mu Us Desert (28.78%) and the Kubuchi Desert (19.17%) account for roughly half of the total terrain in Ordos City, with the other half comprised of undulating plateaus (28.81%), hills and mountains (18.91%), and prairie land (4.33%). It suffers from severe desertification and water and soil runoff. The annual rainfall in Jungar Banner in 2003 and 2014 was 397.2 mm and 402.2 mm, respectively. Thus, it receives an extremely small amount of rainfall.
Dalad Banner	Dalad Banner is located in the Yellow River Basin in the northern part of Ordos City. It has an area of 819,200 ha and a population of roughly 320,000 people. Its main industries include mining and agriculture, and it has numerous coalfields that produce coal as well as a thriving agriculture industry due to its proximity to the Yellow River. Desert regions from the Mu Us Desert (28.78%) and the Kubuchi Desert (19.17%) account for roughly half of the total terrain in Ordos City, with the other half comprised of undulating plateaus (28.81%), hills and mountains (18.91%), and prairie land (4.33%). It suffers from severe desertification and water and soil runoff. The annual rainfall in Dalad Banner in 2003 and 2014 came to 335.6 mm and 400.5 mm, respectively. Accordingly, it receives an extremely small amount of rainfall.
Hanggin Banner	Hanggin Banner is located in the Yellow River Basin in the northern part of Ordos City. It has an area of 1,890,300 ha and a population of roughly 140,000 people as of 2010. Approximately 70% of Hanggin Banner is desert with a low population density, and it suffers from severe desertification and water and soil runoff. Its main industry is agriculture, and it has reserves of underground resources like natural gas. Its annual rainfall in 2014 was below 400 mm, coming in at 278.0 mm. Therefore, it receives an extremely small amount of rainfall.
Dongkou County	Dongkou County is located in the southwestern part of Bayannur City in the southeastern part of the Ulan Buh Desert. It has an area of 416,700 ha and a population of roughly 120,000 people. Its main industry is agriculture, and it produces tomatoes and sunflower oil. Desert accounts for 70% of the county's total area, with mountains at 20% and prairies at 10%. It has a great deal of degraded land, and on the whole it features severe inclines. Of the land area for the county as a whole, 10,467 ha is forest land, 36,933 ha is unfinished forest land, 69,913 ha is shrub land, and 83,483 ha is land that can be afforested. Its annual rainfall in 2014 was extremely low at 125.5 mm. Dongkou County has a temperate continental monsoon climate, where the summers are hot and the sunshine is intense.

Source: Prepared by the external evaluator based on data provided by the Forestry Bureaus of each county / banner



* The pink areas represent Inner Mongolia, while the green areas show the project sites. The red stars indicate the locations of the county (banner) capitals.

Figure 1: Locations and overviews of the counties (banners) targeted by the project

2. Outline of the Evaluation Study

2.1 External Evaluator

Kenji Momota (IC Net Limited)

2.2 Duration of Evaluation Study

This study was carried out as described below for this ex-post evaluation.

Duration of the Study: August, 2015 – January 2017

Duration of the Field Study: November 22–December 17, 2015 and April 10–23, 2016

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

3.1 Relevance (Rating: (3)[6])

3.1.1 Relevance to the Development Plan of China

Immediately following the heavy flooding of 1998, the Chinese government enacted and promulgated the National Ecological Environmental Construction Program (1999–2050) to serve as a national framework covering the four areas of forestry, irrigation, agriculture, and environmental conservation. It established short-term, medium-term, and long-term numerical targets pertaining to improving the environment, as well as four priority areas and priority issues to be addressed by 2010. Inner Mongolia was included in one of the four priority areas of "region undergoing desertification", and it aimed to accomplish the targets of preventing desertification on 9 million ha and planting 1.6 million ha of shelterbelt by 2010. This program is still regarded as the priority national plan regarding improving the environment by the Chinese government, which has continued since the time of the appraisal. Thus, as of the time of the ex-post evaluation, its importance remained unchanged.

The Chinese government has been carrying out the Six Key Forestry Programs (2001) in the form of as national forestry projects. As part of one of these programs called the Key Shelterbelt Development Programs in the Three-North Regions and the Middle and Lower Reaches of the Yangtze

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

[6] (3): High, (2): Fair, (1): Low

River, progress has been made with installing shelterbelt in regions that included Inner Mongolia. The Natural Forest Protection Program designated certain regions, including Inner Mongolia, as priority regions for natural forest conservation. At the time of the ex-post evaluation, these programs were still ongoing, and so this project is consistent with China's national policies for promoting forestry development in Inner Mongolia.

The 12th Five-year Plan for Forestry Development (2011–2015), which is China's medium-term plan for its forestry sector, set the goal of performing afforestation over 30 million ha during the plan period, as well as raising the rate of forest cover for China as a whole to 21.7% by 2015. The Inner Mongolia 12th Five-year Plan for Forestry Development (2011–2015) is the aforementioned plan's region-specific plan. It promotes tree planting and afforestation in Inner Mongolia with the goals of performing afforestation over approximately 4 million ha by 2015 and achieving a 21.5% rate of forest cover in the autonomous region.

This project was carried out in order to perform afforestation and plant vegetation cover, improve the rate of forest cover and vegetation cover in Inner Mongolia, mitigate the damage of desertification, and improve the ecological environment in the target region as part of these development plans and policies. Therefore, its relevance to development plan is high.

3.1.2 Relevance to the Development Needs of China

At the time of the appraisal, roughly 20% of the land that had undergone land degradation throughout China as a whole was found in Inner Mongolia, and 63% of the area in Inner Mongolia was either desert or land undergoing desertification. Afforestation and vegetation cover projects have been carried out in Inner Mongolia since before, through which a sum total of 7.75 million ha was afforested between 1979 and 1998, thus achieving a 14.8% rate of forest cover by the year 1999. However, this remains at a low level when compared against the national average. Thus, further afforestation and vegetation cover is needed.

At the time of the ex-post evaluation, the rate of forest cover in Inner Mongolia had improved significantly, reaching 24.879 million ha of forested area and a rate of forest cover of 21.03% in 2014. However, the target under the Inner Mongolia 12th Five-year Plan for Forestry Development (2011–2015) called for achieving a rate of forest cover of 21.5% by 2015, and so the attainment of this goal remained just slightly out of reach. Moreover, the area undergoing desertification was 42 million ha at the time of the appraisal and 41.47 million ha at the time of the ex-post evaluation, remaining largely unchanged. Airborne yellow sand storms and water and soil runoff in deserts continue to occur. Since preventing desertification and improving the living environment through afforestation and planting vegetation cover continue to pose challenges in Inner Mongolia, the need for afforestation will be high into the future.

3.1.3 Relevance to Japan's ODA Policy

Under Japan's ODA policy, cooperation projects that emphasized conservation of the natural environment were formulated to serve as its cooperation policy for the forestry sector at time of the appraisal. Through this, such policies have provided support for initiatives like afforestation, combatting desertification, reforming forest rights, and the conservation of biodiversity. Preventing desertification and improving the living environment through afforestation and planting vegetation cover were listed as this project's goals, and so this project is highly relevant to Japan's cooperation policy for the forestry sector at the time of the appraisal.

Therefore, implementing this project is highly relevant to China's development plan and

development needs, as well as Japan's ODA policy. Therefore, its relevance is high.

3.2 Efficiency (Rating: (2))

3.2.1 Project Outputs

At the time of the appraisal, the project's outputs were envisioned to be the construction of shelterbelt, forest and grassland enclosures, and production sites for medicinal plants and grass, as well as installing related facilities like those for supplying electricity and water, training for the farmers taking part in the afforestation, and more. The outputs are listed below.

Table 2: List of Outputs

Items	Planned results (2000)	Actual results (2015)	% versus plan
(1) Afforestation and vegetation cover (Unit: ha)			
1) Forest and grassland enclosures	106,175	112,718	106.2%
Of which, supplementary planting area	n.a.	4,167	n.a.
2) Shelterbelt	64,281	68,821	107.1%
Supplementary planting area	n.a.	30,404	n.a.
3) Grass	1,533	1,533	100.0%
4) Shrub seed production sites	2,247	1,200	53.4%
5) Medicinal plant cultivation sites	1,000	1,000	100.0%
6) Seed/seedling production sites	6,737	4,303	63.9%
(2) Related facilities / equipment			
1) Irrigation facilities (km)	79.8	79.8	100.0%
2) Water pumping facilities (locations)	1	1	100.0%
3) On-farm irrigation facilities (sets)	2,974	2,189	73.6%
4) Wells dug (locations)	2,974	1,605	54.0%
5) Power supply facilities (locations)	320	224	70.0%
6) Installation of forest roads (km)	466.4	469.2	100.6%
(3) Training (people)	4,124	7,469	181.1%

The major changes with the outputs are listed below.

1) Under afforestation and vegetation cover, the enclosure forests and shelterbelt both increased from what was planned. Conversely, some of the shrub seed and seed/seedling production sites were set up through budgetary outlays from the Chinese side via a separate project by the Chinese government that preceded this project, and therefore the target number from this project decreased.[7] In addition, because of the prior installation of facilities in this manner, there was also a decline in the on-farm irrigation facilities, wells dug, and power supply facilities incidental to these.

2) The surplus funds from the decline in some of the outputs mentioned above were allocated to the afforestation of additional forest and grassland enclosures and shelterbelt. In addition, supplementary planting[8] was carried out for approximately 35,000 ha of forest land where the

[7] The shrub seedling production site in Dalad Banner was completely cancelled, while those in Horinger County and Jungar Banner were installed according to plan. As for the seed/seedling production sites, roughly 70% of the area for the one in Hanggin Banner was cancelled, while the ones in Horinger County, Jungar Banner, and Dongkou County were installed according to plan.

[8] When the project was planned, it was decided that supplementary planting would be carried out if the survival rates failed to meet a certain standard value at the acceptance inspections performed on the afforestation and vegetation cover after one year and after three years. The budget for the supplementary planting was allocated within the project cost at the time of the

survival rate is low.

3) The number of people who participated in the afforestation and vegetation cover training aimed at eligible farmers increased significantly over what had been planned. This was because the project scope was altered and the afforested area increased. Those eligible for the training included representatives from large-scale farm operators and farmer's organizations that had concluded agreements directly with the Forestry Bureau. The plan was to disseminate management techniques for forest land via a secondary training program in which the farmers that had undergone training would then train the other farmers taking part in the project. At present, a total of 105,139 farmers have received training through this secondary training.

The seed and seed/seedling production sites were installed by a concurrent project, and so the majority of the investments from this project were diverted to installing forest and grassland enclosures and shelterbelt instead. The outputs that had been initially planned were separated but installed, and this can be evaluated as an alteration made according to the needs.

Photo 2: Afforestation of desert land (Jungar Banner)

Photo 3: The seedling nursery in Horinger County

3.2.2 Project Inputs

3.2.2.1 Project Cost

The actual project cost came to 19,930 million yen (of which 1,099 million yen came from foreign currency and 18,831 million yen came from domestic currency) versus the planned project cost of 20,080 million yen (of which 612 million yen was to come from foreign currency and 19,468 million yen was to come from domestic currency). Thus, the project stayed within the planned costs (99% versus the plan). There were changes to the outputs, such as a decrease in the number of shrub seed and seed/seedling production sites, and the addition of more afforestation area developed by reallocating the surplus funds. The project cost for the additional outputs were largely spent according to the reallocated budget plan that was redesigned when the additions were made. Therefore, the final project cost largely stayed within the amount that had been planned initially. The project cost from domestic currency increased marginally because of the increase in the afforestation area. However, because of the Japanese Yen tended to be strong throughout the implementation period, there were no significant changes with the total Japanese Yen-based project cost.

As items were changed from what was initially planned, it would be difficult to perform a simple comparison of the plan versus the actual results. However, after the changes, the plan was carried out mostly as planned, and the project cost was lower than planned. Therefore, the project cost can be

appraisal. The standard for the survival rate was established in accordance with China's Forest Law.

evaluated as having been spent effectively on the whole.

3.2.2.2 Project Period

The actual project period had run from March 2003 to December 2013 (130 months / 158% versus the plan), versus the planned project period from March 2003 to December 2009 (82 months). Therefore, the project period was significantly longer than planned. The implementation periods for each project process are listed below.

Table 3: Comparison between the Planned and Actual Project Periods

County (banner) name	Project implementation period (planned)	Project implementation period (actual)	Versus plan (%)
Agreement - project completion	Mar. 2003 – Dec. 2009 (82 months)	Mar. 2003 – Dec. 2013 (130 months)	158.5%
Design	June 2003 – May 2007 (48 months)	Mar. 2005 – May 2009 (51 months)	106.3%
Training	June 2003 – May 2007 (48 months)	Mar. 2005 – Dec. 2009 (58 months)	120.8%
Afforestation/vegetation cover	June 2003 – Dec. 2009 (79 months)	Mar. 2005 – Dec. 2013 (106 months)	134.2%
Construction of seed/seedling sites	June 2003 – Dec. 2006 (43 months)	Mar. 2005 – Dec. 2009 (58 months)	134.9%
Construction of incidental facilities, etc.	June 2003 – Dec. 2006 (43 months)	Mar. 2005 – Dec. 2009 (58 months)	134.9%

The main reasons behind the substantial delays in the project period are described below.

1) Delay in starting the project

The domestic procedures were delayed following the Loan Agreement, and the completion of the procedures to arrange sub-loans within China and procurement of domestic currency funds, agreement procedures, and so on were all pushed to the end of 2004. Because of this, the actual start of the project was delayed by two years over what was planned, being delayed to March 2005.

2) Extension of the construction period

In the regions targeted by the project, there were some areas where the survival rates did not meet the standard values at the time of the acceptance inspections due to the damage from drought and yellow sand. Therefore, supplementary planting was carried out, which extended the project period. As a result, the implementation period for the afforestation and planting of vegetation cover was extended from 78 months from the time of the planning to 106 months.

3.2.3 Results of Calculations of Internal Rates of Return (Reference only)

This project was an afforestation project with the primary objective of preventing desertification. As no financial return was envisioned with the project, and because preconditions such as the economic benefits are uncertain, the internal rate of return was not calculated at the time of the appraisal or the ex-post evaluation.

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

3.3 Effectiveness[9] (Rating: (3))

The objective of this project was to improve the rate of forest cover and prevent desertification by carrying out afforestation. Based on this, the effectiveness will be evaluated by analyzing the growth status with the afforestation to date and the change in the rate of forest cover serving as the primary

[9] The rating is performed by factoring the impact into the decision on effectiveness.

indicators.

3.3.1 Quantitative Effects (Operation and Effect Indicators)

(1) Operating Status for the Forest Land and Production Sites (Operation Indicators)

1) Growth Status for the Afforestation and Vegetation Cover (Survival Rates)

As indicted in "3.2.1. Project Outputs," approximately 190,000 ha of forest land was developed through this project. The survival rates and growth statuses as of one year and three years after the afforestation of this forest land are shown below.

Table 4: Survival Rates and Growth Statuses for Forest Land by County

County (banner) and its afforestation area		Standard values	Enclosures	Shelterbelt	Medicinal plants
Horinger Planned: 7,734 ha Actual: 7,734ha	One year after afforestation	Enclosed: 60% Protected: 70% Medicinal plants: 20 trees/m^2	76%	83%	Not implemented
	Three years after afforestation	Enclosed: 60% Protected: 60% Medicinal plants: 20 trees/m^2	75%	83%	Not implemented
Jungar Planned: 18,034 ha Actual: 18,211 ha	One year after afforestation	Same as above	Not implemented	65%	25 trees/m^2
	Three years after afforestation	Same as above	Not implemented	71%	20 trees/m^2
Dalad Planned: 8,580 ha Actual: 8,854 ha	One year after afforestation	Same as above	Not implemented	73%	22 trees/m^2
	Three years after afforestation	Same as above	Not implemented	70%	22 trees/m^2
Hanggin Planned: 93,830 ha Actual: 100,982 ha	One year after afforestation	Same as above	36%	Standing trees: 73% Shrubs: 71%	Not implemented
	Three years after afforestation	Same as above	55%	Standing trees: 76% Shrubs: 73%	Not implemented
Dongkou Planned: 53,795 ha Actual: 53,795 ha	One year after afforestation	Same as above	56%	Standing trees: 93% Shrubs: 75%	Not implemented
	Three years after afforestation	Same as above	53%	Standing trees: 93% Shrubs: 75%	Not implemented

Source: Responses to questions

*The standard values were established at the time of the appraisal based on the previously established values in China's Forest Law

The standard values for survival rates for the shelterbelt and medicinal plant cultivation sites were largely attained in each region. Conversely, for the forest and grassland enclosures the survival rates fell somewhat below the standard values in Hanggin and Dongkou, which account for 80% of the afforested area. On a whole, the survival rates can be evaluated as having achieved the planned levels, though it could be mentioned that the primary factor accounting for this is because water retention and desiccation countermeasures were taken. Water retention and desiccation countermeasures are

particularly important when it comes to getting afforestation to take root in Inner Mongolia where there is a great deal of degraded land.[10] The autonomous region has made progress in amassing countermeasures based on its experiences with afforestation projects thus far. To improve the survival rate for the sapling trees, countermeasures were instituted from three primary perspectives: 1. Selection of tree species, 2. Innovative afforestation techniques, and 3. Supplementary planting and reforestation.

1. Selection of tree species

The tree species that were selected were primarily species native to Inner Mongolia that can grow even in arid land and which require almost no watering or other maintenance work. For the shelterbelt in particular, the focus was mainly placed on tree species that do not require watering after they have taken root, with virtually no damage from diseases and insect damage seen. In an effort to find the "the right place and right technique," the appropriate tree species were selected to suit the topography and conditions of the forest land. Examples of this include planting coniferous trees in locations with excellent topsoil and site conditions, mixed forests with both coniferous and broadleaf trees in other locations, and shrubs in infertile land.

2. Innovative afforestation techniques

A number of innovative techniques were incorporated in practice. These include: leveling the ground prior to performing afforestation; planting trees during the rainy season; using potted saplings; using refrigerated seedlings; immersing the saplings in water for ten days prior to planting them to induce water retention; adopting water-retaining materials; adopting medicines that ensure the growth of the sapling trees' roots; planting them while the soil was still frozen; installing irrigation facilities; setting up grass grids (underground fences designed to prevent sand from being moved by the wind), and more. Other innovations were devised to maintain an appropriate planting density given the tree species and soil, ensuring the density necessary to fix soil in place in the desert, particularly with the shelterbelt, as well as to ensure that excessive moisture is not absorbed underground because of overcrowded afforestation. These measures were adopted in the Inner-Mongolia Loess Plateau Afforestation Project (March 2001), a ODA Loan project that was implemented before this project, as well as the afforestation and vegetation cover projects in Inner Mongolia that were implemented by the Chinese government and other donors. These were adopted starting with those that proved effective, with efforts made to improve the implementation methods during this project, which boosted their effectiveness even further. System for handing down and improving technical skills were established within the organizations, including those for amassing this experience within organizations, applying successful technique of a certain project site at another project site, and utilizing it for the next time that similar projects are carried out.

3. Supplementary planting and reforestation

Conversely, the survival rates for the forest and grassland enclosures fell somewhat below the standard values in Hanggin Banner and Dongkou County. Factors on both the technical side and the geographical side are thought to be the primary reasons behind this. According to the executing agency, seeds were sown by airplane over the forest and grassland enclosures, which have an enormous surface area. As a result, it is estimated that the survival rate from this was lower relative to afforestation done by hand. In addition, damage from drought and yellow sand is also believed to have

[10] The annual rainfall in the target regions falls below 400 mm, which is the criteria for arid land, and there are frequent droughts given its desert climate.

had an impact on the tree saplings taking root. In regions where the survival rate fell below the standard value, supplementary planting was performed after stratified soil preparation and further water retention and desiccation countermeasures were carried out over the course of the project. After this, the standards were met with regard to the growth status.

Photo 4: Growth status of a Scots pine (six-years old)

Photo 5: Afforestation of desert land using grass grids

2) Growth Status of Forest Land (Quality of the Tree Species)

The quality of forest land is generally measured by means of forest density, but no statistical data could be collected on the tree crown ratios and crown densities in the project's target regions. Therefore, the growth status of typical tree species was used as an alternative indicator, with experts on afforestation in arid land participating in the field study and performing sample studies on this. The results of the sample studies concerning the growth status in forest land that were carried out during the visit to each county are shown below.

Table 5: Reference: Sample Study on the Growth Statuses of Forest Land

County (banner)	Site species	Tree species	Height	Diameter
Horinger	Seed/seedling production sites	Scots pine	3 m	23 cm (chest height)
Horinger	Shelterbelt	Scots pine	4 m Annual growth: 0.36 m	23 cm (chest height) Annual growth: 0.62 m
Jungar	Shelterbelt	Desert willow	2.5 m	12 cm (base)
Dalad	Grass production sites	Alfalfa	60 cm	Not measured because it was after being felled
Hanggin	Seed/seedling production sites	Desert poplar	4 m	44 cm (chest height)
Dongkou	Shelterbelt	Zag	2 m	80 cm (base)

Source: Estimated results during the field study

According to the opinions of the executing agencies and experts on afforestation of arid land, the growth status mentioned above meet the standard levels for growth in the autonomous region. Thus, they were of the opinion that the conditions are generally favorable. The executing agencies of each county (banner) have been carrying out proper maintenance following the completion of the afforestation and planting of vegetation cover, and the shelterbelt of poplars and other trees have grown to the requisite height and are performing their protection functions. Based on these and other factors, the growth status to date has been favorable. The survival rates meet the standard values and the growth status of the planted trees has been proceeding favorably. Therefore, afforestation from this

project can be evaluated as manifesting the desired results with regard to the forests' qualitative aspects as well.

3) Operating Status of Related Production Sites

At the seed/seedling production sites set up in each county (banner) by this project, the afforestation and harvesting of sapling trees were carried out for commercial purposes. Accurate statistical data on the number of saplings produced are not recorded. However, the Scots pine nursery center set up in Horinger Country produces saplings for shelterbelt and for greening urban areas, where it is able to stably produce and ship 500,000 - 1 million trees for tree afforestation every year, combined with sales of about 600,000 trees each year. In addition, it retains up to 4 million trees. All of the production sites maintain nurseries that are consistent with the production scale and need for seeds and seedlings initially estimated. Therefore, they can be evaluated as fulfilling their envisioned functions.

Photo 6: Growth status of sapling trees (Scots pine)

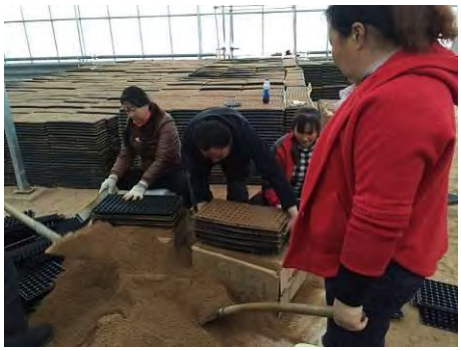


Photo 7: Readying sapling pots

(2) Improving the Rate of Forest Cover (Operation and Effect Indicators)

Afforestation projects, including this project, have been carried out in Inner Mongolia on an ongoing basis, and have resulted in steady improvements in the rate of forest cover within Inner Mongolia and the targeted regions. The trends in the forested area and rate of forest cover ever since this project have been compiled below.

Table 6: Afforestation and Vegetation Cover in the Project Regions
(Target Local Governments in Five Counties)[11]

(Unit: ha)

	Standard values (2002-3)	Target values*1 (2009)	Actual values*2 (2015)	Versus time of appraisal	Versus target
Total area (project target region)	2,140,282	-	2,952,897*4	+812,615	-
Total forested area	524,913	710,887	1,149,667	219.0% (+624,754)	161.7% (+438,780)
Of which, the increase from this project	-	+171,989	+181,539	-	105.6% (+9,550)
Rate of forest cover*3	24.53%	33.21%	38.93%	158.7% (+14.4%)	117.2% (+5.7%)
Vegetation cover rate in enclosed land	30.00%	70.00%	n.a.	n.a.	n.a.

Source: Materials at the time of the appraisal and provided by the executing agencies

*1. Target values for the project's planned completion year (2009) set at the time of the appraisal (three years after the completion of the tree planting)

*2. Actual values at the time of the evaluation (2015) (afforestation was considered complete once the standard values for the survival rates had been achieved three years after the completion of afforestation in each project site; since the completion year varies by project site, here the actual value at the time of the evaluation (2015) is used as the standard)

*3. Rate of forest cover: Total area that passed the acceptance inspection for forest land/Area of the administrative districts at the project sites

*4. The increase in the total area was due to the consolidation of administrative divisions in Hanggin County.

This project produced effects in the following ways when it came to improving the rate of forest cover in Inner Mongolia.

1) The total forested area in the target region is approximately 1.15 million ha, which represents a more than two-fold increase since the time of the appraisal, including the efforts of this project. Approximately 180,000 ha of this represents the increase from this project accounting for approximately 15.8% of the total forested area, thus the project contributed to an increase of 6.1% in the rate of forest cover in the project region.

2) The rate of forest cover in this project's target regions rose to 38.93%, thus achieving the target value of 33.21% set at the time of the appraisal. The fact that the administrative divisions were altered from the time of the plan makes it difficult to perform a simple comparison. However, the increase in the rate of forest cover significantly exceeded the rate of increase for the total area after the changes in the administration divisions. Thus, effects were realized owing to the initiatives from the afforestation project on the whole.

3) Instances where this project served to incite further increases in the afforestation area were seen locally.[12] Examples of this include large-scale afforestation projects that are being carried out through the support of domestic, private companies based on the effects of this ODA Loan project and

[11] Plans for items like forested area were set on a county basis at the time of the appraisal. However, since the start of the project implementation, the county divisions were altered from those at the time of the plan as a result of municipal mergers in the target regions. For the current forest land, monitoring is not performed for the counties as a whole, but in accordance with the municipal divisions targeted by the project. Therefore, this table affirms the envisioned target area and actual results (townships and towns targeted by the project) from the time of the plan based on the divisions confirmed at the time of the ex-post evaluation, and compares the planned/actual results based on this.

[12] An erosion control station in Hanggin Banner that carried out afforestation and planted vegetation cover through this project used to be a desert and degraded land prior to the implementation of this project. However, as a result of performing afforestation and planting vegetation cover the soil has improved and now afforestation can be carried out on the land. Following this, a major company within China was able to attract projects successfully for greening the desert to serve as social contribution projects, and as such further afforestation and vegetation cover projects are being carried out.

others. Likewise, in consultations with people who are involved on the local side, opinions praising the project for its contribution to comprehensive countermeasures were heard, such as affirmation of the effects in preventing desertification from the ODA Loan project has prompted injections of private capital.


Photo 8: Afforestation of desert land
(Dalad Banner)


Photo 9: Image of a shelterbelt
(Dongkou Banner)

3.3.2 Qualitative Effects (Other Effects)

The project's qualitative effects include improving the environment because of performing afforestation and the like. However, these effects frequently overlap with the entries listed in "3.4. Impacts," and so this will be summarized and analyzed in the section "3.4. Impacts".

3.4 Impacts

3.4.1 Intended Impacts

This project's impact is to contribute to improving the living and economic environments by preventing desertification and improving the rate of forest cover, thereby by mitigating the damage from yellow sand as a result. These changes in the natural, living, and economic environments and the contributions of the project will each be summarized below.

(1) Improvements to the natural environment in the project region (contributions to mitigating desertification)

Classifications of the area of desert land and the like which were referenced at the time of the appraisal were not used in Inner Mongolia. Thus, land was defined in written texts in such ways as "desert land area," "degraded land area," and "potential degraded land area." Data based on these definitions are shown below.

Table 7: Desertification Improvement Status (Unit: km^2)

	At the time of the appraisal (2003)	At the time of the ex-post evaluation (2014) (One year after the completion of the project)	Difference from 2003	Versus 2003 (%)
Total area of the autonomous region	1,183,000	1,183,000		
Of which, forested area	206,600	248,790	42,190	120.42%
Of which, potential degraded land area	180,300	174,000	-6,300	96.51%
Of which, degraded land area*	622,400	609,200	-13,200	97.88%
Of which, desert land area	**415,900**	**407,900**	**-8,000**	**98.74%**

Source: Provided by the Inner Mongolia Forestry Bureau
*Degraded land area indicates land area that is at risk of undergoing desertification.

Desert land area, degraded land area, and potential degraded land area all decreased slightly, and gradual improvements in desertification were observed. According to personnel in charge at one of the executing agencies, the project selected afforestation and vegetation cover target regions starting with degraded land that could be afforested. The personnel expressed the opinion that this project contributed directly to the decline in degraded land area and potential degraded land area in particular. What is more, responses were received from the executing agencies stating that the number of outbreaks of violent sandstorms occurring each year fell from seven per year at the time of the appraisal to one in 2014.

Because of the expansion of afforestation and vegetation cover projects, including this project, progress has been made with blocking the wind and fixing soil in place (soil fixation) in desert land, and with mitigating the damage from yellow sand. Those involved have expressed the opinion that improvements have been noted from this in not only the number of violent sandstorms, which has been defined statistically, but also in improvements in the damage from yellow sand on a day-to-day basis. Through actual interviews with the farmers who took part in the project during the field study, the following responses were affirmed a multiple of times.

1) The damage from yellow sand was severe in the years around the start of the project. Damage was observed in that yellow sand would bury tree saplings that grow agricultural produce and prevent them from sprouting, and from yellow sand blowing about so much that they could no longer see ahead of them while doing their farm work.
2) At present, the number of days on which yellow sand is blown about has decreased, and they feel that the damage from yellow sand has been mitigated.

As indicated above, it is conjectured that this project has had an effect to a certain degree in decreasing both degraded land area and potential degraded land area. More than 90% of the local farmers who responded to the beneficiary survey[13] carried out through this project acknowledged that the area of land damaged by drought was reduced roughly by half, which mitigated the damage from yellow sand as well. It was also directly affirmed at the time of the field study that carrying out afforestation on degraded land had brought about clear and lasting effects with respect to fixing soil in

[13] The beneficiary survey was performed on a total of 200 people, including 40 people from each of five counties (banners) targeted by the project. Eligible participants were selected based on a list of farmers participating in the project in each county (banner) provided by the Forestry Bureau. In each county (banner), 20 farmers participating in the project who concluded agreements directly with the Forestry Bureau or other agency, and 20 farmers participating in the project taking part indirectly through farmers' organizations or cooperatives, were selected. The study was carried out in the form of a questionnaire survey, which inquired the changes in the natural, economic, and living environment following the implementation of the project, as well as maintenance under the project.

place. Images of forest land growing in a stable manner on degraded land are corroborated by such pieces of evidence as data on the increase in the afforestation area and the stable survival rates. As a result, it can be conjectured that the spread of desertification has been curbed.

Photo 10: Degraded land prior to the start of the project (Hanggin Banner)

Photo 11: Image of the same site after afforestation was carried out

(2) Contributions to Economic Stability

Since the project began, a total of 100,000 farmers have taken part in it. In addition, farmers who had been hired by large-scale farm operators have also been counted as contributed through the project. The table below shows a comparison of the incomes of the farmers who took part in the project since the start of the project.

Table 8: Trends in and Comparison of Farmers' Average Annual Income since Participating in the Project

	At the time of appraisal (2002)	Target values (2009)*1	Actual values (2013)	Versus 2002
Average annual income of participating farmers	2,096 yuan	2,647 yuan	**11,000 yuan**	**524.8%**
Average annual income in the project implementation region	2,136 yuan	2,996 yuan	n.a.	n.a.
Average annual income in farm regions nationwide*2	2,476 yuan		9,892 yuan	399.5%

Sources: Materials at the time of the appraisal, project completion report, China Statistical Yearbook, etc.

*1. Three years after afforestation was completed

*2. "Average annual income in the project implementation region" was recorded in the materials at the time of the appraisal, but the standard was redefined in the project completion report, so this was changed to "Average annual income in farm regions nationwide."

The average annual income of the participating farmers rose substantially compared with their income at the time of the appraisal, with a 10% or higher rate relative to the average annual incomes in farm regions nationwide. This was backed by the increase in prices and rising labor costs caused by socioeconomic development. However, in addition to this, the results from the direct rise in income sources and boost to agricultural productivity from this project are also believed to have contributed to the increased income to some extent. The effects of the aforementioned beneficiary survey also showed that household annual income from the year the project began (2003) and recently (2015) came to 5,287 Chinese Yuan on average and 19,880 Chinese Yuan on average respectively, marking a substantial increase. Ninety-three (93) % of the respondents have affirmed that their income sources and income increased since the project began, which backs up the trends indicated above.

Examples of the economic effects brought about by this project in the region that were learned through the field study have been compiled below.

Reference: Examples of boosting income and productivity through participation in afforestation projects

1) Increase in income sources

Through their participation in this project, the participating farmers have gained access to three types of income: (1) Income from leasing land, (2) Income from providing labor for afforestation / planting vegetation cover and maintenance,[14] and (3) Income from sales of wood and vegetation with economic value. With regard to (2), for the implementation of this project, an operating structure was adopted in which large-scale farm operators and private companies hire local farmers and pay their wages. Farmers took part in the project in the form of regular employment in which they were engaged in the afforestation and planting of vegetation cover along with maintenance in an ongoing manner, as well as short-term employment in which they were engaged on a temporary basis during the project's busy period.

2) Examples of boosting agricultural productivity

As part of the afforestation and planting of vegetation cover carried out in Dongkou County, in one region a shelterbelt was established so that it enclosed a state-run farm. These farms cultivate corn and alfalfa. At the time of the planning, the seedlings would be buried by yellow sand, which caused damage in terms of poor germination. Because of this, a shelterbelt of poplars was established surrounding the farm. As a result, the damage was alleviated because winds carrying the yellow sand would strike the shelterbelt, and this was effective at protecting the agricultural crops. In Dongkou County, where there is a thriving dairy farming industry, the harvested crops are used to feed the cows at a nearby ranch. Establishing the shelterbelt has contributed to the stimulation of local economy by means of protecting agricultural crops and allowing them to be supplied within the region.

3.4.2 Other Positive and Negative Impacts

(1) Impact on the Natural Environment

As a project designed to ensure vegetation cover for degraded land, one of the project's goals was to improve the environment by enriching forest resources and biodiversity. Thus, no major negative impacts on the natural environment were envisioned from the project.[15] The project was carried out with especial consideration on the following points when the project was planned and implemented.

1) For the creation of forests, consideration is to be given to biodiversity through measures such as planting multiple tree species according to the vegetation without felling the existing forests in principle.

2) The impact on the existing ecosystem is to be kept to an absolute minimum by primarily using species native to the local region when planting trees.

3) To avoid having salt accumulation in semi-arid land, sandy soils and other locations that are resistant to salt accumulation are to be essentially selected for the forest land.

The field study at the time of the ex-post evaluation with the relevant executing agencies checked how the responses mentioned above were carried out. The following answers were received.

1) The regions targeted for afforestation and the planting of vegetation cover were almost

[14] Shelterbelt that consists of tall trees like poplars makes it possible to cultivate vegetables and grass in between the trees after afforestation has been carried out. Therefore, it was confirmed that this has the effect of diversifying income sources through the use of forest land management.

[15] The Environmental Impact Assessment Study Report for this project was approved by the Ministry of Environmental Protection of the People's Republic of China in March 2003.

completely lacking in vegetation cover, and so no felling of existing forests was carried out. What is more, mixed forests that hold multiple tree species together in order to prevent harm from insects were established, primarily for the shelterbelt.

2) Trees species that are suited to the soil and climate in the local region were selected by primarily focusing on species native to the local region.

3) For the afforestation and planting of vegetation cover, mainly those tree species that can grow in an arid climate and that do not need to be watered after they take root were selected in order to obviate the need for excessive irrigation or pumping up groundwater. In addition, other innovations were devised to maintain an appropriate planting density[16] given the tree species and soil, ensuring the density necessary to fix soil in place in the desert, particularly with the shelterbelt, as well as to ensure that excessive moisture is not absorbed underground because of overcrowded afforestation.

The afforestation and planting of vegetation cover by this project was carried out by taking the existing natural environment and ecosystem into consideration, and so its negative impacts on the natural environment were minimal. As the rate of forest cover and vegetation cover in the targeted regions improved as a result of this project, it can be evaluated as having contributed to preventing desertification and improving the natural environment.

(2) Land Acquisition and Resettlement

Since all of the planned sites for afforestation under this project were degraded land, no resident relocation occurred. Land in the target region for the afforestation and planting of vegetation cover was obtained by being leased from the constituents who hold ownership rights to the land. These land included both “national forests,” where the state retains ownership rights, as well as “collective forests,” where ownership rights are retained by local, large-scale farm operators or farmer organizations. Expenses were paid for these in accordance with the area and lease period. It was explained to the nomadic peoples living in the vicinity around the regions targeted for afforestation and the planting of vegetation cover that the project will be implemented, and they were prohibited from grazing animals in the forest and grassland enclosures and shelterbelt. The project was implemented after first consulting and reaching agreements with households that engage in animal grazing.

The project achieved its planned afforestation area, and contributed to the project goals of improving the rate of forest cover and vegetation cover, preventing desertification, and improving the living environment. While there were some regions where the survival rates for the sapling trees remained low, stable survival rates were maintained by responses such as techniques for water retention and desiccation countermeasures, as well as supplementary planting. The improvements in the rate of forest cover served to fix soil in place, which resulted in mitigating damage from yellow sand. On the economic front, it was affirmed that local farmers gained access to new income sources through the project. Thus, it contributed to improving farmers’ incomes.

As the above shows, the implementation of the project gave rise to effects largely as planned. Therefore, the effectiveness and impact of the project are high.

[16] In Dalad Banner, the planting density adopted was the density needed to prevent sand erosion, and this was adopted based on the standards for preventing soil moisture to be absorbed unnecessarily as a result of the density being too high. Moreover, for the zag cultivation site in Dongkou County, the planting density was set at 420 - 450 trees/ha. Based on their experiences to date, this was set as the most appropriate density for achieving soil fixation in the desert of the target region.

3.5 Sustainability (Rating: (3))

With this project, those involved in the project implementation can be classified into three main levels. Specifically, there are the people at the autonomous region governmental level, the local governmental level, and the local residents (farmers) overseeing the implementation work in the field. Therefore, this section will provide an overview of each level and analyze their coordination structures and other elements.

3.5.1 Institutional Aspects of Operation and Maintenance

Prior to the start of the project up to the present, new afforestation projects have been formed and implemented in an ongoing manner within the autonomous region. The International Cooperation Project Executive Office, which oversees these projects, has been established within the autonomous region. The office also oversaw this project. As for a more specific organizational structure, Inner Mongolia Project Management Leading Groups, Inner Mongolia Project Management Offices, and Inner Mongolia Project Implementation Offices were established at each of the three levels of Inner Mongolia, and its cities and counties.

The International Cooperation Project Executive Office persists to this day as an organization that manages afforestation projects as a whole in the autonomous region. In addition to this project, it also implements its own original projects as well as projects undertaken in cooperation with other international agencies, private companies, NGOs, and others. It has been confirmed that the office structure remains largely unchanged, and that it will exist for the time being. An overview of the organizational structures at each level, as well as their responsibilities and jurisdiction, is shown below.

Table 9: Overview of the Implementation Structures at Each Level

Level	Overview
Government of Inner Mongolia	The Inner Mongolia Project Management and Implementation Office serve as the management and supervisory agencies for the project. They have jurisdiction over matters like overall coordination for the project, appraising and approving the plans for each fiscal year, and the examinations and acceptance inspections for each fiscal year. There have been no major structural changes since the completion of the project.
Local government (city - county level)	1. The Inner Mongolia Project Management and Implementation Office at the city and county (banner) level serve as the management and oversight agencies for this project's forest and vegetation land. They have jurisdiction over matters like the project's design, planning, budget management, bidding and procurement, training project implementers, progress management for the project, acceptance inspections and examinations, and reporting to the organizations at the Inner Mongolia-level. Of the tasks mentioned above, the governments at the county (banner) level have jurisdiction over matters like deciding on the land where the project was to be implemented, arrangements for work scheduling, independent inspections of the project implementation site, arrangements for the participating farmers, and technical guidance. 2. At present, the Forestry Bureaus for each region continue to take responsibility for management and supervision when it comes to combatting diseases and insect damage in the shelterbelt and preventing forest fires, the same as they did at the time of the planning. Private companies and large-scale farm operators that have concluded contracts with the government oversee maintenance regarding the grass, shrub seeds, medicinal plants, and seed/seedling production sites.
Residents (farmers, etc.) participating in the project	1. At the time of the project implementation: This project adopted a participatory project implementation structure in which local farmers carried out the actual afforestation and planting of vegetation cover. The Forestry Bureaus with which the offices at the county (banner) level are affiliated concluded subcontracting agreements for the afforestation and planting of vegetation

Level	Overview
	cover with large-scale farm operators and private companies, and these entities hired local farmers and carried out the project by supplying the labor of the participants. 2. Present: Similar to at the time of the project implementation, the participating farmers are in charge of overseeing the tree and vegetation growth and the maintenance of the on-farm irrigation facilities. The Forestry Bureaus of the county (banner) governments and the large-scale farm operators subcontracted to perform the afforestation and planting of vegetation cover hire local farmers as forest protection workers. They perform monitoring for diseases and insect damage, prevent forest fires, perform patrols to prevent grazing, and control vehicle entry. 3. The main course of the maintenance works by the farmers, as found from the results of the beneficiary survey mentioned above, are described below. The project participants primarily handle the weeding and pruning, supplementary planting, monitoring for diseases and insect damage, and forest fire prevention activities. Each person oversees 58 ha on average, performing patrols on a continuous basis roughly once every two to three days. 4. During the field study, experts confirmed the structures and maintenance status regarding maintenance on the farmers implementing the project in each county (banner). They found that the maintenance structures and tasks to be performed were clearly defined and understood. A structure was also set in place in which they would periodically report the growth status and if there were any problems to the townships and towns.

Afforestation projects have been carried out in Inner Mongolia for a long time, with management and operating structures centered on Forestry Bureaus established at each administrative division level. Those involved in this project, as well as many of the Forestry Bureau personnel and engineers, are originally from the region. They have been engaged in afforestation projects in an ongoing manner since the time of the project planning, and have a wealth of experience. Afforestation projects require a great deal of time for project supervision, and so boosting the personnel retention rate contributes to enhancing structural stability from a continuity perspective.

3.5.2 Technical Aspects of Operation and Maintenance

The technical level for the project's operation and maintenance can be affirmed from the following two items: (1) the accumulation of experience thus far; and (2) setting in place training programs to disseminate this.

(1) Harnessing the Experiences from Past Projects

Afforestation and vegetation cover projects have traditionally been carried out extensively in Inner Mongolia, and the region possesses knowledge and a track record with afforestation and vegetation cover planting techniques in arid land. Accordingly, it has a high technical level regarding such efforts. With regard to techniques for water retention and desiccation countermeasures, which are particularly important, it has established effective countermeasures based on its track record.[17]

Moreover, for this project, implementation management via regulations (a type of detailed rules) prepared by the autonomous region's Forestry Bureau was prescribed. This was based on the guidelines enacted through the Inner-Mongolia Loess Plateau Afforestation Project (March 2001), which was a precursor to this project. The regulations are broadly comprised of four areas ((1) Related rules, (2) Operational planning and supervision, (3) Examinations and acceptance inspections, and (4) Financial management). Regulations shared between the counties and regulations that have been customized to suit particular regional characteristics were both adopted and used as guiding principles for the actual project management.

[17] See the "3.3.1. Quantitative Effects" section for details.

(2) Technical Transfer through Training

During the project implementation period, training envisioned for every level, from Forestry Bureau officials to participating farmers, was carried out in an ongoing manner. Technical transfers of the aforementioned techniques for water retention and desiccation countermeasures from the time of the afforestation were carried out to those involved in the project through training. This training included explanations of the project's implementation guidelines and laws and ordinances related to forestry, and it is run in accordance with the country's governmental and legal frameworks. This training has also provided instruction on successful case examples and lessons for afforestation and vegetation cover projects that had been implemented in the past in Inner Mongolia in aiming for coordination with other projects (see Attached Document: Overview of the Training and Implementation Structures for Participating Farmers).

As indicated above, training suited to each implementation level has been set in place and structures for disseminating the wealth of experience from afforestation projects to date have been established. On this account, afforestation projects in Inner Mongolia can be evaluated as having a high level of technical capacity on the whole at each level.

3.5.3 Financial Aspects of Operation and Maintenance

(1) Financial Status at the Governmental Level

There have been no changes to the management structures on the financial side, and in essence the project implementation structure has come about through fiscal expenditures by the state. As for the overall budget for the forestry sector, budgetary allocations have been provided for this from the central government and autonomous region's government for Inner Mongolia, and from the central government, autonomous region's government, and county (banner) governments for each county (banner), respectively. Fiscal management related to this project has not changed from the time of the planning, and it is overseen by the management offices for each county (banner) under the supervision of the offices at the autonomous region-level. The personnel expenses and project investments for forestry areas in the forestry sector in each county are shown below.

Table 11: Budget Trends for the Forestry Sector

	FY	Fixed costs (personnel costs) (10,000 yuan)	YoY growth rate (%)	Forestry investments (10,000 yuan)	YoY growth rate (%)
Inner Mongolia	2012	1,760	-	1,023,000	-
	2013	1,830	104.0%	1,117,000	109.2%
	2014	1,960	107.1%	1,006,000	90.1%
Horinger	2012	2,194	-	3,668	-
	2013	1,979	90.2%	10,608	289.2%
	2014	2,123	107.3%	7,698	72.6%
Jungar	2012	2,930	-	10,421	-
	2013	3,010	102.7%	10,691	102.6%
	2014	2,928	97.3%	10,117	94.6%
Dalad	2012	1,442	-	8,609	-
	2013	1,557	108.0%	13,926	161.8%
	2014	1,656	106.4%	10,332	74.2%
Hanggin	2012	2,174	-	5,248	-
	2013	2,263	104.1%	6,258	119.3%
	2014	2,530	111.8%	9,921	158.5%
Dongkou	2012	190	-	3,125	-
	2013	265	139.7%	4,257	136.2%
	2014	267	100.8%	1,712	40.2%

Fluctuations have been seen with the fixed costs (personnel costs) because of changes in the number of personnel and price increases. However, on the whole, stable spending has continued, and the ordinary budget can be described as stable. Fluctuations in the investments in forestry projects in each county (banner) were seen between the fiscal years, but officials from the Forestry Bureaus offered responses to the effect that the planned project investments have largely been secured in a stable manner.

For example, looking at the FY2015 budgetary trends for Horinger County reveals that the annual budget consisted of an ordinary budget of 13.63 million yuan, grants from the regional government of 20.76 million yuan, and grants from the national government of 40 million yuan, for a total of 74.39 million yuan (roughly 1.5 billion yen). As for the budgetary requests for FY2016, for the ordinary budget the plan is to request 13.62 million yuan, with a planned operating budget using grants from the local and national governments as financial resources of 100 million yuan. The counties have requested an increase in the operating budget for the future, and are planning further afforestation and vegetation cover projects and environmental improvement projects.

The counties have requested an increase in the operating budget for the future, and are planning further afforestation and vegetation cover projects and environmental improvement projects.

(2) Financial Status of the Project Implementers

At the project implementer level, the financial operating structures differ depending on the type of target forest land. However, this basically takes the shape of subcontracting agreements involving maintenance concluded by the Forestry Bureaus from each region with large-scale farm operators, private companies, and others in the target regions. The status for each respective item is described below (see Attached Document 2 at the end of the report for details).

- Shelterbelt: The structure by which these are sustainably managed involves concluding agreements over afforestation and planting vegetation cover between the Forestry Bureaus of each county (banner) and large-scale farm operators and private companies, and using the subsidies and sales revenue obtained from the afforestation and vegetation cover for the said maintenance. Based on existing laws, subsidies of between 150 and 250 yuan are paid per hectare every year for shelterbelt maintenance. These subsidies account for the bulk of the financial resources at present. As for the sales revenue from forest resources, this has not reached the point where the majority of the forest land can be used as thinned wood, so no economic earnings have been received from this.
- Enclosure forests: These are maintained by the state-run farm. Just like with the shelterbelt above, this manages public benefit forests that are eligible for subsidies, and so maintenance is performed based on government subsidies.
- Seed/seedling production sites, etc.: These are operated by private companies that have concluded agreements with the Forestry Bureaus, with revenue from the sale of the seeds and seedlings being used to cover their operating and maintenance costs. If they are not profitable, then the Forestry Bureaus provide financial support so that they can maintain stable operations.

Based on the above, when it comes to the status of budget usage by the autonomous region and the counties, fluctuations in the amount of forestry investments were seen in each fiscal year. However, they can be evaluated as being largely secured at the necessary levels regarding their ordinary budgets. As was previously mentioned in the section on relevance, the political importance of desertification countermeasures in the autonomous region is clear, and subsidies for things like the maintenance of shelterbelt and public benefit forests have been established. In addition, afforestation projects have been carried out in an ongoing manner, including those by other donors, such as the Sustainable Forest

Development Project (2002–2009, Global Environment Facility / World Bank) and the Regional Monitoring and Early Warning Network for Dust and Sandstorms (2003–2005, ADB). Considering the status in which fiscal inputs continue to be made for the afforestation sector in a stable manner, it is hard to conceive of a scenario in which major obstacles would appear in a financial sense. What is more, from interviews with the participating farmers, it was noted that the operating status is stable in the sense that there are no problems with the maintenance costs for shelterbelt being paid, and so on. Therefore, the project's sustainability in a financial sense is deemed high.

3.5.4 Current Status of Operation and Maintenance

The operation and maintenance status for the forest land targeted by this project is summarized below.

(1) Operation and maintenance is being carried out without any problems. The maintenance activities center mainly on monitoring for diseases and insect damage and preventing forest fires. Diseases and insect damage were hardly seen at all because of the schemes and maintenance activities from when the afforestation was carried out, and procedures for reporting to the Forestry Bureau have been set in place in case diseases and insect damage do appear. In addition, there have been no outbreaks of large forest fires.

(2) Under the project, tree species that do not need to be watered after they take root were primarily selected, which has served to prevent salt accumulation as a result of excessive irrigation or the pumping up of groundwater.

(3) Irrigation facilities and nursery facilities were installed primarily in grass, shrub seeds, medicinal plant, and seed/seedling production sites that need nurturing. Specifically, equipment and facilities like wells, sprinklers, water pumps, tractors for transporting seedlings, and greenhouses were installed. The private companies and large-scale farm operators managing the sites are in charge of maintenance, with the revenue from the sales of sapling trees, trees, and vegetation being used to cover the maintenance expenses. Maintenance is being carried out on the equipment and facilities that were introduced in an ongoing manner and the necessary replacement parts and consumable goods and so forth are being procured. As a result, everything is functioning without any problems.

As the above shows, no major problems have been observed in the institutional, technical, and financial aspects of the operation and maintenance system of the project. Therefore, sustainability of the project effects is high.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

This project carried out afforestation and planted vegetation cover in the Yellow River Basin of the southern part of Inner Mongolia. Through this, it aimed to improve the living environment by improving the rate of forest cover and vegetation cover in the region, as well as preventing desertification in the region and the surrounding areas, thereby contributing to social and economic stability in the region.

This project has remained relevant to the development plan and needs in China at the national and provincial levels from the time of the appraisal through to the present, and it is therefore highly relevant. Both the forest land and production sites that were established through this project are showing favorable growth, and progress was made in establishing forest land. As a result of the afforestation and vegetation cover initiatives including the project, the forested area in the autonomous region increased to nearly twice what it was before the implementation of the project, while there was a fall in the share of degraded land, which is a contributor to desertification. As a result, the damage from yellow sand and other problems has been mitigated and this has led to improvements in the living environment for the local residents. Thus, the effectiveness and impact of the project are high. While the project cost was lower than planned, the project period was longer than planned. Therefore, efficiency of the project is fair. There are no major problems with the project's sustainability. Inner Mongolia has many years' experience with implementing afforestation projects using aid and funding from within the region and without, and so no major problems were observed with its institutional and technical aspects of operation. In terms of the project's financial aspect, the fact that afforestation projects continue to be regarded as important has not changed, so the expectation is that stable operations can be maintained for the time being.

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

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

None

4.2.2 Recommendations to JICA

None

4.3 Lessons Learned

Incorporating coordination between organizations into the project plan

This project can be evaluated as having achieved highly satisfactory effects. The greatest contributing factor behind this has been the establishment of a method of project administration involving multiple organizations and stakeholders.

The executing agencies, centered on the Inner Mongolia government, incorporated exchanges between municipalities into their programs during the project implementation period, and used these programs for project supervision and to enhance its effects. For example, the project achieved effects by promoting technical sharing between projects, such as using successful case examples from preceding afforestation and vegetation cover projects, as well as those from the Chinese government, other donors, NGOs, and other private sector players (such as water retention and desiccation countermeasures, etc.). The elements in the background that probably made such results possible are: (1) structures for performing coordination and exchange between projects were incorporated from the

start of the project planning; (2) these initiatives maintained interorganizational and interpersonal connections in a continuous manner throughout the implementation period; and (3) operating guidelines and manuals were uniquely prepared to ensure organizational coordination. Moreover, as was mentioned in the section on effectiveness, flexible plan alterations in the plan during implementation such as efforts like proactively incorporating new water retention and desiccation countermeasures from afforestation project of other project sites carried out concurrently over the project implementation period also contributed to the effectiveness of the Project. Furthermore, the project established a system for securing inputs for afforestation in a sustainable manner following the implementation of the project, such as by obtaining independent support from the private sector for the target region by publicizing the project's results.

The enormous inputs like those from ODA Loan projects can serve as valuable opportunities to promote coordination between such organizations and to establish sustainable structures. Following initiatives are considered effective in planning ODA Loan projects: incorporating structures for coordination and exchange between the various governmental levels, such as autonomous regions, cities, and counties, in the project implementation structure as part of the inputs; granting those at the field the discretion to flexibly alter the project scope and make decisions through exchanges; allocating a personnel with ample personal connections and understanding of the local circumstances to a responsible position at the division for coordination between organizations; adopting structures for clearly stipulating this coordination in documents, such as the guidelines and manuals for sharing such experiences between organizations.

Comparison of the Original and Actual Scope of the Project

Item	Plan	Actual
(1) Project Outputs		
1) Afforestation and vegetation cover		
Forest and grassland enclosures	106,175 ha	112,718 ha
Shelterbelt	64,281 ha	68,822 ha
Grass production sites	1,533 ha	As planned
Shrub seed production sites	2,247 ha	1,200 ha
Medicinal plant cultivation sites	1,000 ha	As planned
Seed/seedling production sites	6,737 ha	4,303 ha
2) Related facilities and equipment		
Irrigation facilities	79.8 km	As planned
Water pumping facilities	1 location	As planned
On-farm irrigation facilities	2,974 sets	2,189 sets
Wells dug	2,974 locations	1,605 locations
Power supply facilities	320 locations	224 locations
Roads installed	466.4 km	469.2 km
3) Training		
Training (for farmers)	4,124 people	4,172 people
(2) Project Period	March 2003 - December 2009 (82 months)	March 2003 - December 2013 (130 months)
(3) Project Cost		
Amount paid in foreign currency	612 million yen	1,099 million yen
Amount paid in local currency	19,468 million yen (1,298 million yuan)	18,831 million yen (1,272 million yuan)
Total	20,080 million yen	19,930 million yen
Japanese ODA Loan portion	15,000 million yen	14,999 million yen
Exchange rate	1 yuan = 15 yen 1 USD = 121 yen (As of September 2002)	1 yuan = 14.8 yen (Average from January 2005 - December 2015)

Attached Documents
Supplementary Documents for "(2) Technical Transfers via Training" of "3.5.2 Technical Aspects of Operation and Maintenance"

Attached Document 1. Overview of the Training and Implementation Structures for Participating Farmers

Eligible participants	Overview of the training and implementation structures
County (banner) government officials	Engineers from the Forestry Bureaus involved in the project implementation received classroom trainings and onsite trainings so that they could train the participating farmers and provide onsite technical instruction. The training included explanations of the project's implementation guidelines and laws and ordinances related to forestry, as well as afforestation and vegetation cover planting techniques and maintenance techniques. It also provided instruction on successful case examples of and lessons for afforestation and vegetation cover projects that had been implemented in the past in Inner Mongolia, such as the Inner-Mongolia Loess Plateau Afforestation Project (March 2001).
Participating farmers	• Training implementation structure: Farmers who concluded direct agreements with the Forestry Bureaus were obligated to take part in the training. Moreover, when the participating farmers were selected, farmers with a basic level of afforestation and vegetation cover planting skills were selected to ensure a basic technical level among the participants. All of the respondents from the beneficiary survey mentioned above took part in the training. On average, they took part in 4.2 training sessions, with 90% learning afforestation and vegetation cover planting techniques, 80% learning maintenance techniques, and 70% learning irrigation and erosion control techniques. • Training dissemination structure: A structure was adopted in which the participating farmers formed farmer groups with anywhere from a few people to a few dozen people, with each group electing a representative to serve as the contact point for the group. In addition, these representatives underwent the training hosted by the executing agency, then provided secondary training to the other participating farmers. Through this, a large number of participating farmers were effectively managed, and this is thought to have ensured quality on the technical side. • Main subjects of the training: According to the participating farmers who carried out the afforestation and planting of vegetation cover in Dalad Banner, through the training and onsite instruction they learned techniques for water retention and desiccation countermeasures. Specifically, they learned things like a water retention method of soaking sapling trees in water for ten days prior to afforestation, a method for digging trenches for planting seedlings, as well as the angle and depth for planting trees. Based on the results of the beneficiary survey, techniques for water retention and desiccation countermeasures such as the method for potted sapling afforestation and the water retention techniques were mentioned as particularly helpful subjects of the training. • Training after the project's completion: Operation and maintenance after the project's competition have been mainly undertaken by the local farmers hired as forest protection workers. Training on maintenance techniques has been provided to the participating farmers, who were instructed on techniques necessary for maintenance such as methods for monitoring for diseases and insect damage and preventing forest fires.

Supplementary Documents for "(2) Financial Aspects of the Project Implementers" of "3.5.3 Financial Aspects of Operation and Maintenance "

Attached Document 2. Financial Status for Each Type of Forest Land

Types of forest land	Financial overview and status
Shelterbelt	1. These are sustainably managed by having the Forestry Bureaus of each county (banner) conclude subcontracting agreements over afforestation and planting vegetation cover with large-scale farm operators and private companies, and using the subsidies and sales revenue obtained from the afforestation and vegetation cover for said maintenance. In China, fixed subsidies are paid per unit of area for forests that are used for public use pursuant to the Division and Demarcation Regulations for State-level Public Benefit Forests. For the shelterbelt established through the project, between 150 - 250 yuan is paid per 1 ha every year in the form of subsidies. At present (2015), the majority of the forest land has not reached the point where it can be used as thinned wood, so no direct economic earnings have been received through the forest resources. The primary revenue sources at present consist of the consigned costs for the maintenance work through these subsidies. 2. Example from Horinger County: According to the interviews held with the farmers carrying out the maintenance work as forest protection workers in Horinger County, five households performed afforestation on roughly 500 ha of land. These households are also currently involved in the maintenance work such as monitoring for diseases and insect damage and preventing forest fires. The areas under their oversight have been designated as priority afforestation and vegetation cover planting regions through national policies, and subsidies are paid by the state for the afforestation, planting of vegetation cover, and maintenance activities. They received wages of 102 yuan / ha when the afforestation was completed in 2005, and 153.75 yuan / ha in 2015. These forest protection workers were previously the farmers who owned 2 ha of farmland. However, their income has increased through their participation in this project, and they show a certain degree of satisfaction still to this day.
Forest enclosures	Roughly one-third of the afforestation and vegetation cover area for this project consisted of the forest enclosures established in Hanggin Banner, in which a state-run farm had been set up. Maintenance is carried out by the state-run farm, and just like with the shelterbelt mentioned above the establishment of this public benefit forest is eligible for subsidies. Therefore, maintenance for this is carried out based on government subsidies.
Seed/seedling production sites, etc.	1. The seed/seedling production sites are operated by private companies that have concluded agreements with the Forestry Bureaus, with revenue from the sale of the seeds and seedlings being used to cover their operating and maintenance costs. The production sites visited during the field study were in a seed/seedling production phase for several years after they were established, and so in some of those years their operating and maintenance costs were in the red. However, at the time of the ex-post evaluation, their production output had stabilized, and they were covering their operating and maintenance costs with the revenue from the sale of the seeds and seedlings. If they are not profitable, then the Forestry Bureaus provide financial support so that they can maintain stable operations. 2. Reference: The Scots pine nursery center in Horinger County currently sells 600,000 trees per year. The sales price for Scots pines in 2012 was 1.5 yuan for

	saplings of less than 0.5 m, and 17 yuan for saplings over 1 m. The increased supply of such trees on the market is putting downward pressure on the sales price. The center was in the process of growing the saplings for several years after it was established, and its sales were between 3 and 6 million yuan per year. Currently its production output is stable, and its sales are around 10 million yuan (180 - 200 million yen) per year. This fiscal year it covered its operating and maintenance costs of this year with its sales. However, while its annual balance is in the black, its initial investment costs for equipment and facilities were expensive, and it is currently still repaying these.

People's Republic of China

FY2015 Ex-Post Evaluation of Japanese ODA Loan
"Huhhot Environmental Improvement Project"

External Evaluator: Shima Hayase, IC Net Limited

0. Summary

The objective of this project is to improve the water quality of rivers in Huhhot City in the Inner Mongolia Autonomous Region by increasing the sewage treatment rate through the construction of sewerage facilities.

This project was consistent with China's development policies and development needs at the national, autonomous region, and municipal levels at the time of the appraisal and the ex-post evaluation; Japan's policy for assistance to China at the time of the appraisal. Therefore, its relevance is high. At the time of the ex-post evaluation,expansion and remodeling of the sewage treatment plant were being carried out to keep up with the urban development plan. Because the operation was suspended or reduced during the period, the sewage treatment volume and the treatment rate were lower than the target values. However, it can be judged that effects have arisen because of the following factors: the volume and the rate are likely to recover after the completion of the remodeling construction; indicators for main effects, such as the sewage treatment rate and the quality of the treated water, have almost achieved the targets; and sewerage service has been spreading smoothly. Moreover, at the time of the ex-post evaluation, the effectiveness and impact of this project are high, because this project seems to widely contribute to improvement in the water quality of rivers in Huhhot City, as indicated by a decrease in the total volume of pollutants discharged into water in the City. Although, just after the beginning of this project, the sewerage master plan was revised and cancellation of the construction of the Ruybaita sewage treatment plant and reduction of the tertiary treatment capacity[1] of the Zhanggaiying sewage treatment plant were done. These changes were due to a review of the sewerage construction plan and were in accordance with this project objective of contributing to urban development. While the project cost was lower than planned, a considerable delay was caused in the project period and the efficiency of the project is fair. Regarding the sustainability of the effects that arose by this project, there is no great problem in the maintenance system of operating agency, technology, and finance. Therefore, the sustainability of the project is high.

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

1. Project Description

Project location

Bio-reaction tank in
the Gongzhufu sewage treatment plant

[1] The process in which organic matters are removed by applying high-level treatment to water discharged from a sewage treatment plant to purify the water for recycling

1.1 Background

Huhhot City, the capital of the Inner Mongolia Autonomous Region, is located in the middle basin of the Yellow River and was developing as an economic, transport, and trade center. In the urban district, industrialization and urbanization rapidly developed and were accompanied by an increase in industrial and domestic sewage. However, the sewage treatment capacity was provided only by an existing sewage treatment plant. As a result, more than half of the sewage discharged from the City flowed into the Xi River and the Xiaohei River, which flow in the City, and the water quality of the rivers[2] worsened below the level usable as agricultural water (inferior class V).

Although Huhhot City set the objective of improving the water quality of rivers in the City to fulfill class V standards and reducing the emissions of Chemical Oxygen Demand (COD) by 10% compared with the emissions in 2000 according to the "10th Five-year Plan (2001 to 2005) for Environmental Protection in Huhhot City," it was difficult to fulfill these objectives by the deadline, due to a delay in planning and fundraising.

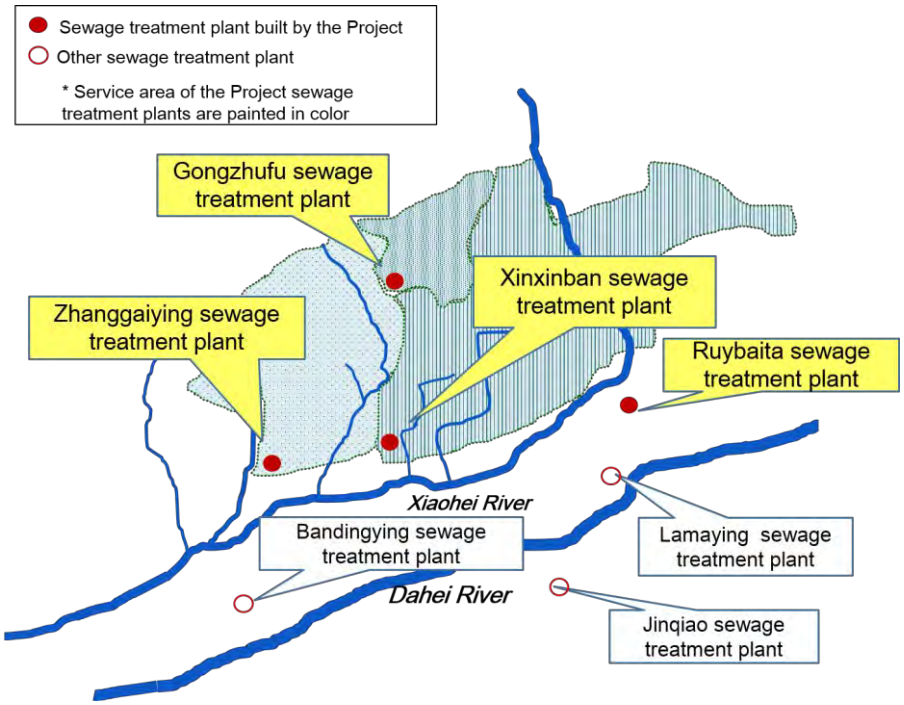
1.2 Project Outline

The objective of this project is to improve the water quality of rivers in Huhhot City in the Inner Mongolia Autonomous Region by increasing the sewage treatment rate through the construction of sewerage facilities, thereby contributing to the promotion of sustainable development of the City.

Loan Approved Amount/ Disbursed Amount	9,747 million Japanese yen / 8,082 million Japanese yen	
Exchange of Notes Date/ Loan Agreement Signing Date	March 2004 / March 2004	
Terms and Conditions	Interest Rate	0.75 %
	Repayment Period (Grace Period)	40 years (10 years)
	Conditions for Procurement:	General Untied
Borrower / Executing Agency(ies)	The People's Republic of China/ Inner Mongolia Autonomous Region People's Government	
Final Disbursement Date	August 2013	
Main Contractor (Over 1 billion yen)	None	

[2] The water quality for rivers, lakes, and other water environments is classified into Class I - V pursuant to the Environmental Quality Standards for Surface Water (GB3838-2002). Class I: Applies primarily to water from water sources and national nature reserves; Class II: Applies primarily to concentrated water sources of potable water for domestic use in Class I preserves, valuable fish protection areas, and fish and shrimp spawning grounds; Class III: Applies primarily to concentrated water sources of potable water for domestic use in Class II preserves, general fish protection areas, and swimming areas; Class IV: Applies primarily to general industrial water areas and water areas for entertainment purposes that do not come into direct contact with humans; Class V: Applies primarily to agricultural water and water areas needed for general scenery.

Main Consultant (Over 100 million Japanese yen)	None
Feasibility Studies, etc.	・F/S (North China Municipal Engineering Design & Research Institute, Inner Mongolia Autonomous Region Water Resource Hydropower Research Institution, Huhhot City Water Bureau (March 2003)
Related Projects	【ODA Loan】 ・Hohhot Water Supply Project (L/A December 1996) ・Hohhot And Baotou Environmental Improvement Project I, II (L/A December 1996, September 1997)



Source: Prepared from materials provided by Huhhot Shouchuang Chunhua Water Development Co., Ltd.
Note: The sewage treatment plant at Ruybaita, whose construction had been planned, was not constructed.

Figure 1: Location of rivers and sewage treatment plants in Huhhot City

2. Outline of the Evaluation Study

2.1 External Evaluator

Shima HAYASE, IC Net Limited

2.2 Duration of Evaluation Study

The ex-post evaluation study was carried out as follows:
Duration of the Study: August, 2015 –January 2017
Duration of the Field Study:
November 30, 2015 – December 11, 2015

April 9, 2016 – April 14, 2016

2.3 Constraints during the Evaluation Study

Although it is said that the construction of sewerage facilities under this project resulted in improvement in the water quality of rivers in the City, it is difficult to directly assess how much this project contributed to improvement in the water quality of rivers in a wide area, for the water quality of the rivers was influenced by many factors other than the construction of the sewerage facilities. Therefore, this ex-post evaluation regards a change in the water quality of all the rivers in the City as impact, and the contribution of this project will be analyzed by qualitatively confirming the factors for the improvement of the water quality and referring to the reduction in the volume of aquatic pollutants as a result of sewage treatment and its ratio to the pollutants discharged into the water in the whole of Huhhot City.

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

3.1 Relevance (Rating:③[4])

3.1.1 Relevance to the Development Plan of China

(1) Relevance to the Development Plan at the Time of Appraisal

The "10th Five-year Plan of the People's Republic of China for Economic and Social Development (2001 – 2005)," the national development plan at the time of appraisal, aimed at harmonious economic and social development and placed importance on the improvement of the environment, which had worsened during economic development. The "10th Five-year Environmental Protection Plan (2001 – 2005)" specified the following objectives concerning sewage treatment and water quality improvement: an increase in the sewage treatment rate to 45% in urban areas (60% if the population is 500,000 or more); improvement of water quality in the upper reaches of the Yangzi River, the central reaches of the Yellow River, and the basin of the Songhua River; and a 10% reduction in the total emissions of main pollutants, as compared to 2000.

(2) Relevance to the Development Plan at the Time of Ex-post Evaluation

The "12th Five-year Plan of the People's Republic of China for Economic and Social Development (2011 – 2015)," the development plan at the ex-post evaluation, specified five propriety fields. Regarding "resource-saving and environment-friendly society" among them, the plan set the objective of improving the general level of infrastructures, including sewage treatment facilities. In the "12th Five-year Environmental Protection Plan (2011 – 2015)," which specified national objectives in the environmental field, among the eight environmental protection projects, three projects concerned the improvement of the water environment and the strengthening of construction of sewage treatment infrastructures. The objectives to be achieved included a reduction in the emissions of COD and ammoniacal nitrogen (NH_3-N), strengthening of construction of sewage pipe networks, division of flow of rainwater and polluted water, an increase in the urban sewage treatment rate, and a reduction in the ratio of water of inferior class V[5] in rivers and lakes.

The "12th Five-year Inner Mongolia Autonomous Region Government Environmental Protection Plan (2011 – 2015)," which was established based on the above-mentioned national policy, specified the following objectives: improvement of the quality of sewage treatment water in basins to improve the water quality of the rivers in the Autonomous Region above inferior class V; and an increase in the sewage treatment rate to 90% and an increase in the purified water use rate to 30% of the sewage volume in the prefecture-level cities[6] including

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

[4] ③ High, ② Fair, ① Low

[5] If water does not meet the standards for class V, the water is classified into inferior class V.

[6] In China, the administrative districts are divided into the following: province level (province, directly controlled

Huhhot City, by 2015.

In this way, the improvement of the water quality of rivers and the strengthening of construction of sewage treatment infrastructures continued to be priority fields for the development plan in the State, the Autonomous Region, and Huhhot City in the period between the appraisal and the ex-post evaluation.

3.1.2 Relevance to the Development Needs of China

Although, at the time of the appraisal, the volume of industrial and domestic sewage was increasing due to rapid development in Huhhot City, there was only one sewage treatment plant, and the sewage treatment rate of the City was only 43%.[7] Untreated sewage flowed into rivers in the City, with the result that the water quality of the Xiaohei River, a main river, was not improved from inferior class V. To improve it, Huhhot City drew up the "Sewerage Construction Master Plan (2005 – 2030)" to construct five sewage treatment plants (with a capacity of 600,000 m^3/day) in the City by 2020. Because it is expected at the time of the ex-post evaluation that the volume of sewage in the City would increase further, the master plan was revised and the construction goal was raised to six sewage treatment plants (with a capacity of 750,000 m^3/day). In this way, the development needs for strengthening the sewage treatment capacity are still high at the time of the ex-post evaluation, as at the time of the appraisal.

3.1.3 Relevance to Japan's ODA Policy

In the "Medium-Term Strategy for Overseas Economic Cooperation Operations (2002 – 2005)," among the priority fields, such as the strengthening of measures for poverty reduction, infrastructure improvement for economic growth, and support for environmental conservation and pollution prevention, JICA specified the need for constructing sewage treatment facilities as a measure against water pollution for avoiding or reducing the negative environmental impact of infrastructure development.

Moreover, in the "Country Assistance Policy for China" established in 2002, JICA regarded environmental conservation and human resource development mainly in inland areas as priority fields. The construction of sewerage facilities was regarded as the construction of economic and social infrastructures that will serve as a basis for the activities of the private sector Importance was placed on the construction of sewerage facilities, because they were expected to facilitate sustainable development.

This project aims to facilitate the sustainable development of the City by constructing sewage treatment plants and improving the water quality of river branches flowing beyond national borders. It was confirmed that, as described above, this project is relevant to Japan's ODA policy that aims to improve the environment mainly in inland areas and develop infrastructures.

3.1.4 Relevance to Appropriateness of Project Planning and Approach

After this project began, the construction of sewage treatment plants in Bandingying and Lamaying was added to the master plan to strengthen sewage treatment in the southern area of Xiaohei River, where development has been advanced further. This resulted in the cancellation of the construction of the Ruybaita sewage treatment plant and pipe networks, which was planned under this project. As a result, the construction was removed from this project and became China's own project. The service area of the Ruybaita sewage treatment plant was divided into areas under the service of the Jinqiao and Lamaying sewage treatment plants.

Although the executing agency proceeded with the domestic procedure to use the surplus produced due to the cancellation for constructing a new plant, the surplus was not used because the closing date of disbursement for the ODA loan came before completion of the procedure. In

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city, autonomous region), prefecture level (prefecture-level cities, autonomous prefectures), county level (county-level cities, city-controlled districts, autonomous county, hosho), and village level (villages, towns, special districts).

[7] Materials provided by JICA

addition, regarding the details of the cancellation and the use, there were insufficient liaison and coordination between the project implementation unit[8]/the executing agency and JICA. In materials provided by JICA, it was also pointed out that "coordination by an increase or decrease in funds was not carried out appropriately, and domestic procedures and domestic fundraising were not carried out by the deadline."[9]

Because opportunities for using the surplus more effectively were missed, it can be thought that there was room for improvement. However, because the construction of the Ruybaita sewage treatment plant was cancelled due to a change in the urban planning of Huhhot City, it can be judged that the cancellation is appropriate from the viewpoint of the objective of this project.

In light of the above, this project is fully relevant to the development policies of the Chinese Government, the Inner Mongolia Autonomous Region, and Huhhot City and needs and Japan's ODA policy. Therefore, its relevance is high.

3.2 Efficiency (Rating: ②)

3.2.1 Project Outputs

Planning and Results of Project Outputs

Although the Gongzhufu sewage treatment plant was constructed and the Xinxinban sewage treatment plant was expanded as planned, a revision of the "Sewerage Construction Master Plan" in Huhhot City resulted in the cancellation of the construction of Ruybaita sewage treatment plant and a reduction in the treatment capacity of the tertiary treatment facilities in Zhanggaiying sewage treatment plant.[10]

A network of rainwater pipes was constructed as planned, while the extension of a network of drainage pipes was reduced. This was because the diameter of the pipes was doubled during designing. The sewage treatment capacity has not been changed.

Although training for the actual project executor was provided less frequently than before, the number of participants was almost as planned. Training on environmental monitoring for the staff of the Environment Protection Bureau of Huhhot City was cancelled because the rules on travel for public servant became stricter. However, because substitutive training was held domestically, the purpose of training under this project was achieved.

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[8] The agency that manages and maintains the sewage treatment plants constructed by projects under the direction of the Huhhot Municipal People's Government.

[9] To make a change, the executing agency has to file applications with and receive approval from many organizations at multiple levels, such as the City, the autonomous region, the Development and Reform Commission, the Ministry of Finance, and the Ministry of Construction at the national level, and the Export-Import Bank of China. Because official coordination with JICA was not able to be carried out during the approval period, such delay occurred.

[10] Sewage in the Ruybaita treatment region will be treated by the Jinqiao sewage treatment plant (with a capacity of 40,000 m^3/day), which will be constructed with domestic funds, and the Lamaying sewage treatment plant (with a capacity of 150,000 m^3/day), which will be constructed by 2020.

Table 10: Comparison of Output of the Plan and the Actual Results

Plan	Actual
A-1) Gongzhufu sewage treatment plant CAST process[11] Secondary treatment[12] 50,000 ㎥/day Tertiary treatment 30,000 ㎥/day	A-1), A-2) As Planned
A-2) Sewage pipe network Φ300～Φ800 ㎜ approximately 30 km	
B-1) Xinxinban sewage treatment plant Activated Sludge process Secondary Treatment 50,000 ㎥/day	B-1), B-2), B-3) As planned
B-2) Sewage pipe network Φ300～Φ900 ㎜ approximately 86km	
B-3) Sewage pipe network Φ300～Φ700 ㎜ approximately 36 km	
C-1) Ruybaita sewage treatment plant CAST process Secondary treatment 40,000 ㎥/day	C-1) C-2) Canceled
C-2) Sewage pipe network Φ300～Φ900 ㎜ approximately 40 km	
D-1) Zhanggaiying sewage treatment plant. Activated Sludge process Secondary treatment 60,000 ㎥/day Tertiary treatment 50,000 ㎥/day	D-1) Secondary treatment as planned Tertiary treatment changed to 30,000 ㎥/day
D-2) Sewage pipe network Φ300～Φ1600 ㎜ approximately 85 km、 Pump station 1 location	D-2) As planned.
E-1) Storm water pipeline (water drainage) approxmately128 km	E-1) Reduced to approximately80 km
E-2) Storm water pipeline (water distribution) approximately 24 km	E-2) As planned
F-1) Training for the staff of Project Implementation Unit 1) October 2004 (8 days) 8 persons 2) January 2005 (6 days) 6 persons 3) September 2005 (6 days) 6 persons Total 20 persons	F-1) 1) January 2007 (12 days) 10 persons 2) April 2007(10 days) 9 persons Total 19 persons
F-2) Training for the staff of the Environment Protection Bureau 1) October 2004 (8 days) 8 persons 2) January 2005 (6 days) 6 persons 3) September 2005 (6 days) 6 persons Total 20 persons	F-2) 1), 2), 3) All canceled

Source: Huhhot Shouchuang Chunhua Water Development Co., Ltd.

[11] Cyclic Activated Sludge Technology: an activated sludge process whereby butch treatment is applied; generally, space-saving.

[12] Among the processes at a sewage treatment plant, the process of removing refuse and other solid matters through filters around the water inlet, or remove solid matters by precipitation in the precipitation ponds prior to biological treatment is called “primary treatment (physical treatment).” The process of removing organic matters by the use of microbes is “secondary treatment (biological treatment).” The process of removing the pollutants that cannot be removed by the former processes after the secondary treatment is called “tertiary treatment (high-level treatment).” The water processed by the tertiary treatment is reused as recycled water.

3.2.2 Project Inputs

3.2.2.1 Project Cost

At the time of the appraisal, the project cost was estimated to be 13,081 million Japanese yen (9,747 million Japanese yen in foreign currency; 3,334 million Japanese yen in domestic currency). After the cancellation of the Ruybaita sewage treatment plant[13] (1,611 million Japanese yen) and the training for the staff of the Environment Protection Bureau (15 million Japanese yen), the project cost was estimated to be 11,455 million Japanese yen. The actual cost was 11,105 million Japanese yen (8,074 million Japanese yen in foreign currency; 3,031 million Japanese yen in domestic currency), 97% of the planned cost.

3.2.2.2 Project Period

At the time of the appraisal, the project implementation period was scheduled from April 2004 to December 2008 (57 months). Actually, it was from April 2004 to December 2011 (93 months), 163% of the planned period, thus the project period was significantly longer than planned. The main reason was a delay in the establishment of a network of rainwater pipes. Because the City reviewed the development plan around the time of the bidding, it was necessary to change the construction schedule. In addition, because, during the construction, there was a delay in road works in the area where the network of rainwater pipes was planned to be established, a delay was inevitable.

3.2.3 Results of Calculations of Internal Rates of Return (Reference only)

The financial internal rate of return (FIRR) was recalculated with the actual costs and benefits by the executing agency.[14] Although it was 3.80% at the time of the appraisal, it was -3.48% at the time of ex-post evaluation. This was because, compared with the plan at the time of the appraisal, the volume of treated sewage was smaller at the time of the ex-post evaluation, and the sewage treatment revenue gained according to the volume was estimated to be lower than planned.

Table 2: Comparison of FIRR at Appraisal and the Actual Results

Plan at Appraisal (2004)	Actual (2015)
Prerequisite ・Cost : Construction, Operation and Maintenance , Business Tax ・Benefit: Sewage Treatment fee revenue, Sales of recycled water (power plant) ・Project Life :35 years	Prerequisite ・Cost : Construction, Operation and Maintenance , Business Tax ・Benefit: Sewage Treatment fee revenue, Sales of recycled water (power plant) ・Project Life :35 years

Source: the evaluator calculated according to the data provided by Huhhot Shouchuang Chunhua Water Development Co., Ltd.

In light of the above, although the project cost is lower than planned, the efficiency is fair because the project period is far longer than planned.

[13] At the time of the appraisal, the cost of constructing Ruybaita sewage treatment plant was estimated to be 1,729 million Japanese yen. Because 118 million Japanese yen was used for designing, the cost remaining due to the cancellation was 1,611 million Japanese yen.

[14] Although each sewage treatment plant's FIRR was estimated at the time of appraisal, each plant's actual FIRR cannot be calculated because the parent company is collectively managing all the plants. The estimated FIRR will be revised as the three plants' FIRR, which then will be compared with the result.

3.3 Effectiveness[15] (Rating: ③)

3.3.1 Quantitative Effects (Operation and Effect Indicators)

At the time of the planning, this project was expected to produce the following effects: improvement in the sewage treatment rate in Huhhot City; and improvement in the quality of treated water. To improve the sewage treatment rate, targets were set for the rate, the sewered population, and the percentage of sewered population.[16] According to the project implementation unit, however, because the sewage treatment regions are not in accordance with the local government's demarcation, and the region covered by the treatment plants are frequently changed, it is impossible to collect accurate data about the population covered by the treatment plants and the sewered population.[17] Alternatively, for Huhhot City, the sewered population is estimated from the volume of treated sewage, while the percentage of sewered population is estimated by comparison with the population estimated from the volume of discharged water. Regarding each of the sewage treatment plants, because, due to the above-described reason, it is impossible to acquire accurate data on the volume of discharged sewage in the treatment regions, which serves as the denominator for the calculation of the sewage treatment rate, the operation rate to the designed capacity, the area covered by sewage treatment service, and the total length of the network of pipes are used for checking the state of spread of sewerage. Improvement in the quality of treated water is checked by the concentration of pollutants included in water discharged from each of the treatment plants.

(1) Operation Indicators

1) The Sewage Treatment Volume and the Rate, the Sewered Population, and the Percentage of Sewered Population in Huhhot City.

According to the plan at the time of the appraisal, it was estimated that volume of sewage would be discharged at 334,000 m3/day in the whole of Huhhot City. The project target was set to treat 294,000 m3/day, which is equal to 88% of the volume one year after project completion (201018.) In reality, the volume of discharged sewage in the whole city one year after project completion (201219) was 267,000 m3/day, about 80% of the expected volume. The volume of sewage flowing into the sewage treatment plants was lower than expected. However, the actual treatment volume was 82% of the target, and the ratio of treated sewage was 90% to the sewage volume, which was higher than the target.. Therefore, it can be said that effects generally arose. When the ex-post evaluation was conducted in 2015, the volume of sewage treatment decreased and the treatment rate was 73%. This was because the three treatment plants covered by this project were remodeled to add facilities or strengthen for treatment capacity in 2015 and the plants suspended the operations and reduced the treatment volume during the remodeling. Both the treatment volume and the treatment rate are expected to recover to the target levels when the remodeling is completed in 2016.

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

[16] The percentage of sewered population is calculated by dividing the population connected with sewage pipes in the treatment region by the total population in the treatmentregion.

[17] The revised Sewerage Master Plan (2010 – 2020) forecasted the population in the whole City. Regarding forecasts for each treatment plant, demand for water supply and demand for sewage treatment were calculated from areas of houses, companies, and public facilities.

[18] The target year set at the time of the appraisal was 2010, one year after project completion in December 2008.

[19] The project completion year was 2012, which is one year after the completion of the rainwater pipes in December 2011.

Table 3: Target and the Actual Results of the Sewage Treatment Volume and the Rate

Year	Baseline	Target	Actual						
		1 year after Completion	Implementation		Completion	1year	2years	3years	4years
	2002	2010	2009	2010	2011	2012	2013	2014	2015
Volume of Sewage Water in Huhhot City (10,000 ㎥/day)	23.0	33.4	23.9	24.7	25.4	26.7	27.9	29.7	30.6
Sewage Treatment Volume in Huhhot City (10,000 ㎥/day)	10.0	29.4*	15.1	19.0	22.6	24.0	24.0	25.8	22.4
Sewage Treatment Rate of Huhhot City	43.5%	88%	63%	77%	89%	90%	86%	87%	73%

Source: Baseline data and target value on materials submitted by JICA, actual data in Huhhot City Statistical Yearbook.
* The target volume of sewage treatment in Huhhot City is the total volume in the four treatment plants, including the cancelled Ruybaita plant.
Note: The values enclosed by bold lines are the actual values one year after the completion.

According to the plan at the time of the appraisal, the population in the sewage treatment region in Huhhot City one year after project completion was estimated to be 1.4 million and the target percentage of the sewered population was set at 100%. According to estimation,[20] the population in the sewage treatment region exceeded the target population of 1.4 million in 2011. One year after project completion (2012) the sewered population reached to 1.5 million, and exceeded the target. .However, the percentage of sewered population was 90% due to an increase in the population in the region.

Table 4: Population in Sewage Treatment Region: Sewered Population and the Percentage of Sewered Population[21]

(unit: 10,000)

Year	baseline	target	Actual						
		1 year after Completion	Implementation		Completion	1year	2years	3years	4years
	2002	2010	2009	2010	2011	2012	2013	2014	2015
Population in the Sewered Region in Huhhot City	115	140	166	171	159	167	174	185	191
Sewered Population in Huhhot City	52	140	105	132	141	150	150	161	140
Percentage of Sewered Population* (%)	45%	100%	63%	77%	89%	90%	86%	87%	73%

Sources: baseline and target values are based on materials submitted by JICA. The population of Huhhot City is based on data in Huhhot City Statistical Yearbook. The sewered population was estimated from the volume of treated sewage. * The percentage of sewered population is the ratio of population connected with sewage pipes in the sewage treatment system to the total population in the treatment region.

[20] Because the Gongzhufu and Zhanggaiying sewage treatment plants were completed in October 2009 and the Xinxinban plant was completed in December 2010, the sewered population and the percentage of sewered population may be overestimated compared with the target values set at the time of the appraisal.
[21] The population in the sewage treatment region and the sewered population were estimated by the use of 144 liters/day from 2006 to 2010 and 160 liters/day from 2011 to 2020 (the volume of water used per person in the Sewerage Master Plan at the time of the planning (180 liters/day from 2006 to 2010; 200 liters/day in 2020) multiplied by the polluted water conversion coefficient).

2) The Treatment Volume and the Rate of the Sewage Treatment, and the Plant Operation Rate[22]of the Plants Constructed under the Project,

Gongzhufu Sewage Treatment Plant

According to the plan at the time of the appraisal, volume of waste water in the service region was estimated as 44,000 m^3/day, 88% of the designed volume of 50,000 m^3/day. The target was set to treat 100% of the volume. In 2010, one year after the completion, both the volume of waste water[23] and the volume of treatment were 35,000 m^3/day, 80% of the target, and the operation rate was 69%. This was because companies in the service areas began treatment of sewage to recycle water in their factories and, as a result, the volume of waste water flowing into the treatment plants was lower than estimated. This was a favorable change for the impact of this project.

Xinxinban Sewage Treatment Plant

At the time of the appraisal, the target volume of treatment one year after project completion was 180,000 m^3/day and the target volume of treatment was 150,000 m^3/day, 83.3% of the waste water. In reality, the volume of treatment was almost as planned and the operation rate was 99% of the designed capacity (150,000 m^3/day).

Zhanggaiying Sewage Treatment Plant

At the time of the appraisal, the target volume of treatment one year after the project completion was 90% of the waste water flow of 66,900 m^3/day. The actual volume of treatment was 57,000 m^3/day, 95% of the plan. The plant operation rate was 95% of the designed capacity (60,000 m^3/day).

Table 5: Waste Water Treatment Volume, Facility Utilization Rate of the 3 Treatment Plants

Year	Baseline	Target	Actual						
		1 year after completion							
	2002	2010	2009	2010	2011	2012	2013	2014	2015
Gongzhufu Sewage Treatment Plant (one year after completion:2010)									
Waste Water Treatment Volume (10,000 ㎥/day)	0	4.4	2.3	3.5	3.3	3.4	3.4	3.2	1.3
Facility utilization rate	—	88%	46%	69%	67%	68%	67%	63%	25%
Xinxinban Sewage Treatment Plant (one year after completion:2012)									
Waste Water Treatment (10,000 ㎥/day)	10.0	15.0	9.2	9.9	13.5	14.8	14.8	13.8	12.3
Facility Utilization Rate	—	100%	62%	66%	90%	99%	98%	92%	90%
Zhanggaiying Sewage Treatment Plant (one year after completion:2010)									
Waste Water Treatment (10,000 ㎥/day)	0	6	3.6	5.7	5.8	5.8	5.8	5.3	5.0
Facility Utilization Rate	—	100%	60%	95%	97%	97%	97%	88%	84%

Source: material provided by Huhhot Shouchuang Chunhua Water Development Co., Ltd.

3) State of Spread of Sewage Treatment Service

Regarding the area of development in the sewage treatment regions and the length of the network of pipes as substitutes for the indicator on percentage of sewered population, both the

[22] Because the plant operation rate (how much each plant is used in comparison with capacity) was not used as an operation and effect indicator at the time of the appraisal, it is calculated as a reference for this ex-post evaluation.

[23] At the time of the appraisal, the volume of sewage was defined as the volume of sewage generated within the treatment area of each treatment plant. However, because the network of sewage collection pipes in Huhhot City can switch the points of connection to the treatment plants to change the treatment plant into which sewage flows, it is impossible to limit treatment region. Therefore, the volume of sewage generated within a treatment area cannot be assessed and the actual volume of sewage is the volume of sewage flowing into each treatment plant.

target area and the target length were achieved 100% one year after the completion in the service areas of the Gongzhufu and Zhanggaiying sewage treatment plants. They almost achieved 100% one year after the completion in the service area of the Xinxinban plant. Because the Xinxinban plant undertook the treatment of sewage generated in the service areas of other plants in 2012 and 2013, the length of the network of pipes has become 108% of the planned length in the service area of the Xinxinban plant.[24]

Inlet filter of the Zhanggaiying

Settling pond in the Xinxinban

(2) Effect Indicators

At the time of the appraisal, as an indicator for sewage treatment's effect of water quality improvement, target values were set for the biochemical oxygen demand (BOD), suspended solids (SS), and NH_3-N concentration of discharged water. One year after the completion, the three sewage treatment plants achieved the target values. Since then, the Xinxinban and Zhanggaiying plants have maintained this effect. Although the Gongzhufu plant (Table 6) achieved the target value of NH_3-N in 2010, the effects were not maintained after that. According to the project implementation unit, the value of NH_3-N at the inlet was 20% to 50% higher than estimated because untreated wastewater flowed from neighboring factories.[25] Because the reduction rate exceeded the target and met the secondary-class national standards, the effect indicators are judged to be almost fulfilled.

Table 6: NH_3-N Treatment in Gongzhufu Sewage Treatment Plant

Year		Target[26]	Actual					
		(2010)	2009	2010	2011	2012	2013	2014
NH_3-N (mg/l)	Inlet	30	38.5	36.8	46.3	41.7	36.6	39.8
	Outlet	15 (30)*	14.2	13.3	20.2	15.4	17.2	17.4
	Reduction Rate	50%	63%	64%	56%	63%	53%	56%

Source: material provided by Huhhot Shouchuang Chunhua Water Development Co., Ltd.

* Because target values are different from the national government's discharge standards, both target values and national standards are written in the table. National standards are written in parentheses.

Although target values were not set at the time of the appraisal, sewage treatment is required

[24] In 2014, because the Jinqiao sewage treatment plant began to operate, the Xinxinban plant ceased to undertake the treatment of sewage generated in service areas of other plants and, as a result, the length of the network of pipes returned to 100% of the total length in its own service area.

[25] Large companies and factories designated as important pollutant sources are required to remove pollutants at their own sewage treatment plants under strict emission control. According to the actual project executor, however, it cannot be said that all companies are under the strict emission control, and some companies elude monitoring and discharge pollutants into sewage or rivers.

[26] According to the actual project executor, although the Gongzhufu sewage treatment plant was under the regulation of the national standard of the secondary class, however the target values were set higher than the standards at the time of the appraisal because the plant adopted the latest CASS method.

to meet the secondary-class national standards[27] concerning not only the above-mentioned three substances but also discharged water's COD concentration, total nitrogen (T-N) concentration, total phosphorous (T-P) concentration, and hydrogen ion concentration (pH). The three treatment plants were able to meet the national standards for the concentration of any substance. In addition, as a result of this project, the quality of water treated at the Gongzhufu and Zhanggaiying sewage treatment plants, where tertiary treatment facilities were constructed, meet the target values of all the substances designated at the time of the appraisal and the national standards for other substances.

In light of the above, Huhhot City has almost fulfilled the targets for the sewage treatment volume and the sewage treatment rate. The treatment volume in the target year (one year after the completion) was 80% at the Gongzhufu plant, which had been influenced by a decrease in the inflow volume, 99% at the Xinxinban plant, and 95% at the Zhanggaiying plant. Additionally, due to the reason that sewage treatment service has been spreading and the effect indicators have been almost fulfilled, it can be judged that quantitative effects have arisen in the project as a whole.

3.3.2 Qualitative Effects (Other Effects)

At the time of the appraisal, it was assumed that qualitative effects were "improvement of water pollution in the Xi River, the Xiaohei River, and other rivers by the establishment of a network of sewage pipes" and "reuse of water after sewage treatment." Regarding the improvement of water pollution, "improvement of the water quality of the rivers in the City," the impact level of this project is applied and integrated into "3.4 Impact" below.

(1) Reuse of Water after Sewage Treatment

At the time of the appraisal, at the Gongzhufu and Zhanggaiying sewage treatment plants, where tertiary treatment facilities were planned to be constructed under this project, reclaimed water was planned to be used as cooling water at power plants (30,000 m^3/day) and as scenic water[28] in parks and the like (50,000 m^3/day).

At the time of the ex-post evaluation, the volume of water used and the recycling rate were lower than the target values, except for the Gongzhufu plant, which achieved the target recycling volume in 2012. At the Zhanggaiying plant, the annual recycling rate was 7% to 12%, considerably lower than the target, and tertiary treatment was not carried out in 2014 and 2015.

The water recycling rate was lower than planned because the tertiary treatment facilities are operated according to the volume of demand for reclaimed water. Demand for reclaimed water was lower than expected because of the following reasons: there was a delay in the construction of power plants to which water was to be supplied; large factories planning to use reclaimed water constructed sewage treatment plants within them to recycle water themselves; and scenic water was used only in the winter season.

The revised "Huhhot City Sewerage Master Plan (2010 – 2020)" specified the policy to increase the volume of use of reclaimed water to 390,000 m^3/day by 2020 through the expansion of use of reclaimed water to industrial purposes, road cleaning, and car washing. In addition, demand for reclaimed water is expected to increase at the Gongzhufu and Zhanggaiying plants. Therefore, it is judged that effects will arise.

[27] Discharge Standards of Pollutants for Municipal Waste Water Treatment Plants (GB18918-2002)

[28] Collective name for water used for watering plants in parks and maintaining landscapes by pouring water into rivers in the dry season in China.

(2) Effect of Training

According to the participants for the training in Japan for the officers in charge of the operation and maintenance of the sewage treatment plants, as an effect of the training, the method of operating and maintaining treatment plants in Japan, odor control, and tidying-up in the plants were added to the design and the operation. In addition, for the purpose of environmental education, preparations have been made to adopt what is carried out in treatment plants in Japan, such as the acceptance of field trips and the cultivation of flowers. On the other hand, two engineers working at the treatment plants answered that because sewage treatment systems in Japan were old-fashioned, they did not serve as a reference concerning the new type of treatment technology adopted in this project.

In light of the above, the targets for the following were almost achieved: the sewage treatment rate, the sewered population, and the percentage of sewered population in Huhhot City; the operation indicators, such as the operation rate, of each treatment plant area of facilities, and length of the network of pipes; and the quality of discharged water as an effect indicator. Therefore, it can be said that the effects of this project have arisen. Although the target recycling rate of water, which was set as a qualitative effect, has not been achieved due to a decrease in demand, demand for reclaimed water is likely to increase. Therefore, good effects have arisen as a whole.

3.4 Impacts

3.4.1 Intended Impacts

The impacts of this project are “improvement in the water quality of the rivers in the City” and “sustainable development of the City.” Regarding them, changes in the water quality of the rivers in the City and the contribution of this project were analyzed. In addition, a beneficiary survey was conducted concerning changes in the river environment and the living environment in the City as a result of the beginning of sewage treatment service, and the state of emergence of project effects was checked.

(1) Improvement in the Water Quality of the Rivers in the City and the Contribution of the Project

1) Improvement in the Water Quality of the Rivers in the City

According to information published by the Inner Mongolia Autonomous Region Environmental Protection Bureau, the water quality of the Xiaohei River improved from inferior class V at the time of appraisal to class V in 2011. The water quality of the Dahei River (the main river of the Xiaohei River) was also improved from inferior class V at the time of appraisal to class V in 2010 and has maintained that level. However, because the change was caused by many other factors in addition to this project, it is difficult to find a direct causal relationship with this project. The factors contributing to the improvement include not only sewage treatment but also the installation of sewage pipes and rainwater pipes. This project installed 35% of the sewage pipes and 20% of the rainwater pipes in the whole Huhhot City. According to the project implementation unit, the promotion of construction of rainwater pipes has produced the effect of reducing flood damage in the rainy season. The “12th Five-year Environmental Protection Plan in Huhhot City (2010 – 2015)” focused on dye factories and other companies to reduce pollutant discharge, obliged factories to treat sewage within themselves, and imposed the objective of reducing pollutants. The degree of achievement is monitored by the Environmental Protection Bureau. If a company fails to achieve the objective, penalty or shutdown will be imposed on the company. Such strict management of discharged water is also one of the factors contributing to the improvement of the water quality of the rivers.

Water treated at the Gongzhufu sewage treatment plant and discharged to a branch of the Xiaohei River

2) Monitoring Data at Points of Observation

At the time of the appraisal, observation points were designated to monitor water discharge from the sewage treatment plants constructed by this project. However, because data on results were not available,[29] it is impossible to analyze the water quality of the rivers quantitatively at each section. Instead, a field survey was conducted to observe the state of each discharge point of each sewage treatment plant.

The wastewater discharge points of the Gongzhufu and Xinxinban sewage treatment plants were located in residential areas where shores were protected by concrete and the networks of sewage pipes were established. The rivers did not emit an odor and water appeared to be transparent. On the other hand, the wastewater discharge point of the Zhanggaiying sewage treatment plant was located in a rural area. The river emitted an odor and the water appeared to be muddy. In this area, because a network of sewage pipes were under construction, domestic wastewater seems to be discharged without treatment. According to the project implementation unit, the effects of discharge of treated water include reducing muddiness and odor through the dilution of river pollutants and easing the problem of river water shortage in the dry season.

Treated water discharged from the Xinxinban sewage treatment plant into the Xiaohei River

Treated water discharged from the Zhanggaiying sewage treatment plant into a branch of the Xiaohei River

3) State of Reduction in Pollutants by the Project

By comparing the total volume of pollutants (COD, NH_3-N) discharged into sewege in the whole of Huhhot City with the volume of pollutants reduced by this project, it is possible to analyze how much this project contributes to improvement in the water quality of the rivers in Huhhot City. The ratio of pollutants reduced by this project to the annual total volume is 1.6 to 8% in the case of COD and 2.7 to 3.6% in the case of NH_3-N. Given the size of inputs into Huhhot City, where various projects are carried out to improve the water environment, this project has considerably contributed to the reduction of pollutants in the whole city.

(2) Beneficiary Survey

Regarding “improvement in the water quality of the rivers” and “sustainable development of the City,” a beneficiary survey on residents[30] (60 samples) and a corporate survey[31] (20

[29] The Environmental Protection Bureau of Huhhot City has established observation points to monitor the water quality of the rivers. Although data on the sections of the rivers are collected at the points every day, no data were disclosed.

[30] The beneficiary survey was conducted door-to-door and covered 60 local residents (20 for each sewage treatment plant) who have houses near rivers and around the three plants that began to provide sewage treatment service under this project. Of the respondents, 58% were men and 42% were women. By age group, 25% were between 20 and 29, 27% were between 30 and 39, 18% were between 40 and 49, 13% were between 50 and 59, 13% were between 60

samples) were conducted to study changes in the river environment, the environments for living and corporate activities before the project (2005) and at the time of the ex-post evaluation, and the degree of satisfaction with sewage treatment service.

1) Beneficiary Survey

According to the results of the beneficiary survey, more than 85% of the respondents recognized improvement in the water quality of the rivers, the river environment, and the living environment, which indicates that sewage treatment made some contribution. On the other hand, although more than 60% are satisfied with sewage treatment service, about 40% answered "If anything, unsatisfactory." This is mainly because of provision of information on services, customer service, and phone response. However, more than 10% of the respondents pointed out a delay in the spread of sewage facilities. It can be said that beneficiaries are expecting wider sewage treatment services.

2) Corporate Survey

According to the results of the corporate survey, more than 80% of the companies answered that improvement was shown in drainage, clogged pipes, odor, and the hygiene environment. However, 35% of the respondents thought that there is no change in flooding around the companies because of heavy rain in the rainy season. This seems because the installation of rainwater pipes in the City is incomplete and drainage ditches are clogged due to refuse dumping and insufficient maintenance.

3.4.2 Other impacts

(1) Impacts on the Natural Environment[32]

1) Monitoring during Project Execution

At the time of the appraisal, no negative impact on the natural environment was assumed. During the construction of the sewage treatment plants under this project, as planned at the time of the appraisal, the observation unit of the Environmental Protection Bureau' conducted unannounced inspections in construction sites to check the state of exhaust, fine particles, noise, vibration, waste, and drainage and reported the results to the Environmental Monitoring Center. The record was reported quarterly to the Environmental Protection Bureau of Huhhot City. According to the results of interviews with the project implementation unit, the construction was in accordance with the environmental protection standards and there was no special problem during the construction.

According to the beneficiary survey conducted to the residents mentioned above, 70 to 80% answered "did not mind at all / did not mind much" to the environmental impacts under monitoring during the project implementation, such as exhaust, waste, drainage, vibration and noise. Regarding the fine particles, 63% answered "did not mind at all / did not mind much." To all the categories a few answered "mind very much/ mind a little", however Inner Mongolia Autonomous Region is the area, where is influenced by yellow sand storms, also the City was developing rapidly with construction of residences and the number of cars was increasing, it is difficult to extract the environmental impact purely by the project and evaluate its impact separately from other causes.

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and 69, and 4% were 70 years old and over.

[31] The corporate survey covered 20 companies around the sewage treatment plants (8 companies around the Zhanggaiying plant; 4 companies around the Xinxinban plant; 4 companies around the Gongzhufu plant). The 20 companies consisted of 10 service providers, 5 manufacturers, 3 constructors, 1 company engaged in agriculture, forestry, or fisheries, and 1 company engaged in medical care.

[32] The survey report on the environmental impacts of this project was approved by the Environmental Protection Bureau of the Inner Mongolia Autonomous Region in July 2003.

2) Monitoring after Project Completion

The completed three sewage treatment plants monitor the concentration of pollutants (COD, BOD, SS, T-N, T-P, pH, etc.) in the water for 24 hours by monitors installed at the sewage inlets and outlets. The monitors are managed by a third-party organization specialized in environmental monitoring. The monitoring data are directly sent online to the State Environmental Protection Bureau. In addition, to check the precision of the observation equipment, the staff of the laboratory in each of the sewage treatment plants inspects the quality of water flowing into and out from the plant every day.

In order to remove odor, the Gongzhufu sewage treatment plant carries out ion deodorization, while the Xinxinban plant carries out bio-deodorization. The Zhanggaiying plant does not apply these deodorization devices as the other plants did, because it is located in an industrial zone apart from residential zones.

Sludge generated in each of the sewage treatment plants is dehydrated to a moisture content of about 80%, is conveyed to suburban waste treatment facilities by trucks, is further dehydrated by heat to a moisture content of 30 to 40%, and is burnt by a refuse incinerator together with household refuse. After being burnt, refuse is buried. At the time of the ex-post evaluation, sludge recycling facilities are under construction in Huhhot City. From 2017 onwards, when the facilities are completed, the sludge disposal method in each sewage treatment plant is likely to change from burying to recycling.

3) Monitoring of the Rivers in the City

Although the Environmental Protection Bureau of Huhhot City is monitoring the water quality of the rivers in the City, data are unavailable because concrete data on the method and the water quality are not open to the public.

(2) Land Acquisition and Resettlement

At the time of the appraisal, it was planned that sites with a total area of 56 ha would be acquired for the four sewage treatment plants. In reality, sites with a total area of 23 ha were acquired, due to the cancellation of the construction of the Ruybaita plant and fine adjustment of a site for additional construction of the Xinxinban plant. Because sites are vacant lots where it used to be factories or undeveloped wasteland, there was no resettlement.

(3) Other Impacts

None in particular.

In light of the above, this project has largely achieved its objectives. Therefore, effectiveness and impact of this project are high.

3.5 Sustainability (Rating:③)

3.5.1 Institutional Aspects of Operation and Maintenance

As planned at the time of the appraisal, the ODA Loan Office was established in the Office of Foreign Affairs, the Department of Finance, Inner Mongolia Autonomous Region. The ODA Loan Office took charge of liaison and coordination with related agencies, domestic fundraising, and repayment of loans.

At the time of the ex-post evaluation, such offices at the autonomous region level has changed its name to public investment offices, and has expanded the jurisdiction over projects with domestic and foreign loans. Because main officers in charge of this project have not been replaced since the appraisal and have continued to be in charge of liaison and coordination and supervise subordinate organizations, such as the project implementation unit, there is no significant change in the substantial operation of this project.

At the time of the appraisal, it was planned that the Huhhot Chunhua Water Development

Co., Ltd.[33](hereinafter referred to as "Chunhua Co.") would take charge of the construction and remodeling of the sewage treatment plants and their operation and management. However, the Huhhot Shouchuang Chunhua Water Development Co., Ltd. (hereinafter referred to as "Shouchuang Chunhua Co.") was established as its subsidiary, and these duties were transferred to the subsidiary in December 2008. The staff members for the operation and maintenance were transferred from Chunhua Co. to the subsidiary.

The sewage treatment plants are actually operated by the Production Management Department of Shouchuang Chunhua Co. Table 7 shows the number of staff in each plant. According to Shouchuang Chunhua Co., staff in charge of clerical work and management are stationed in each plant, and the sufficient number of the staff necessary for the operation of the plant is placed, including the engineers engaged in the operation and maintenance of the plant, the manager of the monitoring room, the patrol staff, and the engineers engaged in water quality inspection.

Table 7: Headcount of Each Sewage Treatment Plants Production Management Department

(unit:person)

	Total	Operation	Management	Administration
Gongzhufu Sewage Treatment Plant	**31**	26	2	3
Xinxinban Sewage Treatment Plant	**41**	36	2	3
Zhanggaiying Sewage Treatment Plant	**27**	21	2	4

Source: data provided by Huhhot Shouchuang Chunhua Water Development Co., Ltd.

To sum up, no problem has been observed in the operating and maintaining institutional systems during and after the project execution.

3.5.2 Technical Aspects of Operation and Maintenance

Technical Level of Operation and Maintenance

The engineers transfer techniques to each other within Shouchuang Chunhua Co., which is in charge of operation and maintenance. Every year, seven to eight types of training are held for engineers and other employees. The company also holds training to respond to emergencies. It appropriately prepares manuals, records management logs, and keeps inventory of parts, etc. and, in each fiscal year, draws up and implements a business plan. The electric and laboratory engineers need to acquire qualifications as technicians. Because there is a term of validity for the licenses and renewal requires undergoing training and examination, the technical level has been maintained. In light of the above, no problem has been observed in the technical aspects of operation and maintenance.

3.5.3 Financial Aspects of Operation and Maintenance

Because 2009 was a year of trial run, the revenue from sewage treatment charges was lower than the operation and maintenance cost. Since 2010, however, the revenue has been higher than the cost.

Although most of the revenue is from sewage treatment charges, they are insufficient for operation and maintenance because they have been set at a low level. To cope with this, the City has given subsidies from the financial budget.[34] Because the sewage treatment plants are regarded as important infrastructures for the City, its subsidies are guaranteed and shutdown is unlikely to occur due to financial shortage. In the development plan at the national level also, improvement of water quality is an important issue and receives priority in budget allocation.

[33] Chunhua Co. is a company totally owned by Huhhot City Government and constructs, operates, and maintains waterworks, sewer, river improvement works, etc. Because it has several subsidiaries engaged in the development of the water environment, the name was changed to the Huhhot Chunhua Water Development Co., Ltd. There is no change in the type of business and the state of investments.

[34] Data on the ratio of the City's subsidies are not available, because the total expenses, including the expenses for using sewerage, are collectively paid from the Finance Agency to Chunhua Co., the parent company.

Because this situation is unlikely to change, it is hard to foresee any problem in securing the operation and maintenance cost. Although sewerage charges are insufficient for financing the operation and maintenance cost, because the City government is expected to continue to give subsidies, there is no problem in the sustainability of the operation and maintenance cost.

3.5.4 Current Status of Operation and Maintenance

According to the results of interviews and a field survey concerning the status of the operation and maintenance of the three treatment plants, the plants constructed by this project have continued to treat sewage, keeping the volume and the water quality in accordance with the project plan and the national standards respectively.

Main machinery, such as pumps and dehydrators were regularly inspected, maintained, and cleaned. Although repairing and expansion were carried out at the time of the field survey, the main machinery was kept sufficient to display the functions planned by this project. Although construction materials were put on the ground, those were put in order, and manuals and maintenance, inspection, and patrol records were kept completely. No problem has observed. In addition, each sewage treatment plant has a private electric generator in case of a power failure.

According to the project implementation unit, the network of rainwater pipes installed in the City is functioning normally. In the whole of China, however, some problems have occurred. Rainwater pipes installed under roads are clogged with refuse and soil. Water for domestic use and oil used for cooking are dumped into drainage ditches. These problems have occurred also in Huhhot City.

The project implementation unit has established mid- and long-term maintenance plans in accordance with the sewage treatment master plan of the City and has renewed and repaired equipment. Although some foreign parts have been introduced, there is no problem in acquiring them because they can be secured through domestic agencies.

In light of the above, no major problems have been observed in the institutional, technical, and financial aspects of the operation and maintenance system. Therefore, the sustainability of the project effects is high.

4. Conclusion, Lessons Learned, and Recommendations

4.1 Conclusion

The objective of this project is to improve the water quality of rivers in Huhhot City in the Inner Mongolia Autonomous Region by increasing the sewage treatment rate through the construction of sewerage facilities.

This project was consistent with China's development policies and development needs at the national, autonomous region, and municipal levels at the time of the appraisal and the ex-post evaluation; Japan's policy for assistance to China at the time of the appraisal. Therefore, its relevance is high. At the time of the ex-post evaluation, addition and remodeling were carried out to keep up with the urban development plan. Because the operation was suspended or reduced during the period, the sewage treatment volume and the treatment rate were lower than the target values. However, it can be judged that effects have arisen because of the following factors: the volume and the rate are likely to recover after the completion of the remodeling construction; indicators for main effects, such as the sewage treatment rate and the quality of the treated water, have almost achieved the targets; and sewerage service has been spreading smoothly. Moreover, at the time of the ex-post evaluation, the effectiveness and impact of this project are high, because this project seems to widely contribute to improvement in the water quality of rivers in Huhhot City, as indicated by a decrease in the total volume of pollutants discharged into water in the City. Although, just after the beginning of this project, the sewerage master plan was revised to cancel the construction of the Ruybaita sewage treatment plant and reduce the tertiary treatment capacity of the Zhanggaiying sewage treatment plant, these

changes were due to a review of the sewerage construction plan and were in accordance with this project's objective of contributing to urban development. While the project cost was lower than planned, a considerable delay was caused in the project period and the efficiency of the project is fair. Regarding the sustainability of the effects that arose by this project, there is no great problem in the maintenance system of operating agency, technology, and finance. Therefore, the sustainability of the project is high.

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

4.2 Recommendations

None

4.3 Lessons Learned

Need for Monitoring and Support during Changes in this Project

Just after the beginning of this project, the urban plan was changed and the construction of the Ruybaita sewage treatment plant and the network of pipes were cancelled. To cancel the construction, the executing agency and the project implementation unit had to file an application with the City, the autonomous region, and the state as well as several agencies at multiple levels, such as the Development Reform Committee, the Finance Agency, and the Construction Agency. Because it was impossible to give any report to JICA or coordinate with it until receiving an official approval, some delay occurred in communication and information sharing with JICA. Although the project executor had an intention to use the surplus resulting from the cancellation for constructing another treatment plant, this could not be materialized until the end of the term of the ODA loan, resulting in loss of opportunity. In JICA's loan projects for developing countries, because many organizations are unfamiliar with making changes in a project plan, it frequently takes a lot of time to proceed with intergovernmental procedures or give approval. In such cases, JICA should monitor the situation even during the procedures up to approval and, on occasions such as dispatch of a midterm supervision mission, consider coordinating with superior organizations and giving support in carrying out the procedures.

Need for Consultation about the Preparation of a Training Plan according to Local Needs

Although the training in Japan for the staff in charge of the operation and maintenance of the sewage treatment plants under this project accomplished some achievements, some participating engineers working at sewage treatment plants answered in interviews that because Japan's sewage treatment systems were old-fashioned, they did not serve as a reference for the new-type treatment facilities constructed by this project.

On the course of designing a detailed training plan, if the project is to implement new technology or specification, JICA should explain the executing agency that the agency should select the contents and visitation destination which fit to the technology and the specification. Moreover, to say, if the training plan is to function an important role in the project, the detailed contents should be made a request item by the agency, subject to JICA's concurrence, so to avoid mismatching to the actual conduct of the project.

Comparison of the Original and Actual Scope of the Project

Item	Plan	Actual
(1) Project Outputs Gongzhufu Sewage Treatment Plant	CAST Process Secondary Treatment 50,000 ㎥/day Tertiary Treatment 30,000 ㎥/day Sewage Pipe Network approx.30 km	As planned
Xinxinban Sewage Treatment Plant	Activated Sludge Process Secondary Treatment 50,000 ㎥/day Sewage Pipe Network approx.120 km	As planned Cancelled
Ruybaita Sewage Treatment Plant	CAST process Secondary Treatment 40,000 ㎥/day Sewage Pipe Network approx.40 km	As planned Reduced to 30,000 ㎥/day
Zhanggaiying Sewage Treatment Plant.	Activated Sludge Process Secondary Treatment 60,000 ㎥/day Tertiary Treatment 50,000 ㎥/day	Reduced to approx. 80 km
Storm water pipeline	Drainage Network approx.128 km Distribution Network approx..24 km	As planned
Training	Project Implementation Unit 3 times total 20 staff Environmental Protection Bureaus 3 times total 20 staff	2 times total 19 staff Cancelled
(2) Project Period	April 2000 – December 2008 (57 months)	April 2004 – December 2011 (93 months)
(3) Project Cost Foreign Currency Local Currency Total ODA loan portion Exchange Rate	 9,747 million Japanese yen 3,334 million Japanese yen (233 million Chinese yuan) 13,081 million Japanese yen 9,747 million Japanese yen 1 Chinese yuan ＝ 14.3 yen (as of September 2003)	 8,074 million Japanese yen 3,031 million Japanese yen (218 million Chinese yuan) 11,105 million Japanese yen 8,082 million Japanese yen 1 Chinese yuan ＝ 13.89 Japanese yen (average rate of IMF2004 -2013)

People's Republic of China

FY 2015 Ex-Post Evaluation of Japanese ODA Loan Project
"Xinjiang Yining City Environmental Renovation Project"

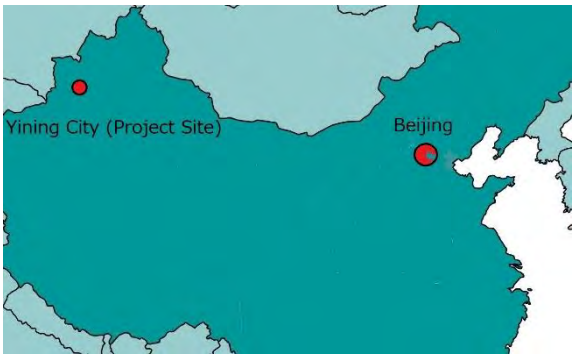
External Evaluator: Kenji Momota, IC Net Limited

0. Summary

This project was carried out with the goal of promoting improvements in environmental infrastructure in Yining City, Xinjiang Uyghur Autonomous Region that includes: (1) Repairing and expanding water supply and sewage systems, (2) Constructing new garbage treatment facilities, (3) Constructing new district heating supply and natural gas supply facilities, and (4) Creating shelterbelt. Through this, it aimed to improve the water supply, cut down on air and water pollutants, and detoxify and dispose of waste, thereby contributing to improving the urban environment of the city and raising the living standards of its residents.

The project has remained consistent with the development policies and needs at the national and city level in China from the time of the appraisal through to the present, and therefore its relevance is high. The facilities that were improved or established through each of the sub-projects are in good working order, and these are giving rise to positive results. The quality of the water in the major river of the city (the Ili River) has not changed significantly since the time of the appraisal. However, since the amount of sewage being generated is declining even as urban development advances, this restrains the deterioration of the water quality in the river. Obvious improvements have been seen in the air quality since the project has been implemented. As a result, the local residents offered opinions to the effect that their living environment has improved. As these and other factors indicate, effectiveness and impact of the project are high. While the project costs for the project did not go over the planned costs, the project period did exceed what was planned. Therefore, efficiency of the project is fair. In terms of sustainability, no major problems were observed on the organizational or technical fronts. However, on the financial front, it will be difficult for the project to turn a profit on its own. Thus, its financial management is expected to keep relying on government subsidies. It is impossible to forecast precisely the medium to long-term future trends regarding financial inputs. As a result, concerns remain on the financial front, and therefore sustainability of the project effects is fair. In light of the above, this project is evaluated to be satisfactory.

1. Project Description



Project location

Pumps installed through the urban water supply system sub-project

1.1 Background

While China has achieved rapid economic growth, environmental pollution has worsened since the 1980s as a result of industrialization and the rising population of the country. Both its water and air quality have continued to fall far below national standards. What is more, as both economic and urban development have advanced, the forest cover rate of the country has continued to decline. As a result, problems like flood damage from soil erosion have grown more severe. Given such circumstances, the Chinese government incorporated a number of issues for this into its "Ninth and Tenth Five-year Environmental Protection Plans (1996-2000 / 2001-2005)". These included improving water supply and sewage systems, countermeasures to industrial pollution, upgrading urban infrastructure for things like city gas, and ecological protection. For its inland areas in which development was lagging particularly far behind, China formulated the "Great Western Development Strategy" and promoted investments into regional development for this area. Yining City is a city in Xinjiang Uyghur Autonomous Region located in the north-westernmost tip of China. As the prefectural capital of the Ili Kazakh Autonomous Prefecture, the city occupies an important position when it comes to the development of the autonomous region that is on par with the capital city of Ürümqi in the region. As a result of the economic development in China over the past ten years, the city has achieved remarkable economic development, primarily in its major industry of stock raising, together with the tertiary industries of commerce and tourism. While the population of the city has grown considerably as a result of development, conversely it has lagged behind in terms of upgrading its environmental infrastructure. Because of factors like the discharge of untreated sewage, the water in the Ili River, which flows through the southern part of the city, has become polluted. It is considered Class V[1], which is below Class III[2] targeted as the national water quality standard in the development plans mentioned above. The city also failed to meet the national environmental standard value (Class 2 standard) for its concentration of air pollutants. Given such circumstances, there was an urgent need to promote improvements in the core infrastructure within the city such as improving water supply, improving district heating supply, treating sewage, disposing of waste, and greening.

1.2 Project Outline

This project promoted improvements in environmental infrastructure in Yining City, Xinjiang Uyghur Autonomous Region that include: (1) Repairing and expanding water supply and sewage systems, (2) Constructing new garbage treatment facilities, (3) Constructing new district heating supply and natural gas supply facilities, and (4) Creating shelterbelt. Through this, it aimed to improve the water supply, cut down on air and water pollutants, and detoxify and dispose of waste, thereby contributing to improving the urban environment of the city and raising the living standards of its residents.

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[1] According to documents from JICA.

[2] The "Environmental Quality Standard for Surface Water GB3838-1988" was enacted in 1988 by the State Environmental Protection Administration (currently the Ministry of Environmental Protection). It classified 30 indicators relating to water quality, such as chemical oxygen demand, into categories from Class I-V. The water quality gets worse as you go down the ranks from Class I to Class V. It stipulates that for chemical oxygen demand, 15mg/l or less qualifies as Class I and Class II, 15mg/l qualifies as Class III, 20mg/l qualifies as Class IV, and 25mg/l qualifies as Class V. Under GB3838-2002, in which these standards were revised in 2002, criterion was changed to 15mg/l or less for Class I and Class II, 20mg/l for Class III, 30mg/l for Class IV, and 40mg/l for Class V.

[ODA Loan Project]

Loan Approved Amount / Disbursed Amount	6,462 million yen / 6,461 million yen	
Exchange of Notes Date/ Loan Agreement Signing Date	March 2005 / March 2005	
Terms and Conditions	Interest rates	1.50%, 0.75%
	Repayment period (Grace period)	30 years, 40 years (10 years)
	Procurement conditions	General untied
Borrower / Executing Agency (ies)	Government of the People's Republic of China / Yining Municipal People's Government	
Final Disbursement Date	July 2013	
Main Contractors	Hubei International Trade Investment and Development Co. Ltd., China National Precision Machinery Import and Export Corp. (China)	
Main Consultant	-	
Related Studies (Feasibility Studies: F/S), etc.	F/S (China Northeast Municipal Engineering Design and Research Institute Co., Ltd., China Academy of Urban Planning & Design, Xinjiang Uyghur Autonomous Region (March 2003))	
Related Projects	Suzhou Water Environmental Improvement Project (March 2000) Anshan Environmental Improvement Project (March 2002) Taiyuan Environmental Improvement Project (March 2002) Jilin Province Jilin City Comprehensive Environment Improvement Project (June 2006) Xinjiang Environmental Improvement Project (I) (March 2007) Xinjiang Environmental Improvement Project (II) (December 2007)	

2. Outline of the Evaluation Study

2.1 External Evaluator

Kenji Momota, IC Net Limited

2.2 Duration of Evaluation Study

This study was carried out as described below for this ex-post evaluation.

Duration of the Study: August 2015–January 2017

Duration of the Field Survey November 22–December 17, 2015, April 10–23, 2016

2.3 Constraints during the Evaluation Study

Information on the concentrations of water pollutants in the Ili River and the concentrations of air pollutants in the city, which constitute the impacts from this project, is governmental information that is not disclosed by the Environmental Protection Bureau of Yining City. As such, their response was that this could not be disclosed and therefore it could not be verified. As a result, the analysis of the water quality and air quality consists of estimates based on the information that could be obtained.

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

3.1 Relevance (Rating: ③[4])

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

(1) Consistency with Development Policies at the Time of the Appraisal

1) Consistency with the Policies of the Chinese Government and Yining City

Through the "Ninth and Tenth Five-year Plans (1996-2000 / 2001-2005)", the Chinese government enhanced its initiatives for achieving its planned environmental objectives by means of installing sewage systems, combating industrial pollution, and upgrading urban infrastructure like that for city gas. The "Tenth Five-year Plan" set the goal of reducing total emissions of major pollutants by 10% relative to 2000 levels. In addition, during the course of this plan the Chinese government enhanced its measures for development projects for its inland regions under its "Great Western Development Strategy". Throughout this, Xinjiang Uyghur Autonomous Region was constantly accorded a high priority level. Based on the development policies of the central government, Xinjiang Uyghur Autonomous Region also formulated its own "Tenth Five-year Plan". In the plan, it defined improving the ecological environment and controlling environmental pollution as priority issues. Based on the "Eco-model Region and Eco-province (City / County) Construction Work Plan"[5] instituted by the State Environmental Protection Administration, it set forth the objective of turning the city into an eco-model city by 2010 and carried out environmental measures.

2) Consistency with Sector Policies

The development policies and priority issues for each target sector at the time of the appraisal of the project are shown in Attachment table 1. All of the areas related to the scope of the sub-projects, including water supply and sewage infrastructure, greening measures, and measures for air pollution, are positioned as important development issues for China and Yining City. Therefore, the consistency of the project with priority issues is affirmed.

(2) Consistency with Development Policies at the Time of the Ex-post Evaluation (2015)

1) Consistency with the Policies of the Chinese Government and Yining City

The "Twelfth Five-year Plan (2011-2015)" defined resolving environmental issues that harm human health, such as safety issues with drinking water and air and soil contamination, as priority issues. Through this, ongoing efforts for environmental protection have been carried out. More specifically, it set the objectives of boosting the share of cities with Class II air quality or higher to 80%, urban sewage treatment rates to 85%, and the detoxification and disposal rates for household garbage to 80%. The "Great Western Development Strategy" deems Xinjiang Uyghur Autonomous Region a priority region and promotes environmental protection and improvements to the living environment of its residents. In particular, it strengthens countermeasures against water pollution, ensures the safety of drinking water, strengthens countermeasures against urban air pollution, and promotes the collection and transportation of waste in rural areas.

Yining City continues to strike a balance between safe water supply and profitability and places rigid restrictions on the total amount of pollutants discharged into the rivers of the city. It is also improving the sewage treatment capacity of the city by proactively building sewage treatment plants and promoting the management of the sewage treatment plants of the city by harnessing market mechanisms. With regard to garbage treatment, the detoxification and

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

[4] (3): "High," (2): "Fair," (1): "Low"

[5] Development Plan for Eco Model Regions, Provinces, Cities, and Counties: A plan that strives for harmonious development that strikes a social, economic, and ecological balance, and which aims to create urban areas that fulfill the requirements demanded of sustainable development in each area.

disposal of waste in rural areas began in 2014. Future plans that have been examined include the sorting recycling of waste and converting food waste into fertilizer for use through financing by the PPP.[6] These have already been incorporated into the "Thirteenth Five-year Plan (2016–2020)".

2) Consistency with Sector Policies

The development policies and priority issues for each target sector at the time of the ex-post evaluation are shown in Attachment table 1. The areas related to the sub-projects have not changed from the time of the appraisal in the sense that they are still regarded as important development issues for China and Yining City. Therefore, the consistency of the project with priority issues is affirmed.

As indicated above, the goal of this project of reducing water and air pollutants is regarded as a priority issue in the development policies of both the state and Yining City, and therefore the project is highly consistent with these. There was no change in how this is positioned from the time of the appraisal through to the time of the ex-post evaluation, and the development plans of the state have been promoting increasingly strict compliance when it comes to reducing emissions of water and air pollutants by setting the quantitative indicators. Xinjiang Uyghur Autonomous Region is still designated as a high priority region within the policies of the state, just as it was at the time of the appraisal, and so the consistency of the project with development plans is high.

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

(1) Consistency with Development Needs at the Time of the Appraisal

Yining City has experienced persistent population growth as a result of the development of the city. In consequence, the water quality of its rivers has deteriorated and air pollution have grown more severe, thus necessitating measures to improve the environment rapidly. The major conditions for each area are shown in Attachment table 2.

(2) Changes to the Project Scope

As a result of coordination with a development plan that was being implemented, the "urban natural gas utilization sub-project," which was one of the sub-projects of this project, came to be carried out using funds from the government of the autonomous region rather than financing from the ODA Loan project. The background behind this change lies in "Xinjiang Gasification Strategy", which was a natural gas strategy by the government of the autonomous region from back then. With this strategy, the government of the autonomous region set forth the goal of using natural gas in 70% or more of the urban areas in Xinjiang over the course of the "Twelfth Five-year Plan" by strengthening cooperation with the China National Petroleum Corporation and the China Petrochemical Corporation. Under the "West-East Gas Pipeline Plan" that was being promoted at the time, a gas export outlet was built in Horgos City, which is 70 km away from Yining City. The gas pipeline extending from this export outlet to Yining City was built using self-funding from the China National Petroleum Corporation and Xinjiang Uyghur Autonomous Region. Based on consultations with JICA, the government of Yining City cancelled the urban natural gas utilization sub-project under this yen-loan project. Those outputs from the plan at the time of the appraisal were set in place via self-financing from the China National Petroleum Corporation and the Yining Municipal People's Government. The decision was then made to use the surplus funds generated from cancelling this to install water supply and sewage systems and expand the construction of garbage treatment facilities through the

[6] The Public-Private-Partnership is a method to improve government services such as constructing urban infrastructures using funds and know-how of private sector companies.

project (as mentioned in the section on outputs). This alteration came about through a decision while coordinating with a development plan as a whole from back then by the government of Xinjiang Uyghur Autonomous Region. Ultimately, the outputs that had been planned initially were set in place and the surplus funds were properly reallocated to expanding and enhancing the other sub-projects. Therefore, this can be evaluated as being appropriate in terms of achieving the goals of the project.

(3) Consistency with Development Needs at the Time of the Ex-post Evaluation

The population of the city has continued to increase since the time of the appraisal, and its total population at the time of the ex-post evaluation (2015) came to approximately 550,000 people,[7] for an increase of roughly 30% from the time of the appraisal (2005). According to the municipal government, the population is expected to continue growing in the future. Thus, there will be an ongoing need to install and improve environmental infrastructure to meet demand as a result of this population increase. The conditions in each sector are detailed in Attachment table 2.

3.1.3 Relevance to Japan's ODA Policy

At the time of the appraisal, the "China Economic Cooperation Plan", which was a Japanese aid policy for China, set forth the policy of emphasizing the conservation of environments and ecosystems suffering from severe pollution and destruction. What is more, both JICA Implementation Guidelines for "Medium-Term Strategy for Overseas Economic Cooperation Operations (FY2002–FY2005)" and the "FY2004 Country Assistance Strategy for People's Republic of China" placed emphasis on environmental conservation. The "Country Assistance Strategy for China" emphasized public projects that required government to play a role, such as support for installing water supply and sewage systems, air pollution countermeasures, the construction of garbage treatment facilities, and afforestation. It states that efforts are to be made to strengthen cooperation with local governments and other entities and to transfer know-how of Japan in order to support capacity building like improving environmental administration abilities. This project is consistent with the priority areas of aid policies of Japan, which provide support for installing and improving comprehensive environmental infrastructure.

Therefore, implementing this project is fully consistent with development policies of China and development needs, as well as aid policies of Japan, and its relevance is high.

3.2 Efficiency (Rating: ②)

3.2.1 Project Outputs

The planned and actual outputs for the project are listed below. Some of the sub-projects were cancelled, and, as a result, additions were made to the scope. The outputs that were initially planned were largely set in place as planned, and from the evaluation the conclusion can be reached that the outputs necessary for achieving the goals of the project were set in place.

[7] Source: National economic and social development statistics for Yining City, Xinjiang Uyghur Autonomous Region

Table 1: Project Outputs (Planned and Actual Results)

Sub-projects	Planned results (2005)	Actual results (the underlined sections indicate changes) (2015)
Urban water supply system	(1) Lay water supply pipes (Length: 135km) (2) Repair the No. 2 water treatment plant Build a clear water reservoir (Volume: 5,000m^3), distribution pumps (Volume: 432 m^3/hour × 4 pumps), etc. (3) Expand the No. 4 water treatment plant Wells × 6 locations (Water supply volume: Increase by 30,000 m^3/day), build a clear water reservoir (Volume: 5,000 m^3), distribution pumps (Volume: 583 m^3/hour × 4 pumps), etc.	*** Some additions were made to the initial plan** (1) Laid water supply pipes (Length: 135km) ＋ **additional length of** 50.6km (newly laid, repaired) (2) Repaired the No. 2 water treatment plant Built a clear water reservoir (Volume: 5,000m^3), distribution pumps (Volume: 432 m^3/hour × 4 pumps), etc. (3) Expanded the No. 4 water treatment plant Wells × 6 locations (Water supply volume: Increased by 30,000m^3/day), built a clear water reservoir (Volume: 5,000 m^3), distribution pumps (Volume: 583 m^3/hour × 4 pumps), etc. **(4) Additions:** A water monitoring and control system and a water quality test lab were added
Urban sewage treatment system	(1) Lay sewer pipes (Length: 102 km) (2) Build eastern sewage treatment plants (second stage) (Treatment method: OD method; Treatment capacity: 40,000 m^3/days) (3) Build western sewage treatment plant (second stage) (Treatment method: Improved SBR method; Treatment capacity: 25,000 m^3/day)	**Some additions were made to the initial plan** (1) Laid sewer pipes (Length: 103.096 km, **Addition:** 23.465 km newly laid) (2) Built eastern sewage treatment plants (second stage) (Treatment method: OD method; Treatment capacity: 40,000 m^3/days) (3) Built western sewage treatment plant (second stage) (Treatment method: Improved SBR method; Treatment capacity: 25,000 m^3/day)
Urban garbage treatment facilities	(1) Build a sanitary landfill disposal site (Treatment capacity: 500 t/day, Landfill area: 147,500 m^2; Service life: 20 years) (2) Build a relay base (Treatment capacity: 600 t/day) (3) Build a medical waste incineration plant (Treatment capacity: 5 t/day) (4) Waste collection system	Some additions were made to the initial plan (1) Built a sanitary landfill disposal site (Treatment capacity: 500 t/day, Landfill area: 147,500 m^2; Service life: 20 years) (2) Built a relay base (Treatment capacity: 600 t/day) (3) Built a medical waste incineration plant (Treatment capacity: 5 t/day) (4) Waste collection system (5) Additions: Snow removal equipment (1 small snow blower, 1 snow removal roller and 1 set of snow removal equipment parts, 1 snow blower (that includes a wheel loader), 1 snow plow, 2 snowplow vehicles, 9 snow removal rollers, 15 snow removal rollers (that include double rotating dump trucks), 2 snow blowing vehicles, 1 hammer, and 70 sets of snow removal roller parts)
Urban district heating supply facilities	(1) Coal-fired boilers (46MW × 2 boilers) (2) Heat exchange stations (15 locations) (3) Heat supply pipelines (mainline pipe networks 2 × 15.3 km, branch pipe networks 2 × 4.45 km)	**Some changes were made** (1) Coal-fired boilers (46MW × 2 boilers) (2) Heat exchange stations (34 locations) (3) Heat supply pipelines (mainline pipe networks 2 × 21.03 km)
Urban natural gas supply facilities	(1) LNG regasification facilities (2) Gas pipeline	**Cancelled** *This was removed from the scope of this yen-loan project and installed as planned through financing by the Chinese side from a different domestic project
Urban ecological forest	Shelterbelt (Afforested area: 3,340ha)	**Largely as planned** Shelterbelt (Afforested area: 3,342ha)
Training	Training in Japan regarding the water supply, sewage, waste, and afforestation sectors	**As planned**

Source: The planned values came from data provided by JICA, while the actual values came from questionnaire responses from the executing agencies

The major changes to the installation status for the outputs are listed below.

1) Cancellation of the urban natural gas utilization sub-project and reallocation of the surplus funds

As was mentioned in the section on relevance, surplus funds arose with this ODA Loan project because of the cancellation of the urban natural gas utilization sub-project. The surplus funds were re-allocated to the expansion of and additions to the other sub-projects. The main additional outputs include the following: 1. Urban water supply system sub-project: Newly adding 50.6 km of water supply pipes, a water monitoring and control system, and a water quality test lab; 2. Urban sewage treatment system sub-project: Newly adding sewage pipes; 3. Urban garbage treatment sub-project: Adding snow removal equipment in order to meet the needs to remove snow from the roads of the city in the winter; and more. It is affirmed that there was a strong need and priority for each of these in the installation plans for each sub-project, and therefore the reallocation can be evaluated as being appropriate.

2) Changes to the urban district heating sub-project

As part of this sub-project, the number of heat exchange stations installed was substantially increased. This came about because of changes[8] to regulations on supplying heat by the government and the increased construction of apartment buildings eligible to be supplied with heat. In addition, the branch pipe network for the heat supply pipelines was cancelled; instead, the total length of the mainline pipe network was extended. This is because policy has changed so that a developer would install each of the facilities for the branch network (installation of the pipe network to each home).

These changes can be evaluated as appropriate changes because they gave rise to the results set forth by the project goals amidst the development of Yining City and the changes in environmental policies and the regulatory environment.

A biological reaction tank at a sewage treatment plant

Coarse screens at a sewage treatment plant

3.2.2 Project Inputs

3.2.2.1 Project Cost

Against the planned project costs of 11,079 million yen (of which 4,737 million yen was foreign currency and 6,342 million yen was domestic currency) at the time of the appraisal, the actual project costs came to 10,966 million yen (of which, 6,462 million yen was foreign

[8] In order to boost the supply efficiency, the heat supply radius per heat exchange station and the heat supply area divisions were altered, and the need arose to install more exchange stations for the same amount of area.

currency and 4,504 million yen was domestic currency). As such, the project stayed lower than planned costs (99% versus the plan). Aside from the urban natural gas utilization sub-project that was cancelled, the other sub-projects were instituted largely as planned. What is more, the surplus funds from the cancellation of the urban natural gas utilization sub-project were invested in expansions and additional procurement for the other sub-projects, and the planned and actual amounts for these additional investments stayed largely within what had been planned. Since cancellations arose from the initial plan, it would be difficult to perform a simple comparison of the plan versus the actual results. However, since the plan after the changes was instituted largely according to plan, the project costs can be evaluated as having been spent effectively in general.

3.2.2.2 Project Period

As opposed to the project period at the time of the appraisal that was planned to run from April 2005 - September 2011 (78 months), the actual project period ran from April 2005 - June 2015 (123 months / 158% versus the plan), thus significantly longer than planned. The implementation periods for each sub-project are listed below.

Table 2: Project Period (Planned and Actual Project Periods)

Sub-projects	Planned (at the time of the L/A signing) (2005)	Actual	Versus plan
Urban water supply system sub-project	April 2005 - December 2010 (68 months)	April 2005 - July 2014 (112 months)	165%
Urban sewage treatment system sub-project	April 2005 - December 2010 (68 months)	April 2005 - December 2013 (105 months)	154%
Urban garbage treatment sub-project	April 2005 - December 2010 (68 months)	April 2005 - May 2013 (98 months)	144%
Urban district heating sub-project	April 2005 - September 2009 (53 months)	April 2005 - December 2012 (93 months)	175%
Urban natural gas utilization sub-project	April 2005 - December 2010 (68 months)	Cancellation	/
Urban ecological forest sub-project	April 2005 - September 2011 (77 months)	April 2005 - June 2015 (123 months)	160%
Training sub-project	April 2006	December 2008 - November 2009	/

Source: The planned values came from data provided by JICA, while the actual values came from questionnaire responses from the executing agencies

The factors that caused the delays have been summarized for each sub-project. Generally speaking, the factors behind the delays came from adjusting to and accommodating the changes in the project environment that arose after the initial plan. There were no major problems regarding the outlook for the project period at the time of the appraisal.

Table 3: Reasons for the Delays in the Project Periods for the Sub-projects

Sub-projects	Factors causing the delays
Urban water supply system sub-project Urban sewage treatment system sub-project	The installation of the water supply and sewage pipe network had to be aligned with a schedule to build city roads that was carried out concurrent with this owing to the nature of the construction work to lay pipes underground.
Urban garbage treatment sub-project	Due to the high water level of the underground water at the relay station and the fact that it was previously a cesspool, additional consideration had to be given to confirming the geological conditions and the treatment method for strengthening the foundation.
Urban district heating sub-project	There was variance in the construction periods for the apartment buildings by the developers that were the targets of the heating supply, and so the actual start of the construction work was delayed in conjunction with this.
Urban ecological forest sub-project	Part of the afforested area was designated as an industrial park, and so the afforestation period was delayed as a result of coordinating over the afforested sections. Moreover, for afforested areas found on mountainsides at high elevations, irrigation water needed to be brought up through the use of pumps. Since the construction work for this was more difficult than anticipated, this lengthened the construction period.

3.2.3 Results of Calculations of Internal Rates of Return (Reference only)

The Financial Internal Rate of Return (FIRR) at the time of the ex-post evaluation for the urban water supply system sub-project came to 1.1%. However, this was negative for the urban sewage treatment system sub-project, the urban garbage treatment sub-project, and the urban district heating sub-project. All of the sub-projects are being managed as public utilities that are predicated on receiving injections of capital from the municipal government,[9] and the fees set through the project were kept at considerably low levels. Therefore, the project runs in a deficit on its own, with aid from the finances of the municipal government used to supplement this.

With regard to the urban ecological forest sub-project, the target region for curbing soil runoff as a result of the sub-project is an uninhabited area, and there are no benefits from this that can be quantitatively measured. Therefore, its Economic Internal Rate of Return (EIRR) could not be calculated.

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

3.3 Effectiveness[10] (Rating: ③)

3.3.1 Quantitative Effects (Operation and Effect Indicators)[11]

This section will offer specific analyses of the operation and effect indicators for each

[9] Details regarding the financial structure are listed in "3.5. Sustainability."

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

[11] Since the respective contents and targets of the sub-projects vary significantly, for the analysis of the effectiveness of the project the completion years for each sub-project and the completion years from the time of the plan will be compared individually. While the year for achieving the target values of the project set at the time of the appraisal was 2011 (completion year), as discussed in the efficiency section the completion of the project was delayed. Moreover, since the completion years vary for each of the sub-projects, the target value at the time of the appraisal and the actual values for the completion years for each sub-project shall serve as the basis for comparison. However, the operating status from thereafter until the present was confirmed together with this, and the effectiveness was analyzed in a comprehensive manner based on the achievement status for results for the project as a whole and the prospects for their achievement in the future. As for the conditions from the completion year onward, this was analyzed by integrating the trends in each indicator at the time of the ex-post evaluation (2015) in the sub-projects.

sub-project.

(1) Urban water supply system sub-project

The main indicators and its target and actual values are shown for the effectiveness of the sub-project in Table 4. The target values were achieved for all of the indicators in the project completion year. The results were slow to manifest as a result of the project delays. However, the project can be evaluated as having played an effective role in supporting the development of the city by supplying safe water in a stable manner. What is more, installing additional pipelines as a result of the changes to the project scope (see the sections on relevance and efficiency) promoted the installation of branch pipe networks, and brought about improvements in the percentage of population served and their installation and dissemination speeds. Furthermore, the operating efficiency in the form of the leakage rate and non-revenue water rate was enhanced, based on which the claim could be made that this has contributed to stably supplying water. It is also believed that the stable water supply partially resulted from improving test capabilities by adding the water quality test lab and the water monitoring and control system to the scope and reducing power consumption, as well as the organizational and human resource development results from improving the operating efficiency via training.

Table 4: Operation and Effect Indicators for the Urban Water Supply System Sub-project

		Standard values	Target values	Actual values	Actual values
		2004	2011	2014	2015
		Year of the appraisal	Project completion year	Project completion year	One year after the project completion year
Operation	Population served (1,000 people)	223.2	332.9	389.0	425.0
	Amount of Water Supply (1,000 m^3/day, average)	57.7	85.6	126.0	139.0
	Rate of Facility Utilization (%, daily average)	83	83	100	100
	Non-Revenue water rate (%)	20.0	10.0	10.6	10.7
	Leakage rate (%)	16.7	9.1	9.1	8.9
	Amount of Water Intake (m^3/day)	/	/	138.6	152.6
	Water quality (Standards of Chinese government for Drinking Water Quality)	Passing	Passing	Passing	Passing
Effect	Percentage of Population Served (%)	70	90	94	96
	Urban household water usage per person (L/person-day, average)	142	150	160	165
	Revenue on Water Supply (10,000 Chinese yuan)	/	/	3,852	4,254

Source: Data provided by JICA and the executing agencies

Note 1: Definition for facility usage rate: Water supply volume (daily average) / Water supply capacity × 100

Note 2: Definition for non-revenue water rate: (Water supply volume – Accounted water volume) / Water supply volume × 100

Note 3: Definition for percentage of population served: Population served / Population in the target area × 100

Note 4: The water source, treated water, and pipe network water quality standards are instituted according to the Standards for Drinking Water Quality. As for the monitoring methods, tests are carried out in accordance with the Drinking Water Quality Standard Test Methods. Multiple water quality standards have been established, and determinations are made on whether the results pass or fail in accordance with the degree to which the regulatory values are achieved.

(2) Urban sewage treatment system sub-project

The population treated exceeded the target value, and, as a result of extending the length of the sewer pipes laid and adding new ones, the demand from the growing population of the city

was met. Indicators pertaining to operating efficiency, such as the BOD and SS concentrations, all achieved their target values. For the improvement of sewage treatment capacity in Yining City, the results that had been initially planned were achieved. Conversely, currently the actual values for the amount of waste water treated remain low at 67,700 m^3/day, which is roughly 50% of the daily treatment volume of 130,000 m^3/day that had been initially planned. According to a manager in charge at the sewage treatment plant, this is backed by factors like the decline in the sewage volume per person against the volume that had been initially envisioned given the increased awareness among the residents of water conservation.[12] Moving forward, the expectation is that demand for sewage treatment will continue to increase as urban development advances.[13] Over the medium to long term, there is a strong possibility that the project will reach its planned treatment volume. However, as things currently stand, its operating status is stalled at a lower level than what had been planned initially.

[12] The estimated consumption of 245 L/day per person at the time of the appraisal decreased toaround 120 - 160 L/day per person at the time of the ex-post evaluation. While it is possible that the estimated figure at the time of the appraisal was incorrect, it is not possible to confirm a clear reason for this fluctuation.

[13] According to Xinjiang Yining City Master Plan, it is estimated that the population of the city will rise to 580,000 and that its city-wide volume of sewage treated will be 280,000 m^3/day by 2020. It is seen as being highly likely that it will experience demand that exceeds its current sewage treatment capacity.

Table 5: Operation and Effect Indicators for the Urban Sewage Treatment System Sub-project

		Standard values	Target values	Actual values	Actual values	Actual values
		2004	2011	2013	2014	2015
		Year of the appraisal	Project completion year	Project completion year	One year after the project completion year	Two years after the project completion year
Operation	Population treated (1,000 people)	143.4	355.3	374.2	389.0	425.0
	Amount of wastetreated (10,000 m^3/day)	6.50	13.00	6.00	6.32	6.77
	BOD concentration at the eastern sewage treatment plant (Inflow, mg/L)	148	200	n.a.	326	300
	BOD concentration at the eastern sewage treatment plant (Effluent, mg/L)	20	20	n.a.	15	17
	Reference: Reducing ratio of BOD concentration at the eastern sewage treatment plant (%)	/	/	n.a.	95.4	94.1
	BOD concentration at the western sewage treatment plant (Inflow, mg/L)	185	250	n.a.	410	430
	BOD concentration at the western sewage treatment plant (Effluent, mg/L)	20	20	n.a.	13	13
	Reference: Reducing ratio of BOD concentration at the western sewage treatment plant (%)	/	/	n.a.	96.6	96.9
	Reference: Suspended solid concentration (Inflow: mg/L, Outflow: mg/L, Reducing ratio: %)	/	/	n.a.	Inflow: 129.3 Outflow: 16.6 Reducing ratio: 86.8	Inflow: 158.0 Outflow: 15.3 Reducing ratio: 90.3
	Reference: Amount of Sludge disposal (DS-t/year)	/	/	n.a.	2,920	3,122
Effect	Improvement of water quality in discharge sites (COD, mg/L)	30	15	n.a.	7	n.a.
	Percentage of population served (%)	65	95	95	96	96
	Percentage of wastewater treatment (%)	57.0	99.1	100.5	101.5	99.6

Source: Data provided by JICA and the executing agencies
Note 1: The definition for percentage of wastewater treatment at the time of the appraisal was “Sewage treatment capacity / Sewage collection volume.” However, at the time of the ex-post evaluation, it was “Actual sewage treatment volume / Total emissions of sewage (excluding the townships and towns around Yining City).”
Note 2: Definition for percentage of population served: Sewage coverage area / Area under construction (excluding surrounding townships and towns); Definition for amount of waste water treated: Treatment capacity
Note 3: The reducing ratio for BOD concentrations was calculated from the inflow and effluent values ((Inflow-Effluent) / Inflow). The target set as a reference for yen-loan project operating results indicators is 80 - 95%.

(3) Urban garbage treatment sub-project

The target disposal volume was largely achieved for the waste disposal volume at the sanitary landfill disposal site. The targets for household garbage and the detoxification and disposal rates for medical waste were both fully achieved, and no problems were seen with their operating status. In addition, it has been confirmed that the operating managers are of the

opinion that the adoption of the snowplow vehicles that were added had results such as alleviating traffic congestion and reducing the number of accidents.[14]

Table 6: Operation and Effect Indicators for the Urban Garbage Treatment Sub-project

		Standard values	Target values	Actual values	Actual values	Actual values
		2004	2011	2013	2014	2015
		Year of the appraisal	Project completion year	Project completion year	One year after the project completion year	Two years after the project completion year
Operation	The amount of waste treated at sanitary landfill disposal sites (t/year)	/	164,600	218,000	237,250	252,580
	Detoxification and treatment rates for medical waste (%)	/	100	100	100	100
	The waste collection rate (%)	90	100	100	100	100
	The amount of waste collected (t/day)	/	/	597	650	692
Effect	The size of the population receiving collection services (10,000 people)	/	/	53.5	55.9	57.9

Source: Data provided by JICA and the executing agencies
Note 1: The detoxification and treatment of medical waste began in 2010.
Note 2: Definition for waste collection rate: Number of households in the coverage area / Number of households in the target area × 100

Waste disposal relay base


Garbage collection within the city

(4) Urban district heating sub-project

Heat supply at or above the scale that had been planned has continued in a stable manner, and the target values have largely been achieved when it comes to major indicators like that for reducing the amount of coal used. While the manifestation of the results lagged behind because of the delays of the project, the fact that the project supplied the residents with a stable heating service via a method that involved less of an impact on the environment[15] means that the

[14] By way of examples, opinions such as "Commutes that previously took about 40 - 50 minutes when it snowed have been shortened to about 15 minutes" and "Before, travel speeds when the roads froze over were 20 km per hour, but this has risen to 40 km per hour" were confirmed.

[15] According to the executing agency, the results from replacing small boilers with large boilers offered reduction results of more than 40% via energy efficiency, which is an excellent result.

project can be evaluated as having found an effective balance between improving the living environment and the air quality compared with that prior to the implementation of the project. By boosting the efficiency of heat supply services that use large quantities of coal, which are the primary heating facilities in Yining City, this project has contributed to improving the air quality.

Table 7: Operation and Effect Indicators for the Urban District Heating Sub-project

		Standard values	Target values	Actual values	Actual values	Actual values	Actual values
		2004	2011	2012	2013	2014	2015
		Year of the appraisal	Project completion year	Project completion year	One year after the project completion year	Two years after the project completion year	Three years after the project completion year
Operation	District heating supply capacity (GJ/year, maximum supply capacity)[1]	427,667	713,572	827,733	827,733	827,733	827,733
Effect	Coal reduction ratio (consumption) (t/year)[2]	/	16,200	18,600	18,600	18,600	18,600
	TSP reduction ratio (t/year)[3]	/	286.4	279.8	279.8	279.8	299.8
	Area supplied (10,000 m^2)	/	/	130	130	130	130

Source: Data provided by JICA and the executing agencies

Note 1: Definition of district heating supply capacity: Amount of heat supplied during the heating period (165 days) when it is hypothesized that all of the boilers are operating at full load every day. For the quantity of district heating supply for 2004, the reference value was provided by the executing agency.

Note 2: Definition for the Coal reduction ratio (consumption): Calculated by comparing the amount of coal used during each heating period (165 days) in a scenario where district heating is supplied by using large boilers with relatively high heating efficiency against a scenario where heat is supplied via small boilers with comparatively poor heating efficiency

Note 3: Definition for the TSP reduction ratio (total suspended particles) emissions: Calculated by comparing the emissions of TSP generated from supplying district heating by using large boilers with relatively high heating efficiency versus the amount of TSP emitted when supplying heat from small boilers with comparatively poor heating efficiency over the same heating period and in the same area supplied with heat

(5) Urban ecological forest sub-project

As of 2015, the afforested area that was established through this project came to 3,342 ha (total afforested area of 10,702 ha), which is largely in line with the target. The total afforested area in the city in 2015 came to 93% versus the 2011 target, and while it lagged behind schedule, the target for this was largely achieved. The survival rate for one to three years after the project was 84% on average, reaching the standard value (75%) in the national technical regulations for artificial afforestation. It is also believed that favorable progress is being made with the growth status.

Table 8: Operation and Effect Indicators for the Urban Ecological Forest Sub-project

		Standard values 2004	Target values 2011 Project completion year	Actual values 2015 Project completion year
Operation	Total afforested area in the city (ha)	7,360	11,500	10,702
	Area afforested by the project (ha)[1]	/	3,340	3,342
Effect	Soil erosion (t/km^2)	30,000	25,000	n.a.

Source: Data provided by JICA and the executing agencies
Note 1: Definition of afforested area: Area of forests with a rate of tree crown of 0.2 or greater or forest zones with a crown diameter of 10 m or greater that are comprised of tall tree species

An image of the afforested land

Forest growth status (six years old)

3.3.2 Qualitative Effects (Other Effects)

For this project, training programs in Japan were planned for each of the sub-projects for water supply, sewage, waste, and afforestation. Roughly 20 people, consisting of managers and top-level engineers at each of the sub-project executing agencies, took part in the training. Many contents of the training, especially those of capacity building in operation and management and a certain advanced technologies, have been incorporated into subsequent operation and management. As such, the thinking is that the training provided results for the project as a whole and was effective to some degree in boosting its sustainability. Through the project, the current deputy mayor and relevant officials occupying key positions in each of the agencies took part in the training. Their subsequent high retention rates and strong sense of ownership of the initiatives have served as one factor in disseminating the results of the project. Case examples in which the experiences from the training in Japan were effectively used in subsequent management are introduced below.

Reference: Experiences with and Outcomes from the Training in Japan

(1) Example from the urban water supply system sub-project

The training in Japan was held in November 2009 in Sapporo and Tokyo with two participants. The training consisted of attending lectures by waterworks bureaus and touring water treatment plants. Zhang Qiang was one of the training participants. At the time of the training, he was the vice president of a water supply company, which is a position he still occupies at present. After returning to China, he proposed to JICA that a water monitoring and control system, like those he observed during the training in Japan, be installed. In addition to initiatives for automation, he also promoted the creation of programs to train the corresponding human resources. He also made efforts to train the human resources that would handle precision equipment. As a result, the technical capabilities of the employees of the city are among the highest levels found within Xinjiang Autonomous Region. The lessons learned and know-how on managing water treatment plants from the training in Japan are also being shared with other regions. One example of this is that representatives from a city targeted by a ODA Loan project in neighboring Ili Prefecture (from Kuytun City, the target city of the Xinjiang Environmental Improvement Project (I)) came to take a tour.

(2) Example from the urban sewage treatment system sub-project

The training in Japan was held in November 2009 in Sapporo and Tokyo with five participants. The training consisted of attending lectures by experts on sewage treatment techniques and touring sewage treatment plants. Zhao Fan was one of the training participants. At the time of the training, he was the vice president of a sewage company, and he currently works as a secretary at a sewage company. After returning to China from the training, he proposed and instituted awareness-raising activities through an environmental protection education program for schools like ones that had been carried out in Japan, and introduced a recreational fishing pond created using treated water. These policies not only aimed to improve the operating status of the treatment plant, but to reduce the amount of sewage water generated, and so comprehensive initiatives to improve the water quality were introduced. There were also numerous cases in which lessons from the training in Japan were harnessed for initiatives conducive to improving the managerial efficiency of the treatment plants. These initiatives have garnered attention from other regions within the autonomous region, and efforts are being made to disseminate these experiences by sharing them with the officials involved in ODA Loan projects in other cities.

(3) Example from the urban garbage treatment sub-project

The training in Japan was held in April 2009 in Sapporo with five participants. The training consisted of touring a waste incineration facility, a waste collection and transportation system, and a recycling business, as well as attending classroom lectures on administrative initiatives. Lijun Cao was one of the training participants. At the time of the training, he was the manager of an operations division, but he currently serves as the president of a waste disposal branch office. After returning to China from the training, he raised the facility mechanization level, which had been around 40% in the initial stages of the project, up to 80% through investments of domestic funds based on the lessons learned in Japan. What is more, he submitted application forms to administrative agencies regarding the detoxification of garbage and the adoption of recycling and sorting systems in rural areas, and is currently working to achieve these.

3.4 Impacts

3.4.1 Intended Impacts

The impacts from the project include improving the environment in Yining City and boosting the living standards of its residents.

(1) Water Quality Improvement Results

1) River Water Quality Improvement Results

The water quality in the Ili River is currently considered Class III under the national standards. This has shown some improvement, as it was Class V at the time of the appraisal. However, neither the data from the monitoring performed by the Ili Prefectural Environmental Protection Bureau on the Ili River Basin region in its entirety (Ili Region) nor the cross-sectional data on the Ili River are disclosed, and so this information remains confidential. Therefore, it is difficult to determine accurately the extent to which this project has been effective at improving the river water quality. However, sewage water that had previously been discharged into the river without being treated is now treated via the project. As a result, the thinking is that this has cut down on the influx of pollutants into the river. In addition, as was mentioned in the section on effectiveness, results were confirmed that the sewage treatment plant was cutting down on pollutants, and so the project has been effective at reducing the pollutant level in treated sewage water discharged into the river. The population of Yining City has risen substantially from the time of the appraisal, and the demand for sewage treatment will continue to increase moving forward. Given this, if sewage treatment plants had not been installed through this project, it is highly likely that the influx of sewage water would have increased further and the river water quality would have deteriorated to an even greater extent. Therefore, based on the above it can be conjectured that this project was effective at curbing the deterioration of the Ili River to a certain degree by means of installing core infrastructure for sewage treatment.

2) Improvements in the Water Supply Status

Regarding the percentage of population served at the time of the ex-post evaluation, 94% of the urban areas were covered. Stable water supply within the urban areas was largely achieved, which is believed to have contributed to qualitatively improving the environment for the residents. To confirm this point, Yining City residents randomly sampled from the resident list for the target area for one of the field survey[16] were selected for an opinion survey. Regarding the frequency of water outages, 34 of the 35 respondents replied that these had decreased from five or six times a year prior to the implementation of the project to one or two times a year at the time of the ex-post evaluation. This indicates that stable water supply has been achieved. This also led to benefits like shortening the time spent on housework each day, thereby bringing about comprehensive improvements in the living environment. Furthermore, improvements were also seen with the sewage treatment equipment and the condition within homes of people as a result of boosting the sewage treatment capacity. Conventionally, nearly 90% of the respondents flushed away used household water through a hole in their garden. However, at the time of the ex-post evaluation a nearly equivalent number of respondents flushed it away via indoor drainage pipes instead. This indicates that a sanitary sewage environment has been set in place. As for the types of toilets in homes of people, prior to the implementation of the project

[16] The number of residents targeted for the survey included 35 residents in the target region for the urban water supply system sub-project, 35 residents in the target region for the urban sewage treatment system sub-project, and 37 residents in the target region for the urban garbage treatment sub-project. Of the total valid responses from 107 people, 71 were from men (66%) and 36 were from women (34%). As for the age distribution, 74% of the respondents were between 30 - 49 years old, with 7% between 20 - 29 years old, 30% between 30 - 39 years old, 44% between 40 - 49 years old, 15% between 50 - 59 years old, and 2% between 60 - 69 years old.

roughly 90% of the respondents used vault toilets, but by the time of the ex-post evaluation 94% had switched over to flush toilets. As this indicates, as a result of improving the core infrastructure within the city, the infrastructure within homes of people has also been upgraded to more sanitary conditions, thus bringing about comprehensive improvements in the living environment.

(2) Improvement Results for the Air Quality

In Table 9 below, the air quality status for Yining City is sorted into the number of days corresponding to each class from the national standards. This shows that, compared with 2005, the number of days equivalent to Class 3 or lower, which indicates poor air conditions, have decreased and the number of good days equivalent to Class 2 or higher have increased over the years. In 2014, the number of days equivalent to Class 2 or higher came to roughly 94% of the annual total (this was roughly 81% in 2005), through which clear improvements in the air quality were observed.

Table 9: Trends in the Air Quality in Yining City

No. of days corresponding to each air quality standard class[17]	2005	2010	2014
Class 2 or higher	295	353	343
Class 3	68	9	19
Below Class 3	1	0	0
Other	1	3	3

Source: Yining City Environmental Protection Bureau
Note 1: "Other" is a total of the number of days on which accurate data could not be measured as a result of power outages and the like.

As was mentioned in the section on effectiveness, progress was made with concentrating and improving the efficiency of heat supply infrastructure within the city through this project, resulting in reducing coal consumption and emissions of air pollutants. Because of this, it is estimated that some measure of progress has been made with reducing air pollutants. It is difficult to gauge accurately the connection between the direct results of the project and the trends with the air quality in Yining City as a whole. However, this project provided heat supply services to a majority of the city, and heat was being supplied inefficiently via small boilers, which were formerly pointed out as a major cause of air pollution in the city. As a result of these improvements achieved by the project, it can be conjectured that it has contributed to improving the air quality to a certain degree.

(3) Reducing Soil Erosion and Flood Damage

According to a report by the Yining City Water Bureau, the area of Yining City suffering soil erosion fell from 30,000 ha at the time of the appraisal to 24,904 ha. Specifically, through the urban ecological forest sub-project under this project, progress has been made in establishing 3,342 ha of forests, while 1,756 ha has been established through another project to grow trees in enclosed mountainous areas by the government. The progress that has been made in fixing soil in place over a total of 5,098 ha as of 2015 has contributed to keeping soil runoff. Precise statistics and data on the damage brought about by soil erosion, such as specific area of sediment runoff or incidence rates for floods, are not maintained, and so this could not be confirmed.

[17] Restrictions for the concentrations of pollutants have been set based on the Air Pollution Prevention and Control Law. The lower the class, the better. For example, the concentration standards for SO_2 were set at 0.06 mg/m^3 for Class 2 versus 0.1 mg/m^3 for Class 3.

3.4.2 Other Positive and Negative Impacts

(1) Impacts on the Natural Environment

At the time of the appraisal, the project was classified as Environmental Category B, and no major negative environmental impacts were anticipated. However, the executing agency took the following points into consideration. The following measures were implemented along with the environmental guideline from the time of the appraisal through to the present by the executing agency and some activities and outputs were observed through the field survey.

1) Countermeasures against Water and Soil Pollution

The urban water supply system sub-project strictly complied with the Water Law of the People's Republic of China and the Environmental Protection Law of the People's Republic of China. This sub-project was promoted by guaranteeing that the environment at water sources and the surrounding environment would not be polluted and by ensuring the safety of the water. The quality of the water discharged by the urban sewage treatment system sub-project met environmental standards, and all of the sludge generated through the treatment process was transported to garbage landfills where it was disposed of in sanitary landfills. For the waste landfill zones, geomembranes, nonwoven textiles, and clay layers were laid down and transudate pipes and gas pipes were installed to prevent exudates and gasses from leaking out.

2) Consideration for the Natural Environment

For the urban water supply system sub-project, there are plenty of groundwater sources. The intake volume at the water treatment plants was set on the basis of the recommended values from a groundwater resource survey,[18] and so no land subsidence has occurred to date. Dust-proof finishes were applied to the facilities and the haphazard disposal of construction waste was avoided with all of the sub-projects, thereby reducing the disruption of vegetation. What is more, after the construction work, the vegetation that had been disrupted was restored immediately.

3) Impact from the Construction and the Establishment of a Monitoring Structure

For all of the sub-projects, steps were taken to prevent dust from being stirred up. These include sprinkling water around at construction sites when appropriate to cause fine dust to fall from the air and setting up protective walls at construction sites. What is more, for the noise that arose during construction, countermeasures to muffle the noise, reduce vibration, perform soundproofing, and reduce noise were taken, and the sound was kept within the standards of the national government.

(2) Land Acquisition and Resettlement

Neither resettlement nor land acquisition occurred across any of the sub-projects.

As indicated above, this project has largely achieved its objectives. Therefore, effectiveness and impact of the project are high.

3.5 Sustainability (Rating: ②)

3.5.1 Institutional Aspects of Operation and Maintenance

(1) Operation during the constructions

[18] Based on a survey performed by Xinjiang Geological Engineering Survey Institute (an engineering company that performs water supply, geological, and other surveys)

The executing agency for the project remained unchanged from that at the time of the appraisal. It consisted of both a leadership group for the Yining City environmental renovation project through the use of Japanese ODA Loans and a city leadership group office under the Yining Municipal People's Government. The roles for both of these have been clearly divided up. The former carries out tasks on behalf of the Yining Municipal People's Government. These include financial management for the project as a whole (procuring financing from ODA Loan projects and domestic financing agencies) and communicating with higher-level government agencies (Xinjiang Uyghur Autonomous Region's government and the central government). The latter serves as a head office that oversees practical affairs for the ODA Loan project. It handles project implementation management and monitoring, communicating and coordinating with external agencies and specific implementers, and the repayment of funds.

The project has continued to be managed thus far without any hindrances under this executing agency structure, and there have been no major problems.

(2) Operation and Maintenance after the constructions

Yining City Lianchuang Urban Construction (Group) Co., Ltd (hereafter referred to as "Lianchuang Corporation") was established in 2003 to serve as the company to which the construction of the project and management were consigned. This corporation is a state-owned company that was fully funded by the Yining Municipal People's Government. At the time of the appraisal, it was comprised of a management division and six subsidiaries that handled the six areas under this project. Afterwards, since the urban natural gas utilization sub-project was cancelled this business was inherited and carried out by Xinjiang Xinjie Co., Ltd., which performed operation and maintenance for this as well. As for the other sub-projects, the subsidiaries of Lianchuang Corporation performed the construction and maintenance for the sub-projects. A construction office was established to serve as a head office at Lianchuang Corporation, and it performed centralized management of the subsidiaries. Yining City Lianchuang Construction (Group) Co., Ltd: Environmental protection and sanitation branch company changed its name to Yining Yimei Environmental Sanitation Service Co., Ltd., but its corporate status and position remained unchanged. As indicated above, the operations of the project and maintenance organization and structure have remained largely unchanged since those at the time of the appraisal, and no problems have been observed.

3.5.2 Technical Aspects of Operation and Maintenance

To evaluate the technical levels of the concerned parties in charge of managing the sub-projects, data like the number of engineers and the structures and qualified personnel at each level were analyzed for each sub-project. In addition, the level of proficiencies of the employees, repair technicians and maintenance workers in each facility were confirmed through interviews at the time of the field survey. For example, surveys were conducted on their perspectives on whether organizational rules, manuals, monitoring system of the equipment and check lists had been created for things like operating and management methods of the equipment, approaches for handling problems, and reporting and communication structures, as well as whether these had been set in place. As a result, it is affirmed that a shared awareness towards the work has been maintained among the personnel and comprehension of manuals remains high for all of the sub-projects. In addition, training structures for incumbent personnel have been set in place, and so on the whole, no problems were observed with their technical levels. Most of these sub-projects have already set in place operating structures, including those for technical aspects and maintenance, within China. Presumably, there will not be any particular difficulties when it comes to operations on the technical side in the future.

As was mentioned in the section on effectiveness, participants in the training in Japan continue to be involved in operations and use their experience, and an approach of proactively incorporating foreign know-how has become entrenched. This has presumably played an

effective role in maintaining and improving the technical level.

A mechanism has been set in place whereby experience is retained in an organized manner by passing down experiences through the training plans that are formulated every year. This is a point that can be evaluated highly.

A water pipe maintenance and inspection team

Sewage pipe maintenance work

3.5.3 Financial Aspects of Operation and Maintenance

(1) Financial Operating Structure for the Project

As has been discussed thus far, this project is currently being operated as a public utility by a company that is mostly state-owned. Therefore, when it comes to the financial management of the project, this aspect must be taken into consideration. This must be based not only on the status for each of the individual sub-projects, but on the financial investments and support trends for the entire project from the Yining City government to the Lianchuang Corporation.

(2) Financial Status of Yining City / Lianchuang Corporation

Table 10 shows the annual income and expenditures of the Yining City government over the past three years. The annual income of the city has been increasing year by year. Subsidies have been provided from the central and provincial governments and the autonomous region, with the expectation being that finances will continue to be provided in a stable manner for public projects in the future. Conversely, the Development of the city and Innovation Council acknowledges the need to improve the efficiency of the finances of the city and investments. It has developed a policy of promoting infrastructural improvements over the long term by giving consideration to the environment and performing measures to save energy. It will also promote efforts like establishing gradual collection systems for fee prices by reforming public projects and diversify its investors to include Public-Private Partnerships (PPP) and the like in order to promote stable development.

Table 10: Financial Status of the Yining City Government

(Unit: 10,000 Chinese yuan)

FY	Total annual income	Of which, income from subsidies	Annual expenditures	Balance
2013	382,962	172,318	369,203	13,759
2014	416,472	171,045	400,848	15,624
2015	469,587	222,696	454,948	14,639

The Yining City government has continued to provide Lianchuang Corporation, which is the executing agency of the project, with funding every year. Its financial support for FY2013–2014 hovered around roughly 40 million Chinese yuan (roughly 800 million yen), and injections of funds have largely continued on in a stable manner. What is more, the sales of Lianchuang Corporation have grown by more than 10% annually, and it has made progress in expanding its business operations.

The financial statuses and future prospects for each of the sub-projects are summarized below.

Table 11: Financial statuses and future prospects for each of the sub-projects

Project name	Evaluation	Overview
Urban water supply system sub-project	**Problematic**	**1) Balance of payments** The balance of payments in the sub-project was in the red from FY2010 - FY2014, and so injections of capital from Lianchuang Corporation continued. The ratio of gross profits to sales has been stable at around 30%, but sales, general, and administrative expenses have been high and its operating profit on sales has been negative every year except for FY2010. **2) Response by the executing agency** By way of countermeasures for operating at a loss, the executing agency raised the amount of fees and is working to reduce the frequency with which it upgrades its equipment through meticulous maintenance.
Urban sewage treatment system sub-project	**Problematic**	**1) Balance of payments** Losses persisted from FY2012 - FY2014. The ratio of gross profits (Revenue from fees in this sub-project) to sales has remained sluggish, and stalled out at 0.35% in 2013. If sales, general, and administrative expenses are included, then its operating profits have been negative in every fiscal year, and it has seen a succession of fiscal years in which its operating costs outstripped its sales. **2) Response by the executing agency** By way of countermeasures for operating at a loss, the executing agency is considering measures like boosting the profitability of the sewage treatment plants by adopting a PPP or assigning special charter licenses.
Urban garbage treatment sub-project	**Problematic**	**1) Balance of payments** As a result of lowering the fees from those at the time of the appraisal in order to maintain its nature as a public benefit, the financial status at the company level has deteriorated over what had been initially envisioned. In particular, the ratio of sales costs to sales proceeds is extremely high and is rising year by year. Both the ratio of gross profits to sales and operating profits on sales remain in the red. Subsidies that are roughly equivalent to the sales costs are provided each year, but the return on revenue remains in the red. The fee collection rate is low at roughly 70%, which affects its income and expenditures. **2) Response by the executing agency** Measures such as improving collection systems, acquiring subsidies through participation in central government programs, and making effective use of garbage are being considered.
Urban district heating sub-project	**No problems**	**1) Balance of payments** The financial statements from FY2012 - FY2013 show that sales costs have risen, and the ratio of gross profits to sales came to around 10% at 14.99% in 2012 and 9.84% in 2013. Subsidies were provided for roughly 10% of the sales of both years, and net profit to sales came to 8.12% in 2012 and 5.47% in 2013. On its balance sheets, on the whole assets remain high and debts have been kept low, while loans are being steadily repaid. As a result, its financial security is relatively high. **2) Response by the executing agency** The executing agency is working to incorporate measures to automate the

		equipment, conserve energy, and offer favorable treatment in terms of tax revenue. It continues to set in place structures for ensuring corporate sustainability.
Urban ecological forest sub-project	**No problems**	**1) Balance of payments** Financial support is provided by the Financial Bureau of the Yining Municipal People's Government. Roughly 2,849 Chinese yuan was secured for the per-hectare costs of managing and protecting forests in 2015, and it hovers around this level every year. Through consultations with the Forestry Bureau of the city government, it was stated that the budgetary provisions necessary for operations are in place, and they were of the opinion that there were no problems. **2) Response by the executing agency** For the future, the executing agency is aiming for more stable financial management. To achieve this, it is working to divide roles by clarifying forest rights and ownership rights between cities, counties, and towns/townships, as well as acquiring subsidies by participating in central government programs. It is also working to establish industrial chains in the forestry industry.

The above summary shows that the position of Lianchuang Corporation as a state-owned company and its financial operating structure both remain unchanged. Financial management of this project by the Yining City government and Lianchuang Corporation will continue by treating the project as a public utility. Aside from the urban ecological forest sub-project, all of the sub-projects collect fees from their service users, but their profitability is low for the individual sub-projects. The fees were set and left at a low level from the perspective of playing up the public nature of the project. Lianchuang Corporation maintains operations by supplementing the revenue from fees with financial support received from the government.

Through the consultations with the Yining Municipal People's Government, it was found that the plan is to continue financial management predicated on injections of subsidies from the government in the future. As a result, there is little possibility of the project operating at a profit through financial independence. To the extent that the financial support from the city government seen thus far has been holding steady, the claim can be made that there are no imminent concerns with financial sustainability of the project. However, specific responses have not been taken with regard to future trends with the finances of the government, and no conclusive evidence could be obtained that proves that medium to long-term stability can be maintained. As a result, concerns remain over the operation of the project, seeing as how this is assured on receiving financial support.

3.5.4 Current Status of Operation and Maintenance

(1) Facility and Equipment Conditions

The subsidiaries for each sub-project have been carrying out operations, maintenance, and management as planned since the completion of the project. As for the monitoring and measurement division, Xinjiang Yining City Environmental Monitoring Center performs monitoring and inspections on a regular basis (monthly) and an irregular basis. The facilities and equipment from the sub-projects that were inspected during the field survey are in good shape, and no major malfunctions or problems have occurred. Sample surveys were performed on the maintenance and inspection records for the various facilities, where it was discovered that there have been no major malfunctions and there are currently no problems with the facility or equipment status.

(2) Maintenance and Support Structure

As for responses when problems arise, manuals have been set in place for this and the response measures and locus of responsibility for when problems occur have been clarified. Interviews were carried out during the field survey for each of the sub-projects, where it was

confirmed that the available maintenance equipment had been procured within the city or in neighboring cities. For the equipment that can be repaired internally, spare parts are kept in reserve within each of the facilities and repair technicians and maintenance workers handle this. For equipment that cannot be handled internally, a liaison system has been set in place in which requests are made to engineers from the manufacturers from which the equipment was procured, who then perform the repairs within a few days.

For the operating and maintenance status, at this point in time, no particular malfunctions or other problems were observed with the facilities or equipment. With respect to maintenance, operation and maintenance structures have been established whereby manuals have been set in place for when problems occur, on the basis of which domestic manufacturers located nearby perform the repairs, or parts are obtained from them. As such, this can be evaluated positively.

Based on the above, there are some problems with the financial status when it comes to the operation and maintenance of the project. Therefore, sustainability of the project effects is fair.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

This project was carried out with the goal of promoting improvements in environmental infrastructure in Yining City, Xinjiang Uyghur Autonomous Region. Through this, it aimed to contribute to improving the urban environment of the city and raising the living standards of its residents. The project has remained consistent with the development policies and needs at the national and city level in China from the time of the appraisal through to the present, and therefore its relevance is high. The facilities that were improved or established through each of the sub-projects are in good working order, and these are giving rise to positive results. The quality of the water in the major river of the city (the Ili River) has not changed significantly since the time of the appraisal. However, since the amount of untreated sewage is declining even as urban development advances, this is presumably keeping the deterioration of the water quality of the river in check. Obvious improvements have been seen in the air quality since the project has been implemented. As a result of this, the local residents offered opinions to the effect that their living environment has improved. As these and other factors indicate, effectiveness and impact of the project are high. While the project costs for the project did not go over the planned costs, the project period did exceed what was planned. Therefore, efficiency of the project is fair. In terms of sustainability, no major problems were observed on the organizational or technical fronts. However, on the financial front, it will be difficult for the project to turn a profit on its own, and so for the future the expectation is that its financial management will continue to depend on government subsidies. It is impossible to forecast precisely the medium- to long-term future trends regarding financial inputs. As a result, concerns remain on the financial front, and therefore sustainability of the project effects is fair.

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

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

As was discussed in the section on sustainability, concerns remain with virtually all of the sub-projects since most of them are in the red in terms of their financial status. It is understandable that they would not seek profitability from the perspective of playing up their public nature as public projects. However, as things currently stand, they have the potential to improve profitability to some degree by reducing sales costs and improving fee collection rates. At present, the city government has been unable to perform an adequate causal analysis on the cost structure, such as on cost prices. Because of this, it would be ideal to improve its cost

structure through individual operating guidance via financial and operating consultants and experts.

4.2.2 Recommendations to JICA

None

4.3 Lessons Learned

Planning of the Training in Japan with a view towards sustainability within the organizations and the potential for disseminating the effect for subsequent development projects

The participants in the training in Japan have played a major role in strengthening operating structures and improving technical capacities, such as introducing the skills and management structures they learned in the training at their respective facilities. As was mentioned in the section on effectiveness, two reasons could be listed for this success. The programs that were suited to needs were organized, and that the majority of the training participants have continued to work in the same organizations and passed down their knowledge and experience. In terms of planning the training in Japan, a proved effective measure in entrenching the results of the training is that JICA selects suitable participants and prepares plans by incorporating well-balanced content of capacity building such as technical skills, operations and installation of rules and systems with a view towards sustainability and potential for disseminating the effect within the organizations. Therefore, when training in Japan is held in the future, it will be important to invite intermix of people in charge in technical divisions and middle management, more so than personnel in management divisions where there is a great deal of mobility among personnel. Presumably, it will also be important to confirm those human resources who show promise within the organizations through monitoring missions and the like, and reflect this in the personnel selection. As for the training programs, it is possible to have them balance influence on organizational reforms with the potential to spread knowledge over the long term. This can be done by incorporating content designed to amass results in an organizational sense and that designed for acquisition of technical capabilities through actual experiences and knowledge management. For example, it will be effective to provide trainees education and training activities on capacity building, such as opportunities to learn the way to install systems and rules which can disseminate knowledge and experiences within the organizations, in addition to practical trainings for actual operations of main equipment.

Comparison of the Original and Actual Scope of the Project

Item	Plan	Actual
(1) Outputs Installation of water supply system	(1) Lay water supply pipes (Length: 135km) (2) Repair the No. 2 water treatment plant Build a clear water reservoir (Volume: 5,000 m^3), distribution pumps (Volume: 432 m^3/hour × 4 pumps (with 1 pump as a spare)), etc. (3) Expand the No. 4 water treatment plant Wells × 6 locations (Water supply volume: Increase by 30,000 m^3/day), build a clear water reservoir (Volume: 5,000 m^3), distribution pumps (Volume: 583 m^3/hour × 4 pumps (with 1 pump as a spare)), etc.	(1) Laid water supply pipes (Length: 135km) ＋ 50.6 km (newly laid, repaired) (2) Repaired the No. 2 water treatment plant As planned (3) Expanded the No. 4 water treatment plant As planned (4) Water monitoring and control system, water quality test lab
Installation of sewage treatment system	(1) Lay sewer pipes (Length: 102 km) (2) Build eastern sewage treatment plant (second stage) (Treatment method: OD method; Treatment capacity: 40,000 m^3/day) (3) Build western sewage treatment plant (second stage) (Treatment capacity: Improved SBR method; Treatment capacity: 25,000 m^3/day)	(1) Laid sewer pipes (Length: 103.096 km) + 23.465 km (newly laid) (2) Built eastern sewage treatment plants (second stage) As planned (3) Built western sewage treatment plant (second stage) As planned
Installation of garbage treatment facilities	(1) Build a sanitary landfill disposal site (Treatment capacity: 500 t/day, Landfill area: 147,500 m^2; Service life: 20 years) (2) Build a relay base (Treatment capacity: 600 t/day) (3) Build a medical waste incineration plant (Treatment capacity: 5 t/day) (4) Waste collection system	(1) Built a sanitary landfill disposal site As planned (2) Built a relay base As planned (3) Built a medical waste incineration plant As planned (4) Waste collection system As planned (5) Additions: Snow removal equipment (1 small snowblower, 1 snow removal roller and 1 set of snow removal equipment parts, 1 snowblower (that includes a wheel loader), 1 snow plow, 2 snowplow vehicles, 9 snow removal rollers, 15 snow removal rollers (that include double rotating dump trucks), 2 snow blowing vehicles, 1 hammer, and 70 sets of snow removal roller parts)
Installation of district heating supply facilities	(1) Coal-fired boilers (46MW × 2 boilers) (2) Heat exchange stations (15 locations) (3) Heat supply pipelines (mainline pipe networks 2 × 15.3 km, branch pipe networks 2 × 4.45 km)	(1) Coal-fired boilers As planned (2) Heat exchange stations (34 locations) (3) Heat supply pipelines (mainline pipe networks 2 × 21.03 km)
Installation of natural gas supply facilities	(1) LNG regasification facilities (2) Gas pipeline	Cancelled *This was removed from the scope of this ODA Loan project and installed as planned through financing by the Chinese side from a different domestic project
Afforestation	Shelterbelt (Afforested area: 3,340 ha)	Shelterbelt (Afforested area: 3,342 ha)
Training	Training in Japan regarding the water supply, sewage, waste, and afforestation sectors	As planned

(2) Period	April 2005 - September 2011 (78 months)	April 2005 - June 2015 (123 months)
(3) Project costs		
Amount Paid in Foreign Currency	4,737 million yen	6,462 million yen
Amount Paid in Local Currency	6,342 million yen (476.8 million Chinese yuan)	4,504 million yen (317.3 million Chinese yuan)
Total	11,079 million yen	10,966 million yen
Japanese ODA Loan Portion	6,462 million yen	6,462 million yen
Exchange rate	1 Chinese yuan ＝ 13.3 yen (As of September 2004)	1 Chinese yuan ＝ 14.8 yen (Average from April 2005 - June 2015)

Attachment: Comparison of the Development Policies for the Sectors Targeted by the Sub-projects at the Time of the Appraisal and the Time of the Ex-post Evaluation

Table 1: Development Policies and Priority Issues for the Target Sectors

Sector / Relevant sub-project	At the time of the appraisal (2005)	At the time of the ex-post evaluation (2015)
Water resource development / Urban water supply and sewage treatment system sub-projects	Water shortages have been regarded as a priority issue nationwide. The city was aiming to enhance its water supply capacity by newly installing water supply facilities or upgrading the facilities that installed between the 1950s and 1970s. It was also working to ensure safe drinking water and conserve water resources by reducing its leakage rate. As for sewage water, it was aiming to reduce total emissions of major contaminants by 10% relative to 2000 levels since it was working to improve the environment further. Regarding the water quality of its sewage water, it set individual targets for things like achieving sewage treatment rates of 45% in urban areas and improving the water quality of major water sources.	Striking a balance between safe water supply and profitability was set forth as a development issue for water supply projects. Specifically, an additional 4 million Chinse yuan was invested as part of the achievement target for 2015 with the plan being to add four wells to increase the water supply capacity to 186,000 m^3. Plans were also made to improve the personnel evaluation and management system in order to strengthen the collection capacity for fees. A number of initiatives were proactively promoted for sewage projects as well. These included rigorous controls on the total amount of pollutants discharged into the rivers of the city, improving the sewage treatment capacity of the city by proactively building sewage treatment plants, and managing the sewage treatment plants of the city using market mechanisms.
Greening measures / Urban ecological forest sub-project	Regarding greening measures, National Ecological Building Plan of China set short, medium, and long-term targets related to things like preventing soil runoff, preventing desertification, and increasing forest area, and initiatives have been promoted in line with the plan. What is more, the grassland zone in regions like Central Xinjiang, which are seeing pronounced desertification, salt accumulation, and grassland degeneration, were positioned as a region warranting emphasis up through 2010. Target values were set for reclaiming grassland, and measures to prevent desertification were promoted.	Specific plans for greening measures were centered around carrying out afforestation projects with a view towards continuously expanding forest area. During the course of the Thirteenth Five-year Plan (2016 - 2020), the plan was to create wide-ranging ecological forests through increasing afforested area by newly planting 24,000 mu (1,600 ha) in a zone running along the northern hillsides. The plan also called for preventing wind, fixing soil in place, reducing water and soil washout, and making urban ecological improvements.
Air pollution countermeasures / Urban district heating sub-project	The aim was to reduce emissions of air pollutants by raising the share of clean energy in the city and boosting energy efficiency. The city suspended the direct combustion of coal in urban areas where the population is concentrated and promoted the dissemination of heat supply facilities and gas supply facilities in the city.	Increasing the efficiency of energy use and structural reforms were set as central tenets of the initiatives to improve air quality. Specifically, the city planned to promote measures like improving the efficiency of energy consumption and establishing regions where the use of heavy-pollution fuels is banned. It also planned to take measures to keep flue dust from power generation and cement particle dust in check, along with measures to reduce total emissions.

Improvements to the living environment / Urban garbage treatment sub-project	Regarding waste disposal, the city promoted the detoxification of household waste from the city and its centralized, safe disposal. It also set forth the targets of boosting its detoxification and disposal capacities for household waste from the city to 150,000 t/day and ensuring that medical waste from cities with populations of 200,000 people or more are safely disposed of.	For waste disposal, the detoxification and disposal of garbage in rural areas began in 2014. Under previous plans, consideration was given to setting in place an industrial park via garbage disposal (for the sorted recycling of garbage and the conversion of food waste to fertilizer for use) through funds from the TPP, which have already been incorporated into the Thirteenth Five-year Plan.

Table 2: Sector-specific Development Needs

Sector / Relevant sub-project	At the time of the appraisal (2005)	At the time of the ex-post evaluation (2015)
Water resource development / Urban water supply and sewage treatment system sub-projects	The lack of a network of pipes to supply water, the deterioration of water supply facilities, and the shortfall in water supply capacity (water supply rate of 70%) have had a major impact on the daily lives of the residents. What is more, the lack of sewage pipes and shortfall in sewage treatment capacity (sewage treatment rate [19] of 57%) meant that polluted water was being discharged directly into the Ili River that flows through the southern part of the city. As a result, the water quality in the Ili River deteriorated down to about the level of Class V in the standards, which is far below the Class III that is the achievement target. What is more, household waste was directly placed in landfills without any sort of leachate prevention measures or the like taken, with concerns that this was affecting the water sources of the city.	Since the implementation of this project, the water supply rate hit 94% in 2014, and the sewage treatment rate was improved to 100% in urban areas. Substantial improvements have been seen with the development of infrastructure related to water resources. However, the water quality in the Ili River basin region in Yining City showed improvement from Class V, which is where it was at the time of the appraisal, but it only improved to Class III. This is believed to be backed by a variety of factors, like the continuously increasing need to improve water supply and sewage systems as a result of the expansion in urban areas due to population growth. It was presumably also affected by factors like the changing lifestyles of the residents as a result of the rising economic level and advances in urbanization. There is a strong possibility that water consumption and the demand for sewage treatment resulting from this will rise in the future, which will necessitate that water infrastructure be developed to cope with this.
Greening measures / Urban ecological forest sub-project	The forest belt on the outer peripherally around the city has been suffering devastation from excessive logging for many years. The rate of forest cover is low at 13.1%, and the forest is losing its multi-functionality in terms of curbing soil runoff and alleviating flooding. As a result, the city is being exposed to damage from soil runoff, such as sand blown from outside the city into it and wind blowing through the inner city. The area experiencing soil runoff in the city is larger than 7,000 ha, which accounts for more than about 10% of the city area. What is more, this is eroding the banks of the Ili River and making it more prone to flood outbreaks. Flooding has occurred at a frequency of three to nine times a year over the past five years.	The forest area of 4,931 ha from 2005 has been expanded to 8,053 ha as of 2014, with progress made in expanding this forest area through the project. Conversely, the rate of forest cover is still low (10.6% in 2014), and the afforested area must continue to be expanded.

[19] The definition for percentage of wastewater treatment is "Amount of sewage treated / Amount of sewage generated."

Air pollution countermeasures / Urban district heating sub-project	The city has been lagging behind in expanding district heating supply and clean energies like natural gas in urban districts. Coal boilers lacking adequate environmentally-responsive devices were being used for heating, and coal was being used as fuel for cooking. Because of this, the concentrations of air pollutants, primarily total suspended particles (TSP), did not meet the concentration restrictions established via environmental standard values (Class 2 standard values). In 2005 emissions of sulfur dioxide (SO_2) came to 1,011.69 t and emissions of particulate matter came to 78.99 t.	Because of policies by the Chinese government, the regulations on air quality have been growing stricter by the year. In 2014, emissions of SO_2 came to 341.00 t and emissions of particulate matter came to 26.62 t, with improvements seen in these since the time of the appraisal. However, it is envisioned that the requirements will grow stricter still in the future. Coal still accounts for a majority of the energy sources for heating in colder districts like Yining City, and so burning it efficiently will continue to serve as an important measure. Moreover, as the city continues to develop in the future, there is a strong possibility that new sources of pollution will increase. As such, improving the air quality will continue to be important.

People's Republic of China

FY2015 Ex-post Evaluation of Japanese ODA Loan
Harbin City Water Environment Improvement Project
External Evaluator: Shima Hayase, IC Net Limited

0. Summary

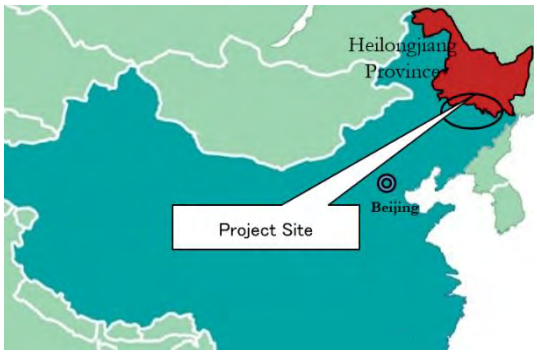
The objective of this project is to improve the sewage treatment capacity in Harbin City by installing sewage facilities, thereby reducing the pollution load of the water discharged into the river within the City, and improving the living environment for the City's residents.

This project was consistent with China's development policies and development needs at the national, provincial, and city levels at the time of the appraisal and the time of the ex-post evaluation, as well as with Japan's policy for assistance to China at the time of the appraisal. Therefore, its relevance is high.

The Pingfang and Songpu sewage treatment plants of the Project were constructed in accordance with the designed capacities in the plan, and meet targets of the Project and the national standards regarding the quality of the water discharged. Conversely, the volume of sewage inflow fell far below the estimates based on which the capacity was designed, and so the operation rate of the treatment plants has remained down below 50%. What is more, facilities to reclaim water were not used at the Songpu sewage treatment plant. This was due to external factors such as the fact that progress was made with autonomous effort to conduct treatment at factories as a result of revisions to drainage water regulations, and the decline in the intake volume into the sewage treatment plants from this project as a result of delays in the construction for the development plan of the City as a whole. Urban development is advancing, with the expectation that the demand levels calculated in the plan will be realized for both the sewage discharge volume and the demand for reclaimed water by 2020. The volume of sewage generated at the time of the ex-post evaluation was to about 90% of the estimates from the time of the appraisal for Harbin City as a whole. However, both the sewage treatment volume and treatment rate exceeded the project's targets. Moreover, the reduction in the total amount of pollutants discharged into the public water within Harbin City is regarded as a contribution from the project when it comes to improving the water quality in the river within the City. Therefore, the claim can be made that its impact is high and it achieved its effectiveness and impact targets on the whole. While the project period was within what was planned, the project costs marginally exceeded what was planned and thus the efficiency is fair. Regarding the sustainability of the effects generated by this project, there is no major problem in the operating agency's operation and maintenance structure, technical level, and financial conditions. Therefore, the sustainability of the project is high.

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

1. Project Description



Project Location

A reaction tank at the Pingfang sewage treatment plant

1.1 Background

Harbin City, which is the provincial capital of Heilongjiang Province, is seeing rapid progress with industrialization and urbanization in metropolitan areas, as well as surging population growth. As a result, its industrial and domestic sewage has increased. Conversely, its sewage treatment rate remained down at 60%[1] in 2005. As a result, large quantities of untreated sewage water were being discharged into the Songhua River that flows through the City. The water quality[2] in tributaries of the Songhua River had deteriorated to the point that they no longer met the standard for drinkable water (Class III). Given this state of affairs, in its Tenth Five Year Plan for Environmental Protection (2001 - 2005), Harbin City set the targets of boosting its sewage treatment rate in metropolitan areas to 90% by 2010 and maintaining Class III water quality in the Songhua River. It also set forth a policy to improve the water environment.

1.2 Project Outline

This project aims to improve the sewerage treatment capacity in Harbin City, Heilongjiang Province by installing sewerage facilities there, thereby contributing to improving the living environment for the City's residents by reducing the pollution load discharged into the river within the City.

[1] Data provided by JICA

[2] The water quality for rivers, lakes, and other water environments is classified into Class I - V pursuant to the Environmental Quality Standards for Surface Water (GB3838-2002). Class I: Applies primarily to water from water sources and national nature reserves; Class II: Applies primarily to concentrated water sources of potable water for domestic use in Class I preserves, valuable fish protection areas, and fish and shrimp spawning grounds; Class III: Applies primarily to concentrated water sources of potable water for domestic use in Class II preserves, general fish protection areas, and swimming areas; Class IV: Applies primarily to general industrial water areas and water areas for entertainment purposes that do not come into direct contact with humans; Class V: Applies primarily to agricultural water and water areas needed for general scenery.

Loan Approved Amount/ Disbursed Amount	7,398 million yen / 6,883 million yen
Exchange of Notes Date/ Loan Agreement Signing Date	June 2006 / June 2006
Terms and Conditions	Interest Rate: 0.75 % Repayment Period (Grace Period): 40 years (10 years) Conditions for Procurement: General Untied
Borrower / Executing Agency(ies)	Guarantor: Government of the People's Republic of China / Harbin Municipal People's Government
Final Disbursement Date	December 2013
Main Contractor (Over 1 billion yen)	・Beijing Zhonghui United Environmental Engineering Co., Ltd. (China) ・China National Precision Machinery Import & Export Corp. (China)
Main Consultant (Over 100 million yen)	None
Feasibility Studies, etc.	・Environmental Impact Assessment Report (Heilongjiang Province Research Institute for Environmental Protection, Harbin City Research Institute for Environmental Protection August 2002) ・F/S (North China Municipal Engineering Design & Research Institute, Harbin Municipal Engineering Design Institute December 2004)
Related Projects	【ODA Loan】 ・Sanjiang Plain Longtouqiao Reservoir Construction Project (L/A December 1996) ・Heilongjiang Songhua River Basin Environmental Improvement Project (L/A December 1998) 【Other Donors】 ・Xinyigou Sewage Treatment Plant Construction Project (ADB L/A 2008) ・Xinyigou Sewage Intercepting Project (ADB L/A 2008) 【Domestic Finance】 ・Hejiagou Development Project (started in 2010) ・Majiagou Development Project (started in 2010) ・Majiagou Sewage Intercepting Project (started in 2010)

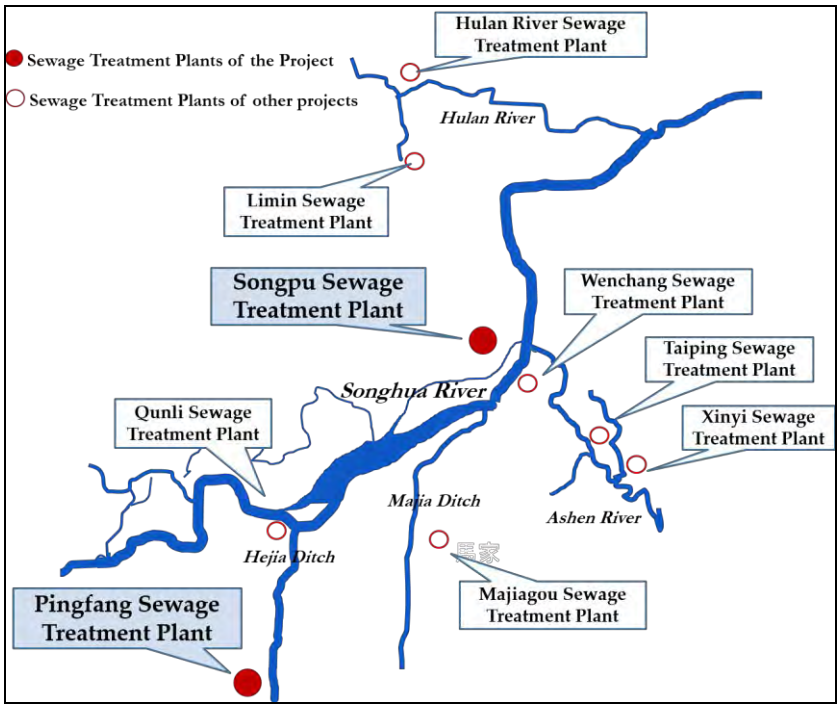


Figure 1: Locations of the river and sewage treatment plants within Harbin City

2. Outline of the Evaluation Study

2.1 External Evaluator

Shima HAYASE, IC Net Limited

2.2 Duration of Evaluation Study

The ex-post evaluation study was carried out as follows:

Duration of the Study: May 2015 – January 2017

Duration of the Field Study:

November 17, 2015 –November 30, 2015

April 5, 2016 – April 9, 2016

2.3 Constraints during the Evaluation Study

At the time of the appraisal, the results indicators for installing sewage facilities through the project were defined as an improvement in the water quality in the City's river. However, the water quality in the river is affected by numerous factors beyond the installation of sewage facilities, which makes it difficult to directly determine the extent to which the project contributed to improving the water quality of a wide river. Therefore, in this ex-post evaluation, changes in the water quality for the City's river as a whole were considered as part of its impact. For this, the contribution the project has made will be analyzed via the share of the level of pollutant load in the water that were reduced as a result of the sewage treatment versus the pollutants discharged into the water throughout Harbin City as a whole.

The evaluator could not obtain cooperation with the Water Resources Bureau and Environmental Protection Bureau of Harbin City for this ex-post evaluation study in terms of providing information and conducting interviews. Alternative information was collected from the Harbin City Inland River Construction and Development Co., Ltd. and directly from the sewage treatment plants. Because of this, data on the City's policies and the water quality in the river could not be obtained, which placed constraints on analyzing the situation of the City as a whole.

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

3.1 Relevance (Rating: ③[4])

3.1.1. Relevance to the Development Plan of China

(1) Relevance to Development Policies at the Time of the Appraisal

The Tenth Five Year Plan for National Economic and Social Development of the People's Republic of China (2001 - 2005), which was the national development plan at the time of the appraisal, aimed at harmonious economic and social development. It emphasized improving the environment, which had deteriorated as a consequence of economic development. It also set targets related to sewage treatment and improving water quality. These included achieving a sewage treatment rate of 45% in urban areas (60% in cities with populations of 500,000 people or more); improving the water quality in the upstream areas of the Yangtze River, the midstream areas of the Yellow River, and the river basin of the Songhua River; and reducing the total amount of major pollutants discharged by 10% relative to year 2000 levels. What is more, the Harbin City Tenth Five Year Plan for Environmental Protection (2001 - 2005) set the targets of boosting the sewage treatment rate in urban areas to 90% by 2010, and achieving and maintaining Class III water quality in the Songhua River. It also set forth a policy of working to improve the water environment.

(2) Relevance to Development Policies at the Time of the Ex-post Evaluation

The Twelfth Five Year Plan for National Economic and Social Development of the People's Republic of China (2011 - 2015), which was the national development plan at the time of the ex-post evaluation, set five priority areas. For one of these, "Resource-saving and environment-friendly society," it set the target of boosting the level of its social infrastructure across-the-board, including sewage treatment facilities.

The Harbin City Twelfth Five Year Plan for Environmental Protection (2011 - 2015) was enacted based on the aforementioned national policy. It promoted comprehensive development plans for tributaries of the Songhua River, through which it maintained water quality at about the Class III standard in the Songhua River. As for the water quality in the river's tributaries, the objective was to have no tributaries fail to meet the standards, and the tributes that were already meeting the standards maintain their present status. Through this, it presented targets for achieving a sewage treatment rate of 95% in urban areas.

Based on the Songhua River Basin Pollution Prevention and Control Master Plan (2006 - 2010), which was a development plan for the Songhua River Basin, Harbin City laid out the objective of boosting the sewage treatment capacity to 795,000 m^3/day. This called for strengthening its two existing treatment plants (the Taiping and Wenchang sewage treatment plants), building seven sewage treatment plants, including two through this project, and installing a pipe system.

As this indicates, from the time of the appraisal, the improvement of the water quality of the river and building and enhancing sewage treatment infrastructures continued to be a priority area in the development plans of the national government and Harbin City at the time of the ex-post evaluation, and the relevance of the project was adequately ensured.

3.1.2. Relevance to Development Needs of China

The population of Harbin City at the time of the appraisal reached 3.47 million people, and industrial sewage and domestic sewage had increased as a result of this rapid development. The treatment capacity from the existing sewage treatment plants[5] and small-scale treatment

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

[4] ③ :High, ② :Fair, ① :Low

[5] In addition to the Wenchang sewage treatment plant (325,000 m^3/day) and the Taiping sewage treatment plant (325,000 m^3/day), apartment buildings and factories had small-scale sewage treatment facilities (totaling 20,000

facilities came to a total of 670,000 m^3/day. As such, the treatment rate versus the sewage discharged (490,000 m^3/day of domestic sewage and 620,000 m^3/day of industrial sewage) remained at 60%, and in regions[6] where the population did not have connection to sewage treatment plants, sewage water was being discharged into the river.

Therefore, Harbin City formulated its Sewage Facility Development Master Plan (2005 - 2020) for up till the year 2020. The plan was to boost treatment capacity to 2.05 million m^3/day and the treatment rate to 90% versus the population of 4.15 million people and volume of sewage of 2.29 million m^3/day (of which, there was 920,000 m^3/day of domestic sewage and 1.37 million m^3/day of industrial sewage) projected for 2020.

At the time of the ex-post evaluation,[7] progress had been made with enhancing in-house treatment at companies within the City, and so the volume of industrial sewage generated came to around 10% of what had been predicted, at 143,000 m^3/day. Conversely, the population of Harbin City increased to 4.35 million people, which exceeded the predictions for 2020 of the master plan, and domestic sewage came to 950,000 m^3/day. The sewage treatment rate for the volume of sewage of 1.09 million m^3/day for the City as a whole came to 88%.[8] However, the target of 95% (for urban areas, excluding towns and townships) from the Harbin City Government's Twelfth Five Year Environmental Protection Plan (2011 - 2015) was not achieved. In consideration for future population growth, the quantity of domestic sewage was expected to increase further at the time of the ex-post evaluation, and so the development needs for sewage treatment will remain high.

3.1.3. Relevance to Japan's ODA Policy

In the "Medium-Term Strategy for Overseas Economic Cooperation Operations (2002 – 2005)," by the Japan International Cooperation Agency (hereafter referred to as "JICA") set forth the priority areas of strengthening responses to reduce poverty, the installation of infrastructure for economic growth, and support for environmental conservation and preventing pollution. As part of these, it indicated the necessity of installing sewage treatment facilities to serve as a countermeasure against water pollution designed to avoid and mitigate the negative effects on the environment via the development of infrastructure.

What is more, JICA's "Country Assistance Strategy for China" (2002 – the first half of 2006) set environmental conservation and human resource development, primarily in inland regions, as priority areas. It positioned the installation of sewage systems as economic / social infrastructure that form the base of the private sector activities, and emphasized the fact that their installation would promote sustainable growth.

This project strived to strengthen sewage treatment capacity of the City and to improve the water quality of the river by building sewage treatment facilities, and aimed to promote the sustainable development of the City. It was confirmed that the project's relevance to Japan's ODA policies, which have the objective of improving the environment and performing social development in inland regions as indicated above, has been assured.

3.1.4. Relevance to Appropriateness of Project Planning and Approach

The sewage treatment plants from this project were completed as planned, and there are no problems with their operation and maintenance status. However, the amount of sewage influent has fallen below the estimates, and their operation rates remain low. What is more, the facility to reclaim water at the Songpu sewage treatment plant are not in operation because the demand for the use of reclaimed water envisioned at the time of the appraisal has not yet appeared as of the time of the ex-post evaluation. These changes are primarily due to delays in the urban

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m^3/day), which were owned privately.

[6] Harbin City had a total of 1,103.34 km in existing sewer pipes, with a breakdown of this coming to 52.94 km of sewage pipes, 972.60 km of combined pipes, and 77.8 km of storm sewer pipes.

[7] The ex-post evaluation was performed in 2015, but the most recent data provided was for 2014.

[8] The volume of sewage came from the China Statistical Yearbook and the sewage treatment rate came from the Harbin City Statistical Yearbook, with data from 2014 used for both.

development plans of Harbin City, with the expectation being that the demand will grow along with the future advances in urban development. At the time of the ex-post evaluation, urban development had already made advances in the region downstream of the Pingfang sewage treatment plant. Countermeasures were examined in response to the capacity shortfall of the Qunli sewage treatment plant that treats sewage in this region. This development was expected to gradually spread to the Pingfang sewage treatment area. Conversely, government-related facilities and the research institutions such as research center of universities began to relocate themselves to the service district of the Songpu sewage treatment plant, and the population trended upward.

In addition, the fact that progress has been made with in-house sewage treatment at large-scale factories that were a source for discharging sewage is a factor that decreased the volume of sewage taken in at the sewage treatment plants. The pollutant reduction was promoted by this self-help effort of the Chinese side in tightening regulations, therefore it yielded positive impact on the Project.

The development of Harbin City continues to make progress as of the time of the ex-post evaluation, and no clear risks or factors that would cause this development trend to fall behind for the foreseeable future have been observed. Given this, it is highly likely that the demand for sewage treatment for the City as a whole will continue to increase over the medium to long-term. Since this project's goal was to improve the water environment in Harbin City, the need for such a project will conceivably remain high over the medium to long-term.

On the other hand, at the time of the ex-post evaluation the relevance between the installation of facilities and their usage methods had not been aligned with the urban plans. Adequate progress has not been made with utilizing excess capacity, for example, by transferring the responsible treatment amounts among treatment plants to optimize the City's capacity as a whole. When it comes to rating the project's relevance, the need for sewage treatment will remain high over the medium to long-term, and so the rating will not be lowered. However, it is recommended that analysis on how to accommodate all the facilities in the City more effectively should have been undertaken at the level of the Harbin City government (see the section on Effectiveness for details).

In light of the above, the implementation of the project is fully relevant to the development policies and needs of China, Harbin City, and the river basin, as well as Japan's ODA policies. Therefore, its relevance is high.

3.2 Efficiency (Rating :②)

3.2.1 Project Outputs

(1) Planned and Actual Outputs

The Pingfang sewage treatment plant and pipeline, as well as the Songpu sewage treatment plant[9] were built as planned. Regarding the construction of the pump station and mainlines (for inlet, outlet, and reclaimed water distribution) [10]for the Songpu sewage treatment plant, the construction schedules for the underground section had to coincide with the construction work to build roads within the City. Because of this, it was cancelled from the scope of this project and carried out via separate domestic financing. An application for the change was submitted from the executing agency to JICA, and officially approved by JICA in August 2008.

For the training for the staff of the executing agency and others, the number of eligible trainees was reduced by one person. However, the courses and facility tours planned at the time of the appraisal were largely carried out as planned.

[9] The data provided by JICA is for the Songbei sewage treatment plant, but officially this is the Songpu sewage treatment plant. The name of the sewage treatment district for this treatment plant is the Songbei District.

[10] According to the material provided by JICA, it is written as "pipelines" (for drainage sewage water discharge, and reclaimed water) "

Table 1: Comparison of Output of the Plan and the Actual Results

Plan (2006)	Actual (2015)
Pingfang Sewage Treatment Plant CASS Process[11]:Treatment Capacity 150,000 m^3/day Among them: All the amount for Advanced Treatment Intercepting Main Lines[12] 900mm-2,800mm Approx. 64 km	As Planned
Songpu Sewage Treatment Plant CASS Process:Treatment Capacity 100,000 m^3/day Among them: 30,000 m^3/day Recycled as Reclaimed Water	As Planned
Songpu Sewage Treatment District Pump Station 2 locations Drainage Mainlines[13] 300mm-2,000mm approx. 67 km Discharge Main Lines[14] 1,400mm approx. 6 km Reclaimed Water Distribution Pipes[15] 100mm-700mm approx. 25 km	Constructed by other projects using domestic financing
Training October 2006 (14 days) 15 persons September 2007 (14 days) 11 persons October 2007 (14 days) 10 persons Destination: Niigata Prefecture Total 36 persons	Training December 2007 (14 days) 15 persons October 2008 (13 days) 10 persons November 2008 (14 days) 10 persons Destination: Niigata Prefecture Total 35 persons

Source: Material provided by JICA and Harbin City Inland River Construction and Development Co., Ltd

3.2.2 Project Inputs

3.2.2.1 Project Cost

At the time of the appraisal, the total project cost was estimated to be 14,983 million Japanese yen (7,969 million Japanese yen in foreign currency; 6,924 million Japanese yen in domestic currency). After deducting the cancellation of the construction for the pipe system (1,977 million Japanese yen), the total project cost was estimated to be 12,916 million Japanese yen. Compared to the actual total project costs of 13,602 million Japanese yen (6,883 million Japanese yen in foreign currency; 6,719 million Japanese yen in domestic currency), the project costs came in at 105%, exceeding the planned value by 5%.

Regarding each output, the construction costs for the two treatment plants substantially increased, in which the Pingfang sewage treatment plant cost came to 139%, and the Songpu sewage treatment plant cost came to 174% of what had been planned.[16] The budget for the pipe system that was removed from the scope of the project was diverted to this. According to the project implementation the reason for the increase in the construction costs is because of the rise in the costs of the materials and personnel, as well as the increased cost for the adoption of the monitoring control system. This was handled by increasing the budget from domestic currency.

3.2.2.2 Project Period

The project implementation period planned at the time of the appraisal was from July 2006 to

[11] CASS Process: a biological treatment process (activated sludge technology) for removing nitrogen and phosphorous. This enables space saving for the facility.
[12] According to the material provided by JICA, it is written as “Intercepting Pipelines.”
[13] According to the material provided by JICA, it is written as “Drainage Pipelines.”
[14] According to the material provided by JICA, it is written as “Sewage Discharge Pipelines.”
[15] According to the material provided by JICA, it is written as “Reclaimed Water Pipelines.”
[16] The costs for each facility at the time of the appraisal came to 120% of the planned values when the rate of inflation from the period (2006 - 2011) is multiplied and figured in to this, meaning that the construction costs increased even more than this.

April 2011 (58 months), and the project was completed as planned.[17] The construction work to lay the pipe system for the Songpu sewage treatment plant that was removed from the project's scope so that it could be instituted at the same time as road construction work was delayed by roughly one year. But since it was completed before the end of the warranty period for the sewage treatment plant, the project could start operation within the planned period.

3.2.3 Results of Calculations of Internal Rates of Return (Reference only)

Only the Financial Internal Rate of Return (FIRR) for the project was calculated at the time of the appraisal. At the time of the ex-post evaluation, the evaluator recalculated the FIRR[18]with the maintenance fees and other costs and the revenue submitted by the executing agency. The FIRR that was envisioned at the time of the appraisal was 5.67%. In contrast, the FIRR at the time of the evaluation turned out to be in at a negative value. This is because the sewage treatment volume at the time of the ex-post evaluation was less relative to what had been planned at the time of the appraisal, and the corresponding revenue from the sewage treatment was calculated to be less than what was planned.

In light of the above, the project period was within the plan, but the project costs exceeded the plan. Therefore, its efficiency is fair.

3.3. Effectiveness[19] (Rating: ③)

3.3.1 Quantitative Effects (Operation and Effect Indicators)

At the time of the planning, this project was expected to produce the following effects: "improvement in the sewage treatment capacity" in Harbin City; and "improvement in the quality of discharged water" from the sewage treatment plants. In response to improving the sewage treatment capacity, target value was set for Harbin City's sewage treatment rate and sewered population. Of these, there is statistical data for the sewage treatment rate, but statistical data regarding the sewered population has not been published, or the data has not been submitted from the executing agency. Therefore, estimated values for the sewered population were calculated from the sewage treatment volume as an alternative method. Targets for each of the treatment plants had not been set at the time of the appraisal, but the achievement status for the effects was confirmed by the sewage treatment volume.

As for improving the water quality of the discharged water, which serves as an effect indicator, this was confirmed by the concentration of pollutants contained in the water discharged from each treatment plant.

(1) Operation Indicators

1) The Sewage Treatment Volume and the Rate, the Sewered Population, and the Percentage of Sewered Population in Harbin City

The plan at the time of the appraisal envisioned sewage discharge of 1.35 million m^3/day across Harbin City as a whole by one year after the completion of the project (2012[20]), and the target of treating 68% of this, or 920,000 m^3/day, was set. Following the completion of the project, both the sewage treatment volume and treatment rate exceeded their target values at the time of the ex-post evaluation, and so the effects could largely be said to have been achieved. Conversely, the volume of sewage discharge for the City as a whole one year after project completion (2012) came to 1.2 million m^3/day, falling below what had been envisioned at the time of the plan. This is due to the fact that the volume of sewage water discharged remained

[17] Project completion is defined as the point "When the warranty period ends." This corresponds to the period guaranteed by the construction company, and is equivalent to the trial run period following the completion of the construction.

[18] Prerequisites include costs (construction costs, maintenance costs), benefits (sewer usage fees), and a project life of 30 years.

[19] The rating is performed by factoring the impact into the decision on effectiveness.

[20] The data provided by JICA listed this as 2010, but going by "when the warranty period concludes," which is the definition for completion, one year after project completion would be 2012.

around 90% of what had been projected as a result of the substantial decrease in the volume of industrial sewage owing to the start of in-house treatment at companies, as well as delays in urban development.

Moreover, the target values for the sewered population and the percentage of sewered population at one year after project completion were estimated from the sewage water volume and the sewage treatment volume to be 3.17 million people and the percentage of sewered population to be 59%. Compared with this, the actual values for 2012 came to a sewered population of 3.98 million people and a sewered population rate of 83%, which exceeded the targets.

Table 2: Harbin city's Sewage Treatment Volume and Rate, Population in the Sewage Service, and the Sewered Population

	Baseline	Target	Actual			
		1 year after completion	completion	1 year after completion	2 years after completion	3years after completion
	2004	2012	2011	2012	2013	2014
Volume of Sewage Water ($10,000m^3$/day)	111	135	115	120	104	109
Domestic Sewage Water ($10,000 m^3$/day)	49	N/A	N/A	N/A	92	95
Industrial Sewage Water ($10,000 m^3$/day)	62	N/A	N/A	N/A	12	14
Volume of Sewage Water Treated($10,000 m^3$/day)	65	90	93	100	90	96
Sewage Treatment Rate	60%	67%	81%	83%	87%	88%
Population （10,000 persons）	444	540	459	479	418	435
Sewered Population （10,000 persons）	260	317	372	398	361	383
Percentage of Sewered Population (%)	59%	59%	81%	83%	86%	88%

Source: The standard values and target values came from data provide by JICA. The actual values for the sewage discharge volume and treatment volume, as well as the treatment rates, came from the Harbin City Statistical Yearbook, while the City's population and sewered population were estimated values calculated from the treatment volume.[21]

[21] The treatment volume for the standard values divided by the population, and for the volume of sewage generated per person estimated values for the sewered population were calculated.

2) Treatment Volumes and Treatment Rates for the Sewage Treatment Plants and the Plant Operation Rate

The Pingfang and Songpu sewage treatment plants were constructed as designed, and they had been furnished with the planned treatment capacity at the time of the appraisal. As such, this has contributed to "improvement in the sewage treatment capacity" of Harbin City, which was an aim of the project. However, no numerical targets were set at the time of the appraisal, but the actual treatment volumes[22]and the operation rates are around 20 to 30% of the design capacity. Therefore, they are not being used to their utmost capacity. According to the interviews during the field study at the sewage treatment plants, the operation rate for Pingfang sewage treatment plant was around 67% during the summer peak and about 30% in the winter. For Songpu sewage treatment plant the annual average is around 50%, with this coming to up to about 70% during peak time.

Moreover, the plan at the time of the appraisal called for a design capacity for the two sewage treatment plants to cover 26% of the total treatment volume for the City one year after the project's completion. The treatment volume by the two sewage treatment plants from the project was 68,000 m^3/day in 2012, which is around 6.8% of the treatment volume for the City, with the share from their contribution falling substantially below what had been envisioned.

This is due to the fact that urban development was delayed, and because the demand for sewage treatment in the areas eligible for sewage treatment by the two plants fell below what had been envisioned. Conversely, the number of companies building in-house waste water treatment plants has increased as a result of discharge regulations that were strengthened in 2010.[23] The volume of sewage discharged by the industrial sector within Harbin City decreased, which is a factor that had a positive effect on the project's impact.

A drainage design institute that analyze the demand for urban infrastructure in the City confirmed that the construction of new sewage treatment plants would be unnecessary, because the total capacity of the current sewage facilities with some additional work would be enough to handle the demand for sewage treatment in Harbin City predicted up through 2040. Regarding the delay in urban development, the plan was to complete the construction of an industrial park that had been initially planned by the year 2020, thus the capacity of the two sewage treatment plants built by this project will be utilized. Conversely, at the time of the ex-post evaluation, the sewage treatment rate for Harbin City as a whole remained 90%, therefore, the surplus capacity from the two treatment plants from this project may be utilized through measures like extending sewage pipeline network and broadening the treatment areas, or promoting transfers between the sewage treatment plants.

[22] Regarding the achievement of the treatment volume to the target, due to the reason that no target volume was set at the appraisal, this evaluation compared the achievement to the designed capacity and the actual treatment volume.

[23] In 2010 the Water Quality Standards for Town Sewage Systems that Discharge Sewage (CZ3082-1999) were revised, and progress has been made with the dissemination of in-house sewage treatment facilities at large factories and the reuse of reclaimed water.

Table 3: Waste Water Treatment Volume, Plant Operation Rate of the Treatment Plants
(Annual average volume)

	Treatment Capacity	Completion	1 year after completion	2 years after completion	3 years after completion	4 years after completion
		2011	2012	2013	2014	2015
Pingfang Sewage Treatment Plant						
Waste Water Treatment Volume ($10,000m^3$/day)	150,000 m^3/day	4.6	4.7	4.7	4.8	4.8
Plant Operation Rate (%)		30%	31%	31%	32%	32%
Songpu Sewage Treatment Plant						
Waste Water Treatment Volume ($10,000m^3$/day)	100,000 m^3/day	0.9	2.1	2.2	2.6	2.8
Plant Operation Rate (%)		9%	21%	22%	26%	28%

Source: data provided by Harbin City Inland River Construction and Development Co., Ltd

(2) Effect Indicators

At the time of the appraisal, target values for the concentration of biological oxygen demand (BOD) in the discharged water were set as effect indicators for improvements in the water quality by the enhanced sewage treatment. The actual results from one year after the project completion for this satisfied the target values at both sewage treatment plants, and since then these effects have been maintained.

Table 4: Water Quality in Pingfang Sewage Treatment Plant

		Target	Completion Year	1 year after completion	2 years after completion	3 years after completion	4 years after completion
		1 year after completion	2011	2012	2013	2014	2015
BOD (mg/l)	Inlet	200	146.0	136.5	145.0	130.5	129.5
	Outlet	20	6.2	5.7	6.1	6.7	5.9
	Reduction Rate	90%	96%	96%	96%	95%	95%
	Standard	≦20	≦20	≦20	≦20	≦20	≦20

Source: data provided by Harbin City Inland River Construction and Development Co., Ltd

Table 5: Water Quality in Songpu Sewage Treatment Plant

		Target	Completion Year	1 year after completion	2 years after completion	3 years after completion	4 years after completion
		1 year after completion	2011	2012	2013	2014	2015
BOD (mg/l)	Inlet	200	127.0	105.0	112.0	129.0	122.0
	Outlet	20	12.6	12.0	13.3	13.4	14.0
	Reduction Rate	90%	90%	89%	88%	90%	89%
	Standard	≦20	≦20	≦20	≦20	≦20	≦20

Source: data provided by Harbin City Inland River Construction and Development Co., Ltd

Although no target values were set at the time of the appraisal,in addition to the above, Pingfang sewage treatment plant was required to meet the standards for Class I B and Songpu sewage treatment plant was required to meet the standards for Class II with regard to the chemical oxygen demand (COD) concentration, suspended solids (SS), NH_3-N total nitrogen (T-N) concentration, total phosphorous (T-P) concentration, and the hydrogen ion concentration index (pH) for the discharged water. According to data provided by JICA, the Pingfang sewage treatment plant has set an objective for itself of performing even more advanced treatment, and so Class I B standards were set as its target.[24] For both sewage treatment plants, the target values and the national standard were met regarding all the pollutants for the water quality of the discharged water.

For the facilities to reclaim water at the Songpu sewage treatment plant, facilities equipped with the capacity planned through this project were constructed. However, no progress was made with the construction of the industrial park that was expected to reuse the reclaimed water, and so at the time of evaluation the facilities were unused. Therefore, there is no time-lapse data on the water quality for the reclaimed water. According to an engineer at the Songpu sewage treatment plant, at the time of the inspection, the quality of the reclaimed water discharged technically met the national standards (Class I A). The plan to build the industrial park was delayed, but it is expected that a power plant which will be the primary user of the reclaimed water will be built by 2020. As such, the expectation is that the demand for reclaimed water planned at the time of the appraisal will be met.

3.3.2 Qualitative Effects (Other Effects)

No qualitative effects were set at the time of the appraisal.

(1) Effects from Training

The participants in the training in Japan, which targeted operation and maintenance personnel at the sewage treatment plants, mentioned acquiring understanding of and learning about a number of subjects as effects of the training. These included daily operation and maintenance of treatment plants in Japan, deodorizing systems, sludge treatment techniques, consideration for issues like the environment and noise for residents, and the diligent approach to work of the Japanese people. Operation and maintenance methods and deodorizing techniques have been adopted at both of the sewage treatment plants built by this project. On the other hand, because the sewage treatment plants visited in Japan were old style, some participants answered that that the plants were not very informative for this particular project which built sewage treatment facilities at a water quality level of Class I B for the discharged water through advanced CASS process.

As the above indicates, the improvements in the sewage treatment capacity and percentage of sewered population in Harbin City through this project were largely achieved. The volume of

[24] The Discharge Standard of Pollutants for Municipal Wastewater Treatment Plants (GB18918-2002).

sewage taken in at the two sewage treatment plants built by this project declined, and their operation rates were 50% or less of the design. As such, their contributions to the treated volume for the City as a whole were limited. This was caused by factors such as the delay in urban development and alterations to policies related to industrial sewage treatment. Conversely, both the project's target values and the national standards have been met regarding the water quality of the water discharged by the two sewage treatment plants. At the time of the ex-post evaluation, the project had achieved its goal of "improvement in the sewage treatment capacity" in Harbin City, and "improvement in the quality of discharged water" were achieved. However, the treatment volumes and operation rates for the two treatment plants fell significantly below what had been envisioned as a result of external factors. Given the advancing urban development and increase in future demand in Harbin City, the operation rates for the two sewage treatment facilities from this project are expected to improve. With these points taken into consideration, the achievement status for the effects could be described as favorable on the whole.

3.4. Impacts

3.4.1 Intended Impacts

For this ex-post evaluation, "Reducing pollutants discharged into the rivers in Harbin City" and "Improving the living environment for the residents" were envisioned as impacts of the project. Regarding them, changes in the water quality of the rivers in the City and the contribution of this project were analyzed. In addition, a beneficiary survey was conducted concerning changes in the river environment and the living environment in the City as a result of the new sewage treatment service to analyze the project impacts.

(1) Improvement in the Water Quality of the Rivers in the City and the Contribution of the Project

1) Improvement in the Water Quality of the Rivers in the City

According to data published by the Harbin City Environmental Protection Bureau, the water quality of the Songhua River, which was Class IV at the time of the appraisal (2004), improved to Class III in 2009. The water quality at the downstream observation point repeatedly alternates between Class III and Class IV. However, there are numerous other factors beyond this project that alter the water quality in the river, and so it is difficult to directly detect the causal relationship with this project.

2) Monitoring Data at Points of Observation

At the time of the appraisal, observation points were designated to monitor the water discharged from the sewage treatment plants from this project and the data was provided. However, because data on results since the beginning of the project to time of the ex-post evaluation was not available,[25] it is impossible to analyze the water quality of the rivers quantitatively at each section. Instead, a field survey was conducted to observe the state of each discharge point of each sewage treatment plant.

No foul odors, turbidity, or suspended solids such as waste were observed with the water discharged from either the Pingfang or the Songpu sewage treatment plants, and no factors that would have a negative environmental impact were seen. The water discharged from the Songpu sewage treatment plant has a higher water temperature than the river water, and the water gathered aquatic organisms. On account of this, the residents enjoyed casting nets and fishing in

[25] The Harbin City Environmental Protection Bureau has established observation points in order to monitor the water quality and other data of the river, at which it collects cross-sectional data on the river every day. In order to perform this ex-post evaluation, a request was made to the Environmental Protection Bureau to provide this data. However, for political reasons it was reluctant to publicly release data related to the environment, and it refused to provide this data.

the vicinity around the discharge outlet.

Water discharged from the Pingfang sewage treatment plant

Water discharged from the Songpu sewage treatment plant

3) State of Reduction in Pollutants by the Project

By comparing the total volume of pollutants (COD, NH_3-N) discharged into the public water with the level of pollutant load reduced by this project analyze how much this project contributes to improvement in the water quality of the rivers in Harbin City. The ratio of pollutants reduced by this project to the annual total volume is 0.9 - 4.2% in the case of COD, and 2.3 - 4.8% in the case of NH_3-N, thus certain contribution can be admitted.

Table 6: COD Emission in Harbin City (unit: 10,000 t/year)

	2011	2012	2013	2014
Emission in Harbin City	33.1	31.5	9.3	9.1
Among Industrial Emission	N/A	N/A	0.7	0.8
Among Domestic Emission	N/A	N/A	8.6	8.3
Reduction by the Project	0.58	0.29	0.29	0.38
Ratio of the Project	1.8%	0.9%	3.2%	4.2%

Source: data on emission in Harbin city came from the National Statistical Year Book, the project's actual data came from Harbin City Inland River Construction and Development Co., Ltd

Table 7: NH_3-N Emission in Harbin City (unit: 10,000 t/year)

	2011	2012	2013	2014
Emission in Harbin City	2.4	2.3	1.5	1.4
Among Industrial Emission	N/A	N/A	0.11	0.11
Among Domestic Emission	N/A	N/A	1.4	1.3
Reduction by the Project	0.056	0.054	0.057	0.068
Ratio of the Project	2.3%	2.3%	3.8%	4.8%

Source: data on emission in Harbin city came from the National Statistical Year Book, the project's actual data came from Harbin City Inland River Construction and Development Co., Ltd

In Harbin City, a number of efforts are being promoted as comprehensive initiatives to improve the water environment. These include promotions of rigorous environmental monitoring by the Environmental Protection Bureau, in-house sewage treatment at large factories, and operation suspension at factories that are regarded as sources of river pollution. This project is one of the core comprehensive water environment improvement efforts in Harbin City, and has been recognized for the contributions to improving the water environment across the City.

(2) Beneficiary Survey

Regarding "improvement in the water quality of the rivers" and "improvement of living / business environment," beneficiary survey[26] with residents (60 samples) and company survey[27] (20 samples) were conducted to study the changes in the river environment, the environments for living and business activities before the project (2005) and at the time of the ex-post evaluation (2015), and the degree of satisfaction with sewage treatment service.

A scene from the beneficiary survey carried out at the Songpu sewage treatment plant

1) Beneficiary Survey

According to the results of the beneficiary surveys, more than 75% of the respondents[28] recognized[29] the improvements in the water quality and environment around the rivers, and the living environment, thus the contributions from the sewage treatment were recognized. On the other hand, 83% were satisfied with the sewage treatment services, but responses of "Somewhat dissatisfied" and "Dissatisfied" accounted for 17%. The primary reasons of dissatisfaction were due to lack of information on sewage treatment services, inefficient and unhelpful responses at customer service and telephone, which are mainly on 'soft' aspects. However, some responses were citing the delay in dissemination of sewage systems and improvements in the water quality.

2) Corporate Survey

From the results of the company surveys, 85% of the respondents replied that drainage flow and pipe blockages have improved and 80% replied that the sanitary environment has improved with respect to the environment for business activities as a result of the start of the sewage treatment service. When they were asked about effects on business activities from the start of the sewage treatment, 80% of the companies responded that productivity had "Improved significantly" or "Improved somewhat," while 55% said the same for efficiency, 55% said the same for business scale, and 50% said the same for the investment environment. As such, there was a particularly strong recognition of its contributions to improving productivity.

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[26] The beneficiary surveys were carried out by gathering together 60 local residents (30 people for each treatment plant) living near the river in the vicinity around the two sewage treatment plants that began offering sewage treatment services as a result of this project. The district resident committees were asked to select the people eligible for the surveys, so these did not constitute a random sample. The surveys were carried out on households that consented to the survey and which agreed to visit their sewage treatment plant and fill out questionnaires. Therefore, it is possible that only cooperative residents took part in the survey, leading to overestimations of the project effects. Moreover, the number of samples is small compared with the total number of beneficiaries (sewered population in the districts). Therefore, it cannot be said to be a representative sample of all the beneficiaries from this project, but considered only as an indication of some of the impressions of the beneficiaries regarding the changes in the surrounding environment.

[27] These were performed on 20 companies eligible for sewage treatment in the area around the Pinsgfang and Songpu sewage treatment plants (ten companies for each treatment plant). As for the type of industries, three companies were in the agriculture/forestry/fishery industry, six were in the manufacturing industry, five were in the service industry, three were in the construction industry, and three were in the public agency or other category.

[28] Those people who did not recognize the improvements made comments like "There was no change," "There was no problem previously," and "No response." When this was cross-referenced against the responses from the interviews with the beneficiaries, their awareness level was low or they thought there was no problem on the issue, and so they selected such response.

[29] 55% of the respondents said that there had been improvements in the growth of harmful plants or plankton and 63% saw improvements in flooding during heavy rains. There was little recognition of the fact that there had been improvements with the other items surveyed, such as improvements with foul odors.

3.4.2. Other impacts

(1) Impact on the Natural Environment[30]

1) Monitoring during Project Execution

At the time of the appraisal, no negative impacts on the natural environment were envisioned. During the construction and remodeling work for the sewage treatment plants through this project, monitoring was carried out on the construction sites and treatment plants by the Harbin City Environmental Protection Bureau and observation units as planned at the time of the appraisal. Ventilation, dust particles, noise and vibration, waste, and drainage were all subject to monitoring. The daily monitoring results were reported to the City's Environmental Protection Bureau each quarter. According to interviews with the project implementation unit, the construction and remodeling work was carried out in conformance with the predetermined environmental protection standards, and no particular problems were seen during the construction work.

Water quality monitoring equipment at the Songpu sewage treatment plant

Sludge treatment facilities at the Pingfang sewage treatment plant

2) Monitoring after Project Completion

Monitoring devises were installed at the inlets and outlets of the sewage treatment plants, and according to the interview with the sewage treatment plant engineers of the project implementation unit, the values for the level of pollutant load in the water (COD, BOD, SS, T-N, T-P, pH, etc.) were monitored around the clock. And these monitoring devises were managed by a third-party agency that specializes in environmental monitoring, and the monitoring data is directly sent online to the State Environmental Protection Bureau. In addition, to check the precision of the observation equipment, the staff of the laboratory in each of the sewage treatment plants inspects the quality of water flowing into and out from the plant every day. According to the interview to the sewage treatment plant engineers of the project implementation unit, the City's Waterworks Bureau performs monthly water sample inspections, the City's Environmental Observation Center performs onsite examinations once each quarter, and the Environmental Protection Bureau performs onsite examinations at a frequency of once a month.

According to the interview to the sewage treatment plant engineers of the project implementation unit, a regulated distance is kept between the plant and the residential area according to "the outdoor drainage design regulation" so as to provide consideration to prevent any negative environmental influence to the residents' sphere of daily life.

At the time of designing, countermeasures were taken by installing equipment that produces noise underground, such as pumps. During the plant operation, foul odors were removed by installing sedimentation basins indoors, and using showers and mineral absorption. As for the

[30] The environmental impact assessment report for the project was approved by the Harbin City Environmental Protection Bureau in November 2002.

sludge generated as a result of the sewage treatment, its moisture content was dried off to 80%, and shipped to an outside sludge treatment center where it was disposed in a landfill. At the time of the ex-post evaluation, the new sludge treatment center built by Harbin City was operating on a trial basis. After the completion, the center is to start treating the sludge from the sewage treatment plants, and reuse it by processing it to soil for greening and other purposes.

3) Monitoring of the Rivers in the City

The Environmental Protection Bureau in Harbin City performs water quality monitoring on the rivers within the City. However, the methods of monitoring or the specific water quality data is not disclosed, and unavailable for the study.

(2) Land Acquisition and Resettlement

Since the construction site had already been secured the land acquired for this project remained small including 0.15 km^2 for the Pingfang sewage treatment plant and 0.11 km^2 for the Songpu sewage treatment plant, and was acquired as planned. Since the area was undeveloped wasteland, no resettlement occurred.

(3) Other Impacts

None in particular

In light of the above, this project has largely achieved its objectives as planned from the implementation of the project. Therefore, its effectiveness and impact are high.

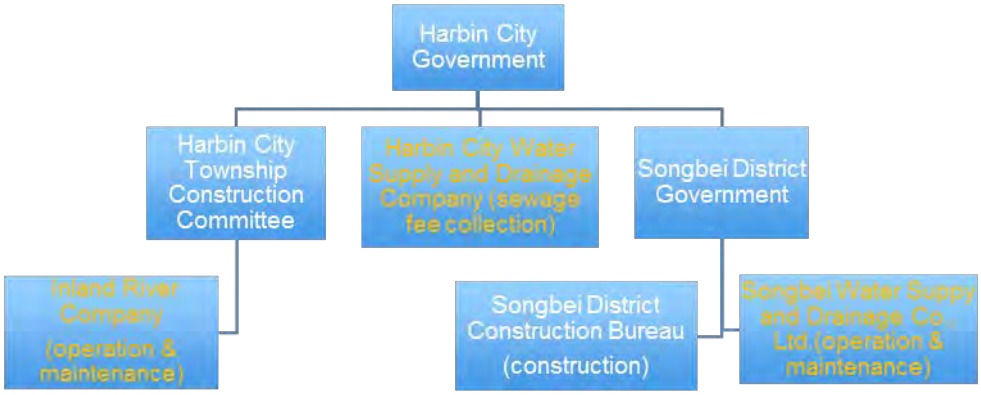
3.5. Sustainability (Rating: ③)

3.5.1 Institutional Aspects of Operation and Maintenance

At the time of the appraisal, with the commission by the city government, the Harbin City Inland River Construction and Development Co., Ltd.[31] (hereafter referred to as the "Inland River Company") was to manage construction of the sewage facilities, construction of the sewage treatment facilities, and maintenance of the sewage pipelines, and was to continue operating and managing the facilities after the completion of the project.

This went in accordance to the plan for the Pingfang sewage treatment plant. For the Songpu sewage treatment plant, since districts were established, the Construction Bureau of the Songbei District became in charge of construction of the Songpu sewage treatment facilities, and operation and maintenance at the time of the test-drive. Thereafter, at the formal operation stage, the responsibilities were transferred to the Songbei Water Supply and Drainage Co., Ltd., which is a state-owned company that was established to handle the operation and maintenance work for the sewage treatment plants.

[31] A state-owned company that handles sewage system projects and public projects related to the water environment (wholly owned by the Harbin City People's Government).



Source: material provided by Harbin City Inland River Construction and Development Co., Ltd
Note) The government agency is white letters, state-owned enterprises by the government is shown in yellow

Figure 2. Operation and maintenance structure at the time of the ex-post evaluation

Both the Inland River Company and the Songbei Water Supply and Drainage Co., Ltd. have defined chains of command and divisions of roles within their organizations. They have stationed the personnel necessary to perform the operation and maintenance of the sewage treatment plants, including administrative and management, engineers for operation and management of the plant facilities, monitoring room operators, patrol, and laboratory technicians. As such, no problems were seen with their operation and management structures. Both the Pingfang and Songpu sewage treatment plants have extremely small numbers of personnel involved in operation and maintenance compared with the numbers at the time of the planning. This is because progress has been made with automation that concentrates control in a central control room by means of installing surveillance cameras and water quality and volume monitoring devices within the plants. A reasonable number of people to carry out operations has been deployed. Thus no problem was found in the institutional aspects of the Project's operation and maintenance.

Table 8 Headcount of Pingfang Sewage Treatment Plant (unit:person)

	Plan (2006)			Actual (2015)				
	Total	Sewage Treatment Plant	Pipes and Pump Stations	Total	Engineers	Management	Administration	Accounting
Pingfang Sewage Treatment Plant	146	83	63	37	25	7	4	1

Source: data provided by Harbin City Inland River Construction and Development Co., Ltd

Table 9 Headcount of Songbei Water Supply and Drainage Co., Ltd. (unit:person)

	Plan (2006)			Actual (2015)				
	Total	Sewage Treatment Plant	Pipes and Pump Stations	Total	Engineers	Management	Administration	Accounting
Songpu Sewage Treatment Plant	100	88	12	35	25	4	5	1

Source: data provided by Harbin City Inland River Construction and Development Co., Ltd

3.5.2. Technical Aspects of Operation and Maintenance

Technical Level for Operation and Maintenance

During the planning, there were concerns about a lack of experience since a newly established company was going to be the project implementation unit. However, this was supplemented for by hiring engineers from university programs with a high level of expertise as well as seasoned engineers who had amassed experience at other treatment plants, and no problems have occurred. At both the Inland River Company and the Songbei Water Supply and Drainage Co., Ltd. new hires undergo training, and after their hiring all of the employees

undergo training several times each year, thus their technical level is maintained.

It was confirmed that both treatment plants carry out their operations, inspect their water quality measurement devices daily, and periodically inspect and overhaul their pumps and other equipment. According to the observation at the field study, manuals and log books for patrols, inspection, and water quality monitoring were equipped at each section. A liaison structure was set in place for when emergencies occur, and response training is carried out. Moreover, training for responding to heavy rains and flooding has been carried out at the Pingfang sewage treatment plant.[32]

Given the above, no problem was found with the technical aspects of operation and maintenance.

3.5.3 Financial Aspects of Operation and Maintenance

The operation and maintenance costs for the sewage treatment plants were paid to them from the Financial Affairs Bureau of the Harbin city as sewer usage fees through the Inland River Company and the Songbei Water Supply and Drainage Co., Ltd. The amount was the actual cost of operation and maintenance that had been established by an audit.

A breakdown of their revenue shows that this primarily comes from sewer usage fees. Since the fee level has been set on the low side[33] the level is not sufficient for operation and maintenance, thus, subsides from the city government is covering the deficit.[34] However the sewage treatment plants are recognized as important infrastructural facilities for the City, and they are operated and maintained by a state-owned company, which is a municipal governmental agency. As such, subsidies from the City have been firmly committed for the operation and maintenance costs.[35] Therefore, situations like the cessation of operations as a result of a lack of funds will not arise. Moreover, improving water quality is a priority in the national development plan, thus budgetary allocations towards sewage treatment have been prioritized. It is expected that the priority will not be changed in the future, thus it is foreseen that any problem will not arise when it comes to securing operation and maintenance costs. The sewer usage fees are inadequate as operation and maintenance costs, but the expectation is that the subsidies from the government will continue. As such, no problems were seen with sustainability in terms of the operation and maintenance costs.

3.5.4 Current Status of Operation and Maintenance

From the field study, it was confirmed that the current status of operation and maintenance at both the Pingfang and Songpu sewage treatment plants is in good shape. Periodic inspections of the sludge treatment facilities have been carried out at Pingfang, and repairs on the underground pipe system have been carried out at the Songpu sewage treatment plant and the pipeline network outside, however both plants were in a condition where they can perform the functions planned through this project. The insides of the plants were meticulously cleaned and kept in order, and they have been fully furnished with manuals and maintenance, inspection, and patrol records. According to the records, responses are promptly carried out when malfunctions with the facilities were discovered, with these including reporting the problems, performing repairs, and replacing parts. Both sewage treatment plants were equipped with generators (that can operate for eight hours) which can operate their intake and drainage pumps in case of blackouts.

Both treatment plants have developed maintenance plans, and according to the plan upgrading and renovation of the facilities have been conducted. For the equipment that was manufactured in overseas countries such as sludge dewatering centrifuges and the switchboards

[32] The area eligible for treatment by the Songpu sewage treatment plant is not at risk from flooding from heavy rains because it has completely finished with branching its storm sewer pipes.

[33] Since the fee for sewage systems are determined by local governments via public hearings, fees have been kept on the low side. From the beneficiary survey it was found that this accounts for a share of 0.9% of household budgets on average.

[34] No response was received from the project implementation unit regarding the share of subsidiaries from the City.

[35] Information on the financial resources of the Harbin City government was not provided by the City.

in the plants, the parts are available at agents nearby, thus no problems have arisen.

At the time of the ex-post evaluation, both treatment plants were at less than 50% of their operation rates. The facilities to reclaim water for the Songpu sewage treatment plant was built in accordance to the plan, but since the construction plan of the industrial park that was slated to reuse the reclaimed water delayed, the facilities were not used at the time of the evaluation. According to the project implementation unit, regardless of the low plant operation rates, maintenance has been carried out at an adequate level to ensure that the treatment plant facilities can immediately accommodate to the demand. According to the City's development plans, the plant operation rates and reused volume for reclaimed water will both rise to the levels expected at the time of the appraisal by 2020.

In light of the above, there are no problems with the project's institutional aspects, technical aspects, financial aspects, or current status of operation and maintenance. Therefore, the sustainability of the project effects is high.

4 Conclusion, Lessons Learned, and Recommendations

4.1 Conclusion

The objective of this project is to improve the sewage treatment capacity in Harbin City by installing sewage facilities there, thereby reducing the pollution load of the water discharged into the river within the City, and improving the living environment for the City's residents.

This project was consistent with China's development policies and development needs at the national, provincial, and city levels at the time of the appraisal and the time of the ex-post evaluation, as well as with Japan's policy for assistance to China at the time of the appraisal. Therefore, its relevance is high.

The Pingfang and Songpu sewage treatment plants of the Project were constructed in accordance with the designed capacities in the plan, and meet targets of the Project and the national standards regarding the quality of the water discharged. Conversely, the volume of sewage inflow fell far below the estimates based on which the capacity was designed, and so the operation rate of the treatment plants has remained down below 50%. What is more, facilities to reclaim water were not used at the Songpu sewage treatment plant. This was due to external factors such as the fact that progress was made with autonomous effort to conduct treatment at factories as a result of revisions to drainage water regulations, and the decline in the intake volume into the sewage treatment plants from this project as a result of delays in the construction for the development plan of the City as a whole. Urban development is advancing, with the expectation that the demand levels calculated in the plan will be realized for both the sewage discharge volume and the demand for reclaimed water by 2020. The volume of sewage generated at the time of the ex-post evaluation was to about 90% of the estimates from the time of the appraisal for Harbin City as a whole. However, both the sewage treatment volume and treatment rate exceeded the project's targets. Moreover, the reduction in the total amount of pollutants discharged into the public water within Harbin City is regarded as a contribution from the project when it comes to improving the water quality in the river within the City. Therefore, the claim can be made that its impact is high and it achieved its effectiveness and impact targets on the whole. While the project period was within what was planned, the project costs marginally exceeded what was planned and thus the efficiency is fair. Regarding the sustainability of the effects generated by this project, there is no major problem in the operating agency's operation and maintenance structure, technical level, and financial conditions. Therefore, the sustainability of the project is high.

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

4.2 Recommendations for the executing agency

Promote the use of excess sewage treatment capacity

The two sewage treatment plants built through this project were built as planned. However, the operating rates at the time of the ex-post evaluation were significantly below their design capacity. This was primarily caused by the fact that the sewage water taken into the sewage treatment plants had decreased because of the delays in the urban development, and as a result of strengthening regulations, in-house treatment promoted at the plants that served as a major source of sewage.

For the future, sewage volume will increase in conjunction with the advances in urban development, and the facility capacities will be expected to be fully used. On the other hand, the sewage treatment rate at the time of the ex-post evaluation was 90% in the Harbin City as a whole, with some sewage that remains untreated. As a countermeasure for this, the executing agency may take examples from other cities, such as planning the expansion and extensions of the pipeline network as well as optimizing sewage volume between treatment plants in view of the development of the city as a whole. Through such measures the remaining capacity from the two treatment plants from this project may be used.

4.4 Lessons Learned

(1) Necessity of appropriate planning and monitoring during the project implementation to take full advantage of the facilities' designed capacity

The sewage treatment volumes and operation rates of the two sewage treatment plants of the project have fallen substantially below the designed capacity. The expectation is that their treatment capacities will be used effectively over the medium to long-term. But on the other hand, there was sewage that was going untreated for the City as a whole at the time of the ex-post evaluation. There could be some leeway to use the underutilized capacity for Harbin City as a whole by promoting the installation of a pipeline network to such sewage treatment plants, or transferring sewage between treatment plants, and so forth.

In Harbin City's case, since it has several state-owned companies that carry out operation and maintenance for sewage treatment plants, the city government must take the lead in coordination for the optimization between plants, and the possibilities can be considered at the time of the project designing, so as to prepare for such situation, as well as any future inspection or repair work for the sewage treatment plants.

JICA must consider ways to use facilities more effectively together with the executing agency when project plans are formulated. In addition, while projects are being implemented, the relevance of the plan must be considered in response to changes in the actual needs through monitoring or mid-term supervision, so as to consider the modification needs such as additional pipelines or adjustment of sewage treatment service districts in accordance to the needs.

(2) Consideration on comprehensive approaches in order to boost the project's effects

Progress has been made with regulating the large-scale factories that were a source of pollutants in Harbin City. As a result, the number of companies built in-house waste water treatment facilities, which has facilitated a reduction in the pollutants discharged into the river. These regulations have brought about positive effects regarding the intended Project's impact in improving the water quality of the river and the living environment for the residents. When formulating similar environmental and hygiene improvement projects in other countries, JICA may be suggested to consider comprehensive approaches in parallel on policy recommendations or policy-making; for instance, combining human resource development training for government and environmental division staff within the ODA loan or by technical cooperation, and so to aim higher effects from the projects.

Comparison of the Original and Actual Scope of the Project

Item	Plan	Actual
(1) Project Outputs		
Pingfaeng Sewage Treatment Plant	CASS Process: 150,000 m^3/day Intercepting Main Lines Approx.64 km	As Planned
Songpu Sewage Treatment Plant	CASS Process: 100,000m^3/day Reclaimed Water 30,000 m^3/day	As planned
Sewage Pipeline Network	Pump Station 2 locations Drainage Approx. 67 km Discharge Conduit Approx.6 km Reclaimed Water Network Approx. 25 km	Cancelled (Constructed by other projects via domestic financing)
Training	3 times total 36 persons	3 times total 35 persons
(2) Project Period	July 2006 – April 2011 (58 months)	As planned
(3) Project Cost		
Amount paid in Foreign Currency	9,747 million Japanese yen	6,883 million Japanese yen
Amount Paid in Local Currency	3,334 million Japanese yen (139 million Chinese yuan)	6,719 million Japanese yen (460 million Chinese yuan)
Total	14,893 million Japanese yen	13,602 million Japanese yen
ODA loan portion	7,398 million Japanese yen	6,883 million Japanese yen
Exchange Rate	1 Chinese yuan ＝ 13.7 yen (as of September 2005)	1 Chinese yuan ＝14.6yen (actual amount 2006 - 2011)