People's Republic of China

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

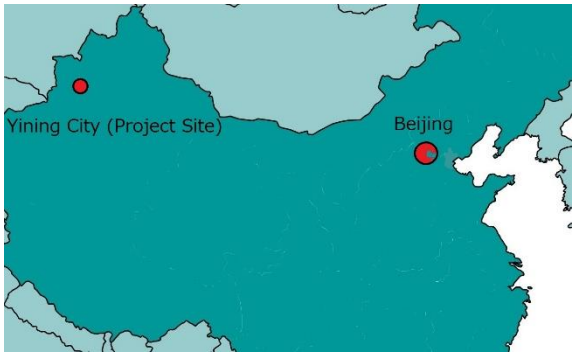
External Evaluator: Kenji Momota, IC Net Limited

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

[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.

harnessing market mechanisms. With regard to garbage treatment, the detoxification and 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

[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.

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 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.

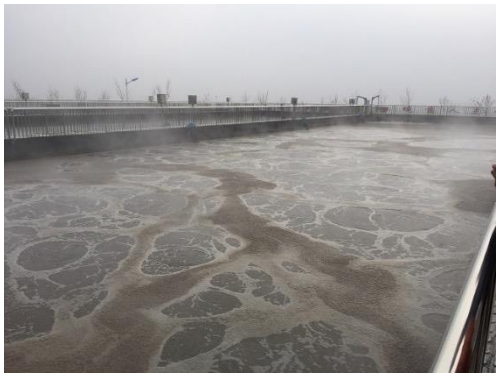
(1) Cancellation of the urban natural gas utilization sub-project and reallocation of the surplus funds

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 sub-project.

[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.

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 project

[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.

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	Target values	Actual values
		2004	2011	2015
			Project completion year	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

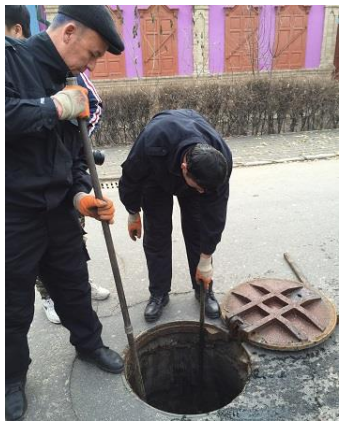
To evaluate the technical levels of the concerned parties in charge of managing the sub-projects, data like the number of engineers and the structures and qualified personnel at each level were analyzed for each sub-project. In addition, the level of proficiencies of the employees, repair technicians 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 status and future prospect 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 provid 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.
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	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

[19] The definition for percentage of wastewater treatment is “Amount of sewage treated / Amount of sewage generated.”

	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.	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.