China

Ex-Post Evaluation of Japanese ODA Loan Project

Lanzhou Environmental Improvement Project

External Evaluator: Kenji Momota, IC Net Limited

0. Summary

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

1. Project Description

Project location

Sewage treatment plant (final settling tank)

1.1 Background

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

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

1.2 Project Outline

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

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

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

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

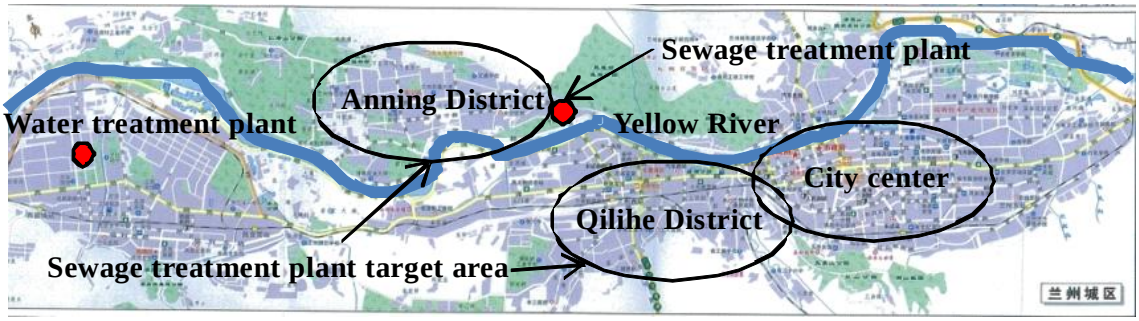


Figure 1: Lanzhou City and Project Sites

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

2. Outline of the Evaluation Study

2.1 External Evaluator

Kenji Momota, IC Net Limited

2.2 Duration of Evaluation Study

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

Duration of the Study: November 2010–November 2011

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

2.3 Constraints during the Evaluation Study

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

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

3.1 Relevance (Rating: ③[2])

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

(1) Development Plan at the Time of Appraisal

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

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

(1) Consistency with national policies (development plans)

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

(2) Consistency with sector and regional measures

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

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

[2] ③: High; ② Fair; ① Low

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

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

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

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

3.1.2.1 Subproject Needs

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

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

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

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

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

3.1.3 Relevance of Project Objective Settings

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

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

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

3.1.4 Relevance with Japan's ODA Policy

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

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

evaluated as an important concrete step toward implementing it.

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

3.2 Efficiency (Rating: ①)

3.2.1 Project Outputs

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

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

water treatment plants		

The main changes were as follows.

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

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

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

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

Fig.2 Biological Treatment Basin at the Sewage Treatment Plant

Fig.3 Water Discharged After Treatment

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

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

Fig.5 Heat Provision Project Central Heat Provision Facility

3.2.2 Project Inputs

3.2.2.1 Project Cost

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

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

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

3.2.2.2 Project Period

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

Table 1 Planned/Actual Ratio for Subproject Project Periods

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

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

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

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

(2) Lanzhou Sewage treatment project; reasons for delay

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

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

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

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

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

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

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

3.3 Effectiveness (Rating: ③)

3.3.1 Quantitative Effects

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

(1) Achievement of the entire project

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

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

(Unit: Tons/year)

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

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

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

(Unit: Tons/year)

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

Source: Edited based on responses from subproject implementing agencies

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

[8] SO_2 is a gas that is one of the major air pollutants resulting from the burning of fuels that contain sulfur, such as coal and heavy oil. It is a cause of acid rain.
[9] Total suspended particulates: A term used to refer to all particulate matter.
[10] Biochemical oxygen demand: Amount of dissolved oxygen required by aerobic biological organisms. Used as an indicator of water pollution, particularly important as one of the controlled items for factory wastewater and the like. This is the volume of oxygen consumed by microorganisms when they decompose organic matter in the water. The higher the number, the more the water is polluted.
[11] Chemical oxygen demand: Often used as a measurement of the amount of water pollution, it is a measure of the capacity of water to consume oxygen during the decomposition of organic matter.
[12] Suspended solid: Refers to insoluble particulate matter. This includes particles from clay minerals, phytoplankton, zooplankton and their carcasses, as well as organic and metallic sediment from sewage and factory water discharges.
[13] For example, at the time of planning, the heat provision volume per hour was 300 Gcal/h but the actual results for 2010 were only 206 Gcal/h. According to the implementing agency, this was not due to a shortage at the heat source, but instead due to the construction of housing with high heating efficiency, which led to a reduced heat provision volume per household.

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

1) The Lanzhou Gas Supply Pipeline Network Project

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

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

2) The Lanzhou Heating Supply Pipeline Network Project

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

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

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

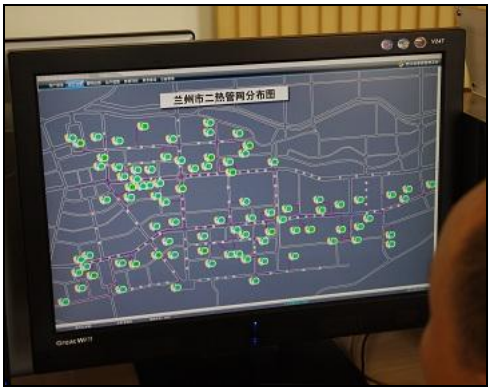


Fig.7 Map Showing the Location of Heat Exchange Stations in the City

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

3) Lanzhou Sewage treatment project

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

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

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

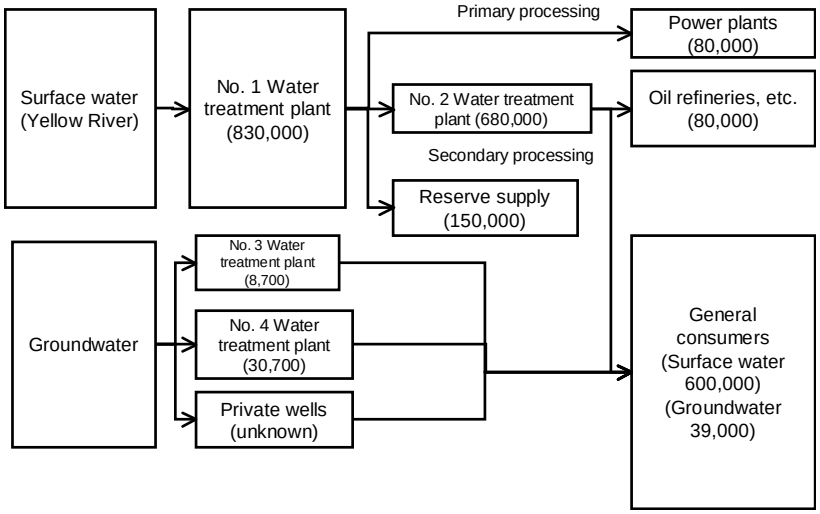
Source: Lanzhoucheng Environmental Protection and Water Service Co.

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

4) Water supply expansion project

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

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



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

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

3.3.1.2 Results of Calculations of Internal Rates of Return

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

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

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

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

3.3.2 Qualitative Effects

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

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

3.4 Impact

3.4.1 Intended Impacts

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

3.4.1.1 Improvement of the Atmospheric and Water Environments in Lanzhou City

(1) Improvement of the atmospheric environment

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

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

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

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

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

Source: Lanzhou City Environmental Bulletin

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

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

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

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

Table 7 Changes in Sewage Discharge Volume of Lanzhou City

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

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

Source: Lanzhou City Environmental Bulletin

Fig.8 Discharge Outlet for Treated Sewage

Fig.9 Yellow River (in Lanzhou City)

3.4.1.2 Improvement of the Living Environment of Residents

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

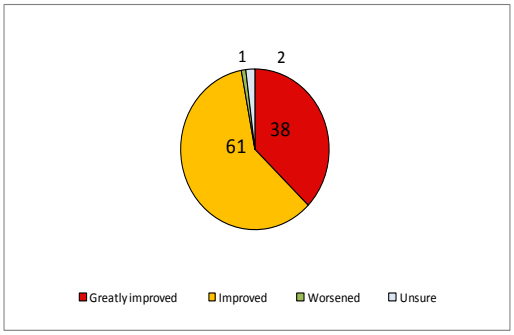


Fig.10 Evaluation of the Improvement in Air Quality in Lanzhou City

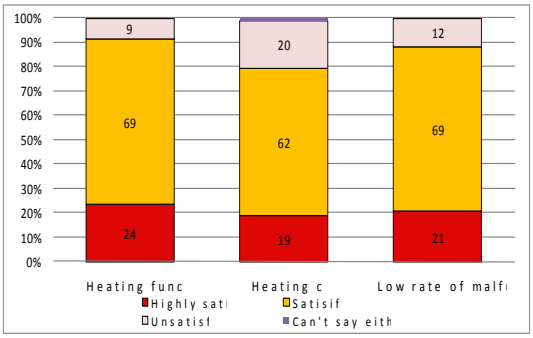


Fig.11 Degree of Satisfaction with Heat Provision Functions

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

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

3.4.2 Other Impacts

(1) Current Situation and Issues Regarding Sewage Treatment

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

Fig.12 Sludge Landfill in the City Suburbs

Fig. 13 Sludge Processing Facilities

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

(2) Resettlement of Residents/Acquisition of Land

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

(3) Impact on the Natural Environment

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

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

3.5 Sustainability (Rating: ③)

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

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

3.5.1 Structural Aspects of Operations and Maintenance

(1) Transitions in the Project Implementation Structure

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

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

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

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

3.5.2 Technical Aspects of Operations and Maintenance

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

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

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

3.5.3 Financial Aspects of Operation and Maintenance

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

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

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

Table 8 Lanzhou City Kunlun Gas Operating Revenue and Expenses

(Unit: 10,000 Yuan)

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

Source: Lanzhou City Kunlun Gas

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

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

Table 9 Lanzhou Thermal Power Company Operating Revenue and Expenses

(Unit: 10,000 Yuan)

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

Source: Lanzhou Thermal Power Company

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

3) Lanzhou Sewage Treatment Project: No Issues

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

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

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

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

3.5.4 Current Status of Operations and Maintenance

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

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

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

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

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

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

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

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

4.2.2 Recommendations to JICA

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

4.3 Lessons Learned

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

End

Comparison of the Original and Actual Scope of the Project

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

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

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

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

Ratings calculation method:

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

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

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

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

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

1-1 The Lanzhou Gas Supply Pipeline Network Project

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

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

1-2 The Lanzhou Heating Supply Pipeline Network Project

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

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

2-1 Lanzhou Sewage Treatment Project

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

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

2-2 Lanzhou Water Treatment and Supply Project

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

Attachment 3 3.5 Sustainability Rating Results By Subproject

(1) Evaluation Standards for Ratings

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

(2) Ratings Results

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

Ratings calculation method:

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

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