Ex-Post Project Evaluation 2017:
Package II-1 (China)

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People's Republic of China

FY2017 Ex-Post Evaluation of Japanese ODA Loan Project

"Higher Education Project (Liaoning Province)"

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International Development Center of Japan Inc.

0. Summary

This project aimed at improving education and research at 15 universities in Liaoning Province by improving facilities and equipment as well as training teachers. The project was highly relevant and performed according to the higher education human resource policies of China and Liaoning Province. Furthermore, it aligned with China's and Liaoning Province's development needs for quantitative and qualitative expansion of education at universities and Japan's ODA policy. Therefore, relevance is high. In terms of effectiveness, increases and improvements were evident for many indicators related to quantitative and qualitative improvement. It was also confirmed that the project contributed to obtaining approval for founding new graduate schools and key disciplines or laboratories, and improved education, research conditions, and the environment. In terms of impacts, the universities involved in the project demonstrated substantial improvements compared to the pre-project period for indicators such as employment rate, number of award-winning research papers, number of patented research outcomes, and number of published research papers. In addition, in terms of contributions to regional revitalization, strengthening of market rules, and environmental conservation, the development of human resources in related fields at participating universities became more robust, and various initiatives are making progress through both commissioned and research projects. There are also many examples of how cooperation and mutual understanding has been fostered between Chinese and Japanese universities. As such, the effectiveness/impact is high as outcomes were produced mostly as planned. Because the project cost was slightly higher and the project period significantly lasted longer than planned, the efficiency is low. No major problems have been observed in the institutional, technical and financial aspects of the operation and maintenance, as well as in the status of the operation and maintenance.

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

1 . Project Description

Project location

The International Education College building of Liaoning Shifua University

1 . 1 Background

In China, the reform and open policy has since 1978 brought about the transition to a market economy, rapid economic development, and associated environmental problems. This became even truer with China's accession to the World Trade Organization (WTO). Against this background, it was becoming necessary to strengthen education and research activities related to market rules and environmental problems. In addition, as regional economic disparities had become visible, it required regional revitalization to fill the gap. In response to these demands as well as increasing demand for the higher education, it became necessary to quantitatively and qualitatively improve higher education. To address this, the Chinese government set the following goals in its *10th Five-Year Plan for National Economic and Social Development (2001-2005)*: a 15% enrollment rate in higher education institutions (HEIs); enrollment of 16 million students in HEIs; and development of human resources in fields such as law, finance, and trade.

Liaoning Province, located in northeastern China, has an area of 146,000 km², and a population of 41.2 million people (2004). The per capita GDP of Liaoning Province was 16,298 yuan (2004), higher than the national average of 10,561 yuan, but much lower than the coastal province average of 27,802 yuan. In addition, because the revenue of Shenyang City and Dalian City, which accounted for approximately half (56%) the province's total GDP, was on a self-paying basis, the revenue of both these cities was excluded from the province's budget. Therefore, these funds cannot be used for provincial educational expenses such as the operating expenses of provincial universities including those participating in this project, creating a shortage of revenue that can be allocated to higher education expenses across the province.

In terms of educational level, although Liaoning Province's 2004 higher education

enrollment rate of 29.3% was high compared to the national average of 19%, the province lagged behind in terms of the amount of educational and research equipment, and particularly the school building area provided. Furthermore, Liaoning Province had numerous state-owned enterprises, and the unemployment rate became severe when many went bankrupt consequent to the effects of reform and open policy, creating an urgent need to develop human resources to work toward regional revitalization in Liaoning Province.

1.2 Project Outline

The objective of this project is to quantitatively and qualitatively improve higher education in Liaoning Province by providing 15 target universities with "hard" (improvement of school buildings and equipment) and "soft" (conducting training for faculty) support, thereby contributing to developing human resources who could work toward strengthening market rules, environmental conservation, and regional revitalization in Liaoning Province.

(Participating universities[1]) Liaoning University, China Medical University, Shenyang University of Technology, Liaoning Technical University, Shenyang Agricultural University, Dalian Medical University, Dalian Jiaotong University, Dalian Polytechnic University, University of Science and Technology Liaoning, Shenyang University of Chemical Technology, Liaoning Shihua University, Dongbei University of Finance and Economics, Liaoning Normal University, Shenyang Normal University, and Liaoning University of Technology (15 universities in total)

Loan Approved Amount/ Disbursed Amount	5,775 million yen / 5,650 million yen	
Exchange of Notes Date/ Loan Agreement Signing Date	June 2006 / June 2006	
Terms and Conditions	Interest Rage	1.5% (0.75% for training component)
	Repayment Period (Grace Period	30 years (40 years for training component) 10 years)
	Conditions for procurement	General untied
Borrower /	The Government of the People's Republic of China/	

[1] The university names are those used at the time of the ex-post evaluation. (Among the 15 universities, four have changed their names since the appraisal period.)

Executing Agency (ies)	Liaoning Provincial People's Government
Project Completion	December 2015
Main Contractor(s) (Over 1 billion yen)	—
Main Consultant(s) (Over 100 million yen)	—
Related Studies (Feasibility Studies, etc.)	- F/S by Liaoning Construction Consultancy Company, 2005 - "Special Assistance for Project Implementation (SAPI) for Higher Education Project in China", Japan International Cooperation Agency (JICA), 2003, 2004 and 2005 - "The Supervision Survey Report on JICA Loaned Higher Education Project", JICA, 2010
Related Projects	- ODA Loan: "Higher Education Project (Hebei Province)" (June 2006) - ODA Loan: "Higher Education Project (Hainan Province)" (June 2006)

2. Outline of the Evaluation Study

2.1 External Evaluators

Toshihiro Nishino/Ayako Nomoto (International Development Center of Japan Inc.)

2.2 Duration of Evaluation Study

This ex-post evaluation study was conducted with the following schedule.

Duration of the Study: August 2017-November 2018

Duration of the Field Study: December 3, 2017-December 16, 2017 and May 13, 2018-May 18, 2018

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

3.1 Relevance (Rating: ③[3])

3.1.1 Consistency with the Development Plan of China

The objective of this project has been consistent with the development plans of China, including the five-year plans at the national and provincial level, five-year plans in the

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

[3] ③: High, ②: Fair, ①: Low

education sector, and other education-related strategies both during the appraisal and the ex-post evaluation. They stated that they "aim to develop advanced human resources that meet societal needs by quantitatively and qualitatively improving higher education with the goal of achieving social and economic development and correcting issues of regional disparities." Although there have been no major policy changes at the appraisal stage or ex-post evaluation stage, *the Thirteenth Five-Year Plan (2016–2020)* presents a policy of "building world-class universities and disciplines (promoting the building of leading universities and disciplines), while gradually increasing world-class university and academic fields."

Table 1 Primary Targets for Development Plans Related to the Project

Type	During Appraisal	During ex-post evaluation
National Development Plan	Tenth Five-Year Plan for National Economic and Social Development (2001–2005) ・ Increase the rate of enrollment in HEIs (students enrolled/school-age [18–22] population) to around 15%. ・ Improve educational conditions: Primarily expand the scope of education at the higher education stage in large and medium cities, and enhance the quality of education.	Thirteenth Five-Year Plan for Economic and Social Development (2016–2020) ・ Continue to promote vocational education, university reform, improvement of capabilities of human resource development, educational equality, and educational reform. ・ The numerical target for higher education is an enrollment rate in university education of 90% or higher.
National Educational Development Plan	Tenth Five-Year Plan for Education (Educational Plan 10-5) (2001–2005) ・ Numerical target: Increase the number of enrolled students at HEIs to 16 million by 2005 and 23 million by 2010. ・ Response to adjustments in industrial structure: Develop human resources who have advanced skills related to high-tech work, biotechnology, and manufacturing technology, and develop human resources who are advanced in fields like law, finance, and trade to be compatible with membership in the WTO.	Thirteenth Five-Year Plan for Education (2016–2020) and National Plan for Medium and Long-term Education Reform and Development (2010–2020) ・ Promote "the building of leading universities and disciplines" and "improvements in the cultivation of core/key universities in midwestern China[4]." ・ Increase the rate of enrollment at HEIs from 26.5% (2010) to 40% (2020).

[4] Although Liaoning Province is not normally included in the midwestern part, it is a participating region in such projects constructing higher education institutions in the midwestern part as a part of the Project for the Promotion of Higher Education in the Midwestern Part.

Provincial-level Development Plan	Tenth Five-Year Plan (2001–2005) for Education in Liaoning Province and 2010 Long-term Provincial Plan ・ In the area of university education, improve the conditions for school operation, strive to improve the capabilities of teachers, and streamline school expansion and establishment of specialties. Furthermore, bring university standards up to those of leading universities by improving the standards of education and scientific research. ・ Aim for the following targets. Student population size: 1.1 million in 2010; rate of enrollment in higher education: 33% in 2005, 38% in 2010.	Thirteenth Five-Year Plan (2016–2020) for Education in Liaoning Province, Thirteenth Provincial Five-Year Plan (2016–2020) ・ "Build approximately ten top-class, distinctive disciplines across the country," "raise the employment rate of people with bachelor's degrees to 92%," "increase the abilities of universities to make scientific and technological reforms," etc. ・ "Continue to prioritize the development of human resources such as those who are advanced in management/technology," "increase investment in scientific and technological fields," etc.

Source: Documents provided by JICA, texts of each plan

３．１．２ Consistency with Development Needs of China

At the time both of the appraisal and ex-post evaluation, the needs for quantitative and qualitative expansion of education at the 15 participating universities were recognized.

At the time of the appraisal, higher educational needs in Liaoning Province were expected to grow, and the filling the gap of economic disparities with other coastal provinces described in "1.1 Background" was needed. The number of enrolled students at HEIs in Liaoning Province was 213,000 in 2004, and a 2012 demand forecast estimated it would increase to 788,000 people. Although the central government had called for universities to make improvements to hard (expansion of school buildings and equipment) and soft (teacher training) areas to meet these growing needs, there were financial limitations.

At the time of ex-post evaluation, strong needs to develop human resources for regional revitalization, strengthening market rules, and environmental conservation remained. Liaoning Province is highly dependent on state-owned enterprises in its economy and industries, and has a low rate of economic growth compared to the national average. This can be attributed to factors such as the slow reform of state-owned enterprises and slow structural transition from heavy industries, giving it a particularly high level of needs in these areas. These issues were raised in *the 13th Five-Year Plan for Liaoning Province.* As (i) *the 12th Five-Year Plan for Liaoning Province* demonstrated achievements in the quantitative expansion of higher education and (ii) an increasing need for developing human resources that emphasize the quality

of graduate-level education consequent to the influence of improved economic and industrial standards in China, plans are being made to shift the emphasis of policies from quantitative expansion to quality improvement. This is represented by "promoting the building of leading universities and disciplines." This project aligns with the province's needs from the perspective of improving educational quality.

3.1.3 Consistency with Japan's ODA Policy

At the time of the appraisal, the project was highly consistent with Japan's ODA policy. The fundamental principles of *the Japan's ODA Charter* emphasized support to Asian regions and in the field of human resource development, which was consistent with the project.

Furthermore, at the time of the appraisal, *the Economic Cooperation Program for China (FY2001), the Medium-Term Strategy for Overseas Economic Cooperation Operations (FY2005–FY2007)*, and *the Country Assistance Strategy (FY2005)* supported China's policies of the open and reform. Furthermore, from the perspective of dealing with adjustments in economic structure after China joined the WTO, they emphasized the development of human resources, thus the project was consistent with these strategies. The *Country Assistance Strategy* included regional revitalization and interaction, strengthening market rules, and environmental conservation as key areas for human resource development.

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

3.2 Efficiency (Rating: ①)

3.2.1 Project Outputs

The extent to which project outputs were achieved is as described in the "Comparison of the Original and Actual Scope of the Project" at the end of this report. In terms of hard outputs, Dongbei University of Finance and Economics and Shenyang Normal University used their own funds to construct a library and school building respectively, because they needed construction to take place early. At the Liaoning Shihua University, plans for construction using Japanese ODA Loan funds changed from focusing on a school building to a building for the International Education College, which comprises international student dorms and classrooms for international students (primarily international students from Asia and Africa) (no changes were made to the construction area). Because Dongbei University of Finance and Economics and Shenyang Normal University used their own funds to construct a library and school building, the

construction area funded by the Japanese ODA Loan funds decreased dramatically (The funds for construction were diverted to procuring equipment).

Furthermore, in terms of school building construction, Liaoning Shihua University was expected to "utilize the building to conduct joint research with Japan," but that objective has not been achieved because of the change in construction plans. Changes to the construction plans were made to accommodate changes in university needs, and no major issues related to the project output of school building construction were observed. In addition, as a result of the steadily increasing number of international students, primarily from Africa and Asia, hard project outputs are being used either as planned or more than planned.

Table 2 Actual Results of School Building Construction

	Plan	Actual	Content of changes
Liaoning Shihua University	11,000 ㎡	19,000 ㎡	Changed from school building to building for the International Education College
Dongbei University of Finance and Economics	17,000 ㎡	-	Excluded from the project: Self-funded construction of library
Shenyang Normal University	10,000 ㎡	-	Excluded from the project: Self-funded construction of school buildings
Total	38,000 ㎡	19,000 ㎡	

Source: Documents provided by JICA, questionnaire responses and interviews from executing agency/participating universities

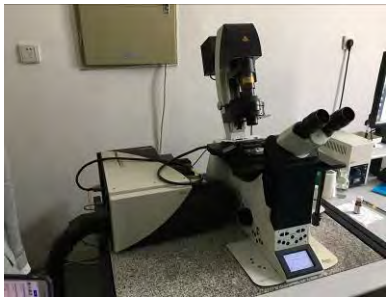
In terms of improvement of educational equipment, procurement was split into multiple packages during this project. Furthermore, because of the long period of procurement[5], there were frequent cancellations of and slight changes or adjustments to equipment based on (i) changes to equipment specifications and (ii) changing needs at the respective universities[6]. Despite this, delivery mostly followed the initial plans and installation was completed according to the plan.

Regarding soft outputs, the actual total number of university instructors who received training in Japan, were accepted as trainees, experts, or participated in joint research

[5] Although the contract for standard university procurement packages (product-based packages) was formulated in 2009, because three years had already passed since the initial plans were developed from 2005 to 2006, and urgently needed equipment had been already installed, some adjustments were made to the specifications of equipment and devices. In addition, subsequent installations focusing on individual university procurement packages (university-based package) primarily occurred from 2014 on, and adjustments were made to accommodate equipment that had already been installed using a university's own funds during that period.

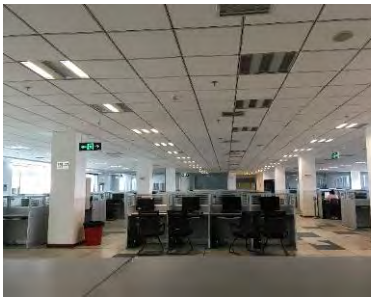
[6] The funds saved because of the result of bidding and those from canceled packages in the initial procurement packages were allocated to later packages within the ODA Loan approved amount after following formal procedures.

was about 10% higher than planned. While training results were significantly higher than planned, there were zero results for joint research and expert acceptance, much lower than planned. According to interviews with people affiliated with the participating universities, there were no results for joint research and expert acceptance because (i) many universities thought that training in Japan was more effective from a human resource development standpoint; (ii) expert acceptance and joint research could be achieved using budgets from other projects, making it more logical to use funds from this project for training; and (iii) for universities with little interacting with Japanese universities, it was difficult to conduct joint research or be accepted as an expert.



A confocal laser microscope provided to Dalian Medical University has a dedicated experimenter assigned to it and a high rate of use.

A nuclear magnetic resonance device provided to Shenyang University of Chemical Technology. One of the most cutting-edge pieces of equipment in the province, with many analysis requests coming from outside the university.



PCs set up in the library of Shenyang Agricultural University. These are frequently used by students.

３．２．２ Project Inputs

３．２．２．１ Project Cost

The total project cost slightly exceeded that planned (114% of the planned cost). The higher cost is attributed to the following aspects. (i) Because extreme depreciation of the yen continued from 2013 and shortfalls were covered using local currency, project costs increased (exchange rate: at the time of appraisal, 1 yuan = 13.7 yen, average of 14.9 yen over the entire period, 12.6 yen in 2012, and 19.4 yen in 2015). (ii) Costs increased after equipment specifications changed from those in the initial plan. In particular, the actual cost of educational equipment in local currency was 4,628 million yen, a significant increase from the 1,611 million yen planned. Furthermore, the actual cost of training was approximately 135% of the planned cost, because the results of sending personnel for training exceeded that planned, and the expense of sending personnel for training after 2013 increased

because of the depreciating yen.

Table 3　Planned and Actual Project Costs

(Unit: million yen)

	Planned (appraisal)						Result					
	Foreign currency		Local currency		Total		Foreign currency		Local currency		Total	
		ODA loan		ODA loan		ODA loan		ODA loan		ODA loan		ODA loan
School building construction	299	299	1,361	0	1,660	299	110	110	87	0	197	110
Provision of educational equipment	4,949	4,949	1,611	0	6,560	4,949	5,300	5,300	4,628	0	9,928	5,300
Training, etc.	297	297	11	0	308	297	240	240	175	0	415	240
Tax	0	0	55	0	55	0	0	0	0	0	0	0
General administrative expenses, etc.	0	0	47	0	47	0	0	0	65	0	65	0
Price escalation	172	172	0	0	172	172	0	0	0	0	0	0
Contingency	299	58	149	0	448	58	0	0	0	0	0	0
Total	6,016	5,775	3,234	0	9,250	5,775	5,650	5,650	4,955	0	10,605	5,650

Source: Compiled from documents provided by JICA and the executing agency

Note: 1) Exchange rate was 1 yuan = 13.7 in planned amounts and 1 yuan = 14.9 yen in actual amounts (2006–2015 average). 2) Because no information was obtained regarding actual interest during construction, they are excluded from both the planned and actual figures. 3) There is no information regarding a breakdown of local and foreign currencies for actual ODA loan amounts. Local currency refers to domestic funds in China.

３．２．２．２ Project Period

The actual project period was 115 months, a significant increase from the planned project period of 58 months (198% of the planned period). The reasons for exceeding the planned project period are described below.

1) Procedures were time-consuming, because the complexity of the various procedures to procure educational equipment necessitated corrections of paperwork.

2) After the project started, procurement proceeded based on standard packages that followed the Department of Education of Liaoning Province's policy of creating procurement packages common among universities, and adjustment among universities was time-consuming because of the large number of universities

participating[7]. Furthermore, procedural delays at some universities affected overall progress.

3) In addition to in-country procedures that became time-consuming due to making corrections to equipment specifications, procurement procedures were also delayed because of the processing of bidder complaints regarding the bidding results.

4) Because the Department of Education of the province and universities lacked experience in sending personnel overseas for training as part of an international cooperation project, preparation for long-term specialized training of university teachers and in-country procedures were especially time-consuming.

5) For the construction of school buildings, procurement plans needed to be adjusted because of increases in material costs, requiring more time for in-country procedures.

Table 4 Planned and Actual Project Period

	Planned (appraisal)	Result
Signing of loan agreement	June 2006	June 2006
School building construction	July 2006–April 2009	March 2011–September 2014
Procurement of educational equipment	July 2006–April 2008	October 2006–December 2015
Training, etc.	October 2006–March 2011	October 2007–October 2015
Project completion (project period)	March 2011 (58 months)	December 2015 (115 months)

Source: Compiled from documents provided by JICA, documents provided by executing agency, and responses from executing agency

3.2.3 Results of Calculations for Internal Rate of Return (Reference only)

Since the Internal Rate of Return (IRR) was not calculated at the time of appraisal, IRR was not calculated in the ex-post evaluation either.

Thus, the project cost slightly exceeded the plan and the project period significantly exceeded the plan. Therefore, efficiency of the project is low.

3.3 Effectiveness and Impacts[8] (Rating: ③)

3.3.1 Effectiveness

3.3.1.1 Quantitative Effects (Operation and Effect Indicators)

[7] According to the Provincial Department of Education, procedures for government procurement in Liaoning province were simplified in 2018. In particular, the procurement of imported equipment was changed to a university-led system.

[8] Sub-rating for Effectiveness is to be put with consideration of Impacts.

The operation and effect indicators established at the time of the appraisal and indicators measuring other quantitative effects all nearly attained target values or showed a pattern of improvement. Thus, the expected effects are produced. When this project was being implemented, various similar projects were being conducted by the province and participating universities, and improvements of indicators will likely be attributable to the combined effects of project development that include these projects. Among these projects, contributions by the ODA loan were offered through a framework unrelated to public financial support mainly by the central government for all universities (ODA loan does not affect the amount of normal university support). The ODA loan greatly contributed to the overall improvement of school buildings and educational equipment at participating universities. In particular, at the start of the project, all universities lacked funding for the construction of school buildings and purchasing of equipment, therefore, these funds were valuable. As this report subsequently describes, the construction and equipment provided by this project made certain contributions that raised schools to university status and ensured the approval of key departments and laboratories, contributing to promoting improvement of school buildings and educational equipment at participating universities.

(1) Quantitative improvement in education/research

The number of students enrolled at participating universities (in 2016, one year after project completion) increased by approximately 35,000 compared to the appraisal stage. (However, result data could only be obtained from 13 universities of the 15 planned.) The target value was missed by approximately 90,000 people (when considering the 2 universities from which data could not be obtained, the shortfall is estimated at about 50,000 people). The target was not met, because (i) the Provincial Department of Education adopted quota restriction policies for universities, ahead of other provinces, based on anticipating future decreases in the province's youth population, and (ii) recent national policies have been pushing for the independence of academies affiliated with universities. Accordingly, the number of students at the majority of participating universities peaked between 2014 and 2015, after which student numbers in all decreased.

The school building area of participating universities significantly increased at all universities. Although the amount of data that could be obtained from universities was limited (13 universities), the actual school building area in 2016 was more than 2.9 million m^2 compared to actual numbers in 2004, nearly doubling over the 12-year period.

Table 5 Number of Students Enrolled (Total of Graduate Students, Undergraduate Students, Special-Course Students) and School Building Area (Classrooms, Laboratories, Libraries, Gymnasiums, Lecture Halls) (Total of Participating Universities)

	Baseline	Target	Actual	Actual
	2004	2012	2012	2016
		1 Year after Project Completion	Initial Planned Year of Completion	1 Year after Project Completion
Number of enrolled students (10,000 students)	21.3	33.9	24.9	24.8
(Simple single-school average)	1.42 (15 schools)	2.26 (15 schools)	2.08 (12 schools)	1.91 (13 schools)
School building area (1,000 m^2)	3,325 (15 schools)	5,828 (15 schools)	4,686 (11 schools)	6,235 (13 schools)

Source: Documents provided by JICA, questionnaire responses from universities

The total amount of educational/research equipment at participating universities rose significantly, although both a baseline and actual value could not be obtained for some universities. Although target values were not set for the total amount of educational/research equipment, a simple average of universities from which data could be obtained indicates an increase from 71.51 million yuan in 2004 to 190.56 million yuan in 2012 and 290.72 million yuan in 2016. This rate of growth is high, even compared to that of the number of enrolled students or school building area. This high growth rate has continued as of the ex-post evaluation.

Table 6 Total Amount of Educational/Research Equipment (Total of Participating Universities)

	Baseline	Actual	
	2004	2012	2016
		Initial Planned Year of Completion	1 Year after Project Completion
Total amount of educational/research equipment (10,000 yuan)	71,507	228,674	348,872
(Simple single-school average)	7,151 (10 schools)	19,056 (12 schools)	29,072 (12 schools)

Source: Questionnaire responses from universities

The equipment installed by the project has been used well, and responses from each school indicated a utilization rate for main equipment of about 95–100%. Furthermore, site surveys of each school confirmed that the equipment have been used.

(2) Qualitative improvement in education/research

Table 7 shows the status of school building area per student and amount of educational/research equipment per student, indicators set at the time of appraisal to demonstrate qualitative improvement in education and research.

The school building area and amount of educational/research equipment per student at participating universities improved significantly at all universities, because the increase in the school building area and amount of educational/research equipment exceeded the student population. As a result, almost all universities are at a level that exceeds national standards[9].

Table 7 School Building Area/Amount of Educational Equipment per Student

	Baseline	Target	Actual	
	2004	2012	2012	2016
			Initial Planned Year of Completion	1 Year after Project Completion
School building area per student (m^2/person)	16.1 (15 schools)	16.5 (15 schools)	21.4 (11 schools)	23.3 (13 schools)
Amount of educational/research equipment per student (yuan/person)	5,326 (15 schools)	6,455 (15 schools)	8,064 (11 schools)	13,333 (12 schools)

Source: Documents provided by JICA, questionnaire responses from universities, etc.
Note: 1) Figures are simple average of participating universities. 2) Based on calculation methods from the appraisal, special-course/undergraduate students were converted as one student and graduate students as two students for the calculation.

The status of improvements in major educational and research indicators are as shown in Table 8.

First, this report examines indicators for which target values were set at the time of appraisal. Although a simple comparison was not possible because responses regarding actual values could not be obtained from all 15 universities for which baseline values and target values were set, the average number of master's degree programs at the universities exceeded the target value as of 2012. On the other hand, the number of doctorate degree programs and key disciplines (state level and provincial/ministerial level[10]) did not attain the target value and have not changed compared to the baseline value in 2004. According to the executing agency and universities, the primary reason the target value for number of key disciplines was

[9] National standards (for ordinary university departments) differ according to department, as described below. School building area per student: 9 m^2 for medical studies (minimum) and 22 m^2 for social sciences (maximum). Amount of educational equipment per student: 3,000 yuan for social sciences (minimum) to 5,000 yuan for scientific disciplines such as engineering, agriculture, and medical studies (maximum).

[10] Those designated by a provincial government or ministry, such as the Ministry of Education, are classified as "provincial/ministerial level" while those designated by the state are classified as "state level".

not attained was that policies by the national and provincial governments restricted the designated number of key disciplines and granted almost no new approvals in recent years.

The number of key laboratories, undergraduate disciplines, and research projects have been trending upward from the 2004 results, except for the number of state-level laboratories, for which national and provincial governments restricted the designated number, same as the case of key disciplines. In particular, the number of research projects demonstrated immense growth in the 2016 results, increasing four to six times compared to 2004.

As described, although some indicators were not achieved because of restrictive government policies and some indicators showed little actual growth, other indicators demonstrated improvements or increases. To obtain approval for key disciplines, key laboratories and research project (state/provincial/ministerial level), keeping hard aspects (school buildings and educational equipment) above a certain standard is essential. The hard outputs produced by this project made important contributions to this end.

Table 8 Changes in Main Educational/Research Indicators

(Total of Participating Universities)

	Baseline	Target	Actual	Actual
	2004	2012	2012	2016
		1 Year after Project Completion	Initial Planned Year of Completion	1 Year after Project Completion
Number of key disciplines (state level)	9	51	6	6
Number of key disciplines (provincial/ministerial)	76	182	84	88
Number of key laboratories (state level)	7	-	2	4
Number of key laboratories (provincial/ministerial)	62	-	77	109
Number of undergraduate faculties/departments	266	-	527	599
Number of master's degree programs	488	946	680	704
Number of doctorate degree programs	153	274	139	154
Number of research projects (state level)	48	-	294	298
Number of research projects (provincial/ministerial)	321	-	1,363	1,526

Source: Documents provided by JICA, questionnaire responses from universities, etc.

Note: 1) Indicators for which no target value was set at the time of appraisal were also added to the performance indicators. 2) The target value is the total value for the 15 universities. 3) Baseline values (2004)

are the total value from 15 universities for the following indicators with target values set during the appraisal: number of key disciplines, number of key laboratories, number of master's degree programs, and number of doctorate degree programs. The baseline values for the other indicators are the respective total values from 7 of the 15 universities that responded regarding the number of undergraduate faculties/departments, 9 universities regarding the number of research projects at the state level, and 8 universities regarding research projects at the provincial/ministerial level. 4) Of the 15 universities, 12 provided the actual values for the number of key disciplines and key laboratories; 10 for the number of undergraduate faculties/departments, master's degree programs, and research projects; and 11 for the number of doctorate degree programs.

3.3.1.2 Qualitative Effects (Other Effects)

Interviews with executing agency and universities and a literature review confirmed the information described in Table 9 regarding the following primary qualitative effects of hard aspect: contributions to the establishment of new graduate schools and acquisition of approval for key disciplines and laboratories; improvements in education, research conditions, and the environment; and recruitment of human resources.

Table 9 Effects in Hard Aspect

Contributions to the establishment of new graduate schools and acquisition of approval for key disciplines and laboratories: The improved status of school buildings and educational equipment is an important indicator for approval for graduate schools, particularly the establishment of doctorate degree programs and key disciplines and laboratories. In many instances, the hard outputs provided by this project have contributed to these ends. [Example 1] The project contributed to universities being designated to the National High School Basic Ability Construction Project of Western and Central China, which promotes higher education in the western and central regions (five universities in Liaoning Province were designated, four of which were participating in this project). [Example 2] Utilizing a noise measurement device, one university applied to the Vital Science Platform of Liaoning Province (a research institution) and received approval from the Key Research Center for Automobiles and Automobile Parts (a research organization).
Improvements in education, research conditions, and the environment: The project enabled universities to (i) conduct new research and experiments utilizing up-to-date equipment not available before the project. (A variety of research was made possible by the combination of basic and core equipment provided through this project and the practical equipment provided via the university's own funds. In addition, there were many cases in which this project provided expensive equipment that a university or region only had one piece of, such as the nuclear magnetic resonance device provided to Shenyang University of Chemical Technology.) (ii) increase opportunities for training and practical experience by increasing the amount of equipment per student. (When equipment was being brought in, in some cases at the departmental or analysis center level, the value of equipment installed via this project comprised more than a 50% share of the total equipment value.) (iii) use the equipment brought in to provide more practical classes and improve student understanding, and (iv) make foundational improvements to education and research by promoting digitization through providing library systems, for example.
Recruitment of human resources: The fact that universities participating in this project have more specialized equipment than other universities shows that the project contributed to raising the standard of research at these universities, and succeeded in recruiting exceptional doctorate recipients who seek out advanced research that uses this specialized equipment.

Source: Interviews with the universities

Furthermore, the following effects of soft aspect were confirmed in interviews with participating universities and teachers who participated in training in Japan: development of core human resources to lead universities, establishment of new courses and courses in Japanese, improvement of disciplines and laboratories, improvement of research standards and development of heretofore untried research that is advanced or in new fields, improvement of educational methods, improvement of university administration, and human resource recruitment.

Table 10 Effects in Soft Aspect

Development of core human resources to lead universities: At all universities, training participants were positioned as key human resources who would lead the university. Many participants were promoted when they returned to China and are now serving important roles such as head instructors in key laboratories in universities and departments. The majority of training recipients have written research papers that employ the outcomes of their training in Japan after returning to China.
Establishment of new courses and courses in Japanese: Some universities have established new courses using the knowledge and data they obtained through training in Japan. Specifically, courses related to Japan such as accounting courses taught in Japanese, “Japan’s economic challenges,” and “History of Economic Development in Postwar Japan” have been newly established, increasing opportunities to learn about Japan.
Improvement of disciplines and laboratories: In many cases, universities utilized training from the standpoint of effectively advancing new initiatives such as establishing new disciplines and laboratories or shoring up key disciplines, and then employed the resulting outcomes. In such cases, many universities demonstrated more effective improvement by combining improvements in soft and hard areas. Some universities also employed IT in laboratory management (building equipment reservation systems and websites for various researchers’ research results and data, and so on) using examples from Japan as a reference.
Improvement of research standards and development of heretofore untried research that is advanced or in new fields: Participating universities stated that they began new research (biofuel cells, Alzheimer's, biomass-based synthetic rubber, etc.) and they also revealed that they achieved a higher research standard (such as receiving awards for superior master’s theses on a provincial level or obtaining patents), because of the cutting-edge research fields and research equipment they encountered in Japan. Other resultant outcomes included approval for national research projects. Some universities also brought in new equipment based on the training in Japan and future research prospects.
Improvement of educational methods: In many cases, teachers are practically applying the educational methods from Japanese universities they learned through training. For example, instructors (i) in terms of how to enhance students’ capacity, create lesson plans, consider them with students, and share the results; and (ii) send students materials for classes in advance so that students can give lectures and exchange opinions rather than having the instructor give a one-sided lecture.
Improvement of university administration: In feedback on training regarding university administration, participants shared that the training suited the need for promoting modernization and raising administrative standards amid changes in the environment such as the expanding size and systemic reforms of Chinese universities. There are many examples of specific changes made that reflect a shift toward a student-focused mindset, like reforms to campus culture such as setting up furniture like tables across campus to create an environment wherein students can have discussions.
Recruitment of human resources: When training in Japan, participants recruited Chinese students who studied in doctoral programs at Japanese universities as the university teachers.

Training contributed to recruiting superior human resources and improved universities' research standards.

Source: Interviews with the universities and training participants

3.3.2 Impacts

3.3.2.1 Intended Impacts

(1) Improvements in educational and research outcomes

Indicators achieved as a result of improvements in educational and research outcomes are organized in Table 11.

Excluding the rate of advancement to graduate school, improvement was observed for the following indicators compared to the pre-project figures: graduation rate, employment rate, number of award-winning research papers, number of patented research outcomes, and number of published research papers. Marked quantitative improvement was observed for the following indicators: number of award-winning research papers; number of patented research outcomes; and number of research papers published in the SCI (Science Citation Index), EI (Engineering Index), and ISTP (Index to Scientific & Technical Proceedings).

The fact that the majority of the above indicators improved demonstrates that quantitative and qualitative improvements in education and research at the participating universities concretely manifested as externally recognized results.

Table 11 Changes in Main Educational/Research Indicators (Impacts)
(Participating Universities)

	Baseline	Actual	Actual
	2004	2012	2016
		Initial Planned Year of Completion	1 Year after Project Completion
Number of award-winning research papers (state level)	6	23	22
Number of award-winning research papers (provincial/ministerial level)	111	199	147
Number of patented research outcomes	54	351	532
Number of research papers (Social Science Citation Index: SSCI)	1	8	27
Number of research papers (SCI/EI/ISTP)	387	3,305	4,058
Graduation rate	96.9%	95.4%	97.0%
Graduate employment rate	92.4%	94.4%	93.7%
Rate of advancement to graduate school	13.2%	12.9%	13.1%

Source: Questionnaire responses from universities
Note: 1) Rates are the average of participating universities, while other figures are the total of participating universities. 2) The number of universities that responded with baseline values and actual values are as follows: 8 universities for number of award-winning research papers at the state level, 9 universities for the same category at the provincial/ministerial level, 10 universities for number of patented research outcomes/number of research papers (SSCI), 11 universities for number of research papers (SCI/EI/ISTP), and 9–13 universities for graduation rate, graduate employment rate, and rate of advancement to graduate school. 3) The target value for the graduation rate one year after the completion of the project is 97.5%. There is no target value for the other indicators.

(2) Expansion of education/research at the provincial level

Indicators for higher education at the provincial level are shown in Table 12. Although the target for number of students per teacher was not achieved, the following indicators exceeded their target values and showed significant improvement: number of universities, number of students, floor area per student, and amount of educational/research equipment per student. The universities participating in this project represent the top regular higher education institutions in the province and play a major role in improving these higher education indicators at the provincial level.

Table 12 Higher Education Indicators in Liaoning Province

	Baseline	Target	Actual	Actual
	2004	2012	2012	2016
		1 Year after Project Completion	Initial Planned Year of Completion	1 Year after Project Completion
Number of regular higher education institutions (HEIs)	70 schools	60 schools	112 schools	116 schools
Number of students at HEIs	860,000	1,100,000	1,199,717	1,230,158
Number of students per teacher	15.6	12.0	17.2	17.5
Floor area per student (m^2/person) (= floor area/number of students)	14.6 ㎡/person	20.0 ㎡/person	26.6 ㎡/person	30.5 ㎡/person
Amount of educational/research equipment per student (yuan/person)	5,357 yuan	7,250 yuan	8,749 yuan	12,736 yuan

Source: Documents provided by JICA, questionnaire responses from executing agency

(3) Regional revitalization, strengthening of market rules, and contributions to environmental conservation

It was difficult to collect quantitative data of the status of the impacts on the following three development agendas expected at the time of the appraisal: regional revitalization, strengthening of market rules, and environment conservation.

Furthermore, larger universities were conducting numerous projects other than this one, making it difficult to observe the impacts of this project. However, the below examples of contributions made by the project were observed.

(a) Regional revitalization

The universities participating in this project included major universities in science and technology, education, medicine, and social sciences, and the universities are developing and producing target human resources in fields essential to regional revitalization. In addition to utilizing the equipment procured under the project at participating universities to advance research that contributes to promoting regional industries in Liaoning Province, key industries such as information technology, biochemistry, energy saving, and environmental conservation are one primary source of employment opportunities for graduates, meaning that the number of employed people increases alongside the number of graduates.

As development of key industries (industry-academia partnerships) is an important policy matter for all provincial governments, universities implement many projects commissioned by government administrations, primarily the provincial government, which contribute to regional revitalization. In many cases, the equipment provided by this project is used in these projects. Furthermore, expensive equipment provided by this project has been registered on a large equipment sharing platform by science and technology universities in the province, and many examples exist that other universities or external institutions achieved results by using that equipment. Some examples of industry-academia and external partnerships are described below.

- Jinzhou City's key industry is automobile parts, and in 2013, the Electric Vehicle Propulsion Technology Laboratory became a province-level key laboratory. The laboratory conducted joint research with a local company to turn an electrical control unit into a product. (Liaoning University of Technology)
- Medical equipment given to universities has been used as a public good by medical personnel in a city. For example, one university is a center for forensic medicine and training for declarations of death. (China Medical University)
- The nuclear magnetic resonance device provided by this project is an advanced piece of equipment even on the provincial level, and is used to provide services such as sample measurement analysis requested by other universities and structural analysis needed for pharmaceutical companies to develop new drugs. (Shenyang University of Chemical Technology)

(b) Strengthening of market rules

As the number of students increases, so too does the number of graduates in related fields overall. In addition, from the standpoint of strengthening market rules, universities have recently been characterized by their emphasis on and active promotion of the development of human resources who will be immediate assets at work and contribute to business activities. Specific examples of implemented initiatives related to the strengthening of market rules include the formation of new accounting classes in Japanese and promotion of modernization by universities using the content of training on administration.

(c) Contributions to environmental conservation

In response to a growing need in China, the environmental field has become a key field at many universities, which are attempting to strengthen their environment-related disciplines. After the start of this project, some environmental disciplines were newly established or designated as key disciplines, and the number of graduates in environmental fields has increased.

Environmental conservation is also a key field in the provision of educational equipment in this project. Universities often took on research project grants or commissioned projects, and the equipment provided by this project was utilized in some of these cases. Furthermore, as described below, university teachers who received training in Japan presented what they learned during their training in their research and at symposiums.

- The University of Science and Technology Liaoning jointly held symposiums on environment and economy with Korean universities and the Saitama Institute of Technology, which had been a training site, multiple times, and has held debates regarding economic development and environment conservation.
- Professor Feng of Liaoning Technical University used Japanese ideas to conduct the research course “Waste Collection Methods and Recycling at Solid Waste Processing Stations” over three years from 2014 to 2016.
- Professor Zhou of Shenyang Agricultural University learned about the construction of a recycling-oriented society in Japan, particularly the three Rs (reduce, reuse, recycle), and presented them in various settings after returning to China.

３．３．２．２ Other Positive and Negative Impacts

(1) Impacts on the natural environment

No negative impact on the natural environment has been noted. According to interviews with the Provincial Department of Education and asset management staff at participating universities, environmental impact assessments for the construction of school buildings were properly implemented. Although at the time of appraisal, an undesirable impact on the environment was expected to be at a minimum, because construction sites were within university grounds, the impact on the environment was regularly checked (including through surprise inspections) by the Municipal Environment Bureau, especially when construction was in progress. No major issues with the natural environment were indicated. Furthermore, according to the relevant staff at universities and executing agency, no external complaints regarding the environment were made, because construction took place on campus. When improvements to oversight for noise or construction materials were deemed necessary, members of the project investigated what measures might be needed. These measures were based on regular standards according to construction plans and there was no difference from usual practice. However, according to involved staff members at the executing agency, the international cooperation aspect of the project meant that the inspections for environmental impact by the Municipal Environment Bureau tended to be slightly more frequent and stricter than for other projects. This resulted in improved construction methods/construction timelines (e.g., restrictions for noisy work at night) and management/construction methods (e.g., more frequent water sprinklings to prevent dust).

(2) Resettlement and land acquisition

With school building construction taking place on existing campus, there was no resulting resettlement and land acquisition, and no negative impact on the social environment was noted, as planned at the time of appraisal.

(3) Promotion of cooperation/interaction between Chinese and Japanese universities

Although there were differences among universities, there was a confirmed impact on the promotion of cooperation and interaction with Japanese universities. Most universities for which an effect was confirmed had a track record of interaction in the past that they were able to strengthen through this project. Specific instances in which an effect was observed are described below.

Table 13　Examples of Interaction/Cooperation with Japanese Universities

Dalian Polytechnic University: Although only the School of Textiles and Materials at the university had a relationship with Gunma University, other schools such as the School of Foreign Languages used this project as an opportunity to start interacting with Gunma University. In addition, the School of Foreign Languages began sending students to Japan for short-term winter exchanges (with credits recognized).
University of Science and Technology Liaoning: ・ This university used sending personnel for training as an opportunity to jointly establish the Magnesium Alloy Research Center with the Saitama Institute of Technology. (The Anshan area, where the University of Science and Technology Liaoning is located, is rich in magnesium resources.) This joint research has resulted in 12 joint research papers. ・ After the training was concluded, the university invited experts in the field of environmental management from the Kanagawa University multiple times and held academic exchange events.
Liaoning Technical University: After returning to China, trainees who had been sent to the Tohoku Institute of Technology established the Sino-Japanese Center, made progress in joint research, and reached an agreement in 2017 between the two universities regarding plans to conduct future research on earthquake resistance.
Shenyang Agricultural University: After returning to China from training, trainees promoted long-term interaction and cooperation with the teachers and students of the Department of Agriculture at Kyoto University. As of the ex-post evaluation, three trainees from Shenyang Agricultural University were studying abroad at Kyoto University. Furthermore, after returning to China, the advising professor during training was invited three times to Shenyang Agricultural University.
Shenyang University of Chemical Technology: ・ This school has cooperative agreements with Gunma University, Toyama Prefectural University, Hokuriku University, and Hirosaki University, and is currently in talks with the Japan Advanced Institute of Science and Technology. The cooperative agreements are for foreign exchanges with credit recognition and others. In total, 75 students have been sent from Shenyang University of Chemical Technology, and the school has accepted 103 students from Japan. The director of the School of International Education also participated in training in Japan, promoting that cooperation. ・ The advising professor during training at University of Toyama was designated as a specially appointed professor at Shenyang University of Chemical Technology, and three students were sent to University of Toyama.
Dalian Medical University: Dalian Medical University employed this project as an opportunity to enter into a cooperative exchange agreement with Nagasaki University. The agreement consists of visits by students from each school to the other. Thus far, four students have been sent to Japan and four students from Nagasaki University have been accepted.

Source: Interviews with the universities and training participants

As described above, this project has largely achieved its objectives. Therefore, effectiveness and impacts of the project are high.

3.4 Sustainability (Rating: ③)

3.4.1 Institutional/Organizational Aspect of Operation and Maintenance

The roles of the involved institutions are clear. As planned during the appraisal, universities are in charge of the operation and maintenance (O&M) of the equipment

and facilities provided by this project, and the relevant bureaus at the Provincial Department of Education, which is the executing agency, supervise this. At all participating universities, the facilities and equipment provided through this project are part of the university's fixed assets, and O&M systems are maintained according to large equipment O&M fund management procedures, experimental education work regulations, and fixed asset management procedures, which also define responsibilities and procedures. To improve unified management, universities with a large amount of equipment have adopted comprehensive management systems through "large equipment centers" for precise or expensive devices including those provided by this project. Universities are also taking steps to actively hire teaching staff to ensure they have the necessary number of teachers for operation and equipment usage. No issues with personnel numbers have been noted. As equipment is brought in, some universities have been hiring multiple students who completed doctorate degrees as members of the university teaching staff, and these doctorate holders are highly specialized human resources.

３.４.２ Technical Aspects of Operation and Maintenance

All the universities conduct regular maintenance checkups and send equipment to be repaired by outsourced contractors such as suppliers. Thus far, no technical issues have arisen in terms of O&M. The universities have assigned full-time laboratory technicians who uniformly operate and maintain large experimental devices and provide precise measurements or analysis, which ensures the availability of the necessary technology. At all the universities, manuals and warnings for individual devices are displayed close to the devices, ensuring they are easily visible. Instructors responsible for the O&M of precision devices receive the necessary technical training from manufacturers regularly. In some universities, users obtained know-how to effectively utilize advanced equipment through training in Japan. Another example shows through training of undergraduate and graduate students on operation of equipment, those who acquired the technical knowledge are allowed to operate the equipment after obtaining a certificate valid within the university.

３.４.３ Financial Aspect of Operation and Maintenance

No problems have been observed in terms of the O&M finances necessary to maintain the effects of the project. The budget for providing equipment and O&M at participating universities is comprised of grants from the country or province (public expenditures) and independent earnings such as tuition and profit from commissioned projects. According to the interviews with the universities, public financial support of

universities from the provincial government was gradually increased under *the Eleventh Five-Year Plan (2006–2010)*, and further improved in *the Twelfth Five-Year Plan (2011–2015)*. The provincial education budget in 2015 was approximately 2.4 times the actual spending in 2007. Furthermore, it became easier for universities to mobilize financial resources from banks, for example. According to interviews with the executing agency and universities, although there are differences among universities, the central government provides minimum annual public support of millions of yuan, and combined with the provincial government support, large universities receive more than 50 million yuan per year with which they obtain equipment and conduct O&M. Both the provincial education budget and university budgets are stable, and according to the interviews, the result is that universities actively update and improve various equipment. Among the main equipment procured through this project, none have fallen into disuse because of budget shortfalls for operation and repairs. Increases in public financial support are expected in the future.

Table 14　Public Expenditure Results for Liaoning Province

(Unit: 100 million yuan)

	2013	2014	2015
Educational expenses	669.48	604.49	610.24
Educational expense index (2007 = 100)	266	240	242

Source: Liaoning Province statistical data and questionnaire responses from executing agency

３．４．４ Status of Operation and Maintenance

At all universities, the equipment provided by this project is registered in the database for control and management. In addition, some universities have also installed surveillance cameras for expensive equipment or introduced systems in which only related personnel with a key card can enter the room where it is housed. Visual inspection and usage records/inspection records for each piece of equipment were used to confirm that the status of facilities and equipment was positive overall. For important devices, every university has users record the status of the device in the usage records each time they use it. While aging is becoming an issue for some devices with short service lives such as PCs, they are still currently in use. Furthermore, although it was observed that some equipment was out of order, nearly all were in the process of being repaired. For inventory and the purchasing of consumables, each school responded that there were no issues regarding maintaining inventory as long as the items were still in production.

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

4. Conclusions, Lessons Learned, and Recommendations

4.1 Conclusion

This project aimed at improving education and research at 15 universities in Liaoning Province by improving facilities and equipment as well as training teachers. The project was highly relevant and performed according to the higher education human resource policies of China and Liaoning Province. Furthermore, it aligned with China's and Liaoning Province's development needs for quantitative and qualitative expansion of education at universities and Japan's ODA policy. Therefore, relevance is high. In terms of effectiveness, increases and improvements were evident for many indicators related to quantitative and qualitative improvement. It was also confirmed that the project contributed to obtaining approval for founding new graduate schools and key disciplines or laboratories, and improved education, research conditions, and the environment. In terms of impacts, the universities involved in the project demonstrated substantial improvements compared to the pre-project period for indicators such as employment rate, number of award-winning research papers, number of patented research outcomes, and number of published research papers. In addition, in terms of contributions to regional revitalization, strengthening of market rules, and environmental conservation, the development of human resources in related fields at participating universities became more robust, and various initiatives are making progress through both commissioned and research projects. There are also many examples of how cooperation and mutual understanding has been fostered between Chinese and Japanese universities. As such, the effectiveness/impact is high as outcomes were produced mostly as planned. Because the project cost was slightly higher and the project period significantly lasted longer than planned, the efficiency is low. No major problems have been observed in the institutional, technical and financial aspects of the operation and maintenance, as well as in the status of the operation and maintenance.

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

4.2 Recommendations

4.2.1 Recommendations to Executing Agency

None

4.2.2 Recommendations to JICA

None

４．３ Lessons Learned

The importance of thoroughly discussing and sharing information of the proper form for realistic procurement packages with executing agency

Experiences from past Chinese human resource training projects (the ODA loan “Inland Higher Education Projects [Regional Vitalization, Market Reform Support and Environmental Conservation [Guangxi Zhuang Autonomous Region] [Jiangxi Province] [Hubei Province] [Shanxi Province]”) revealed an important lesson; Standard university procurement packages (product-based packages) that require time for reconciliation among universities should be limited to highly universal devices like PCs or those that can be procured in bulk at a reduced price. Instead, procurement through individual university packages (university-based packages) should be standard. Based on that past lesson, this project initially planned to procure equipment through individual university packages (university-based packages) as the default. However, the executing agency proceeded with procurement using standard university packages (product-based packages) as the default, making the process more time consuming. As a result, procurement was time-consuming overall, and this was one of the causes of project delays.

When the set-up of procurement packages is expected to have a major impact on the efficient implementation of a project and improvement of its results, it is important to warn executing agencies starting in the appraisal period and thoroughly discuss the proper form for realistic procurement packages. After that, initiatives should be strengthened and project management geared toward supporting this end.

END

Comparison of the Original and Actual Scope of the Project

Item	Plan	Actual
① Project Outputs (1) Hard improvements a. School building construction	Participating universities s: 15 universities in Liaoning Province Educational buildings etc. at 3 universities Total 38,000 m^2	Same as planned 1 university (School of International Education building) Total 19,000 m^2
b. Provision of educational equipment	Economics, finance, pathology, biochemistry, electrical/electricity-related, safety technology-related, soil science, fermentation-related, applied science, education, multimedia-related, etc.	Mostly as planned
(2) Soft improvements Training, expert acceptance, and joint research in Japan	265 persons	295 persons (No results for expert acceptance or joint research from Japan)
② Project Period	June 2006–March 2011 (58 months)	June 2006–December 2015 (115 months)
③ Project Cost Amount Paid in Foreign Currency	6,016 million yen	5,650 million yen
Amount Paid in Local Currency	3,234 million yen (236 million yuan)	4,955 million yen (332 million yuan)
Total	9,250 million yen	10,605 million yen
ODA Loan Portion	5,775 million yen	5,650 million yen
Exchange Rate	1 yuan = 13.7 yen (as of September 2005)	1 yuan = 14.9 yen (Average of period from June 2006–December 2015)
④ Final Disbursement	October 2015	

People's Republic of China

FY 2017 Ex-post Evaluation Report of Japanese ODA Loan Project
"Inner Mongolia Autonomous Region Hohhot City Atmospheric Environmental Improvement Project (I) (II)"

External Evaluator: Hiromi Suzuki S., IC Net Limited

0. Summary

This project was implemented under the objective to mitigate the burden of air pollution through reduction in small-scale sources of pollutants in Hohhot City, the Inner Mongolia Autonomous Region (IMAR), People's Republic of China, by developing energy-efficient intensive heat supply facilities with lower pollution load, thereby contributing to the improvement of the living environment and stable heat supply in the city. This project was fully consistent with the development, environmental protection, heat supply plans, and the development needs of China, IMAR, and Hohhot City at the time of the appraisal and the ex-post evaluation[1] as well as Japan's ODA policy at the time of the appraisal; therefore, the relevance of the project is high. The outputs of the project underwent substantial review from the time of the appraisal. However, after the review, in both Phases 1 and 2, it was carried out as planned. The efficiency of the project is high because its total cost and period were as planned. The outcome expected as the primary effect of the project was to "mitigate the air pollution burden through reduction in small-scale sources of pollutants," and the impact was the "improvement of the living environment and stable heat supply in Hohhot City." Regarding outcome, in both phases, the project was highly effective because it achieved the goal of reducing emissions of sulfur dioxide (SO_2), nitrogen dioxide (NO_2), and total suspended particulate (TSP) matter, its three major indicators, and all auxiliary indicators showed a tendency toward improvement. Therefore, the effectiveness of the project is high. With regard to impact, the project contributed to improvement of residents' living environment by prompting all small coal-burning stoves and small boilers to shift to intensive heat supply. Necessary land acquisition was implemented appropriately, forcing no resettlement of residents. Regarding impact on the natural environment during the construction and at the time of the ex-post evaluation, appropriate measures were taken, and monitoring was conducted properly, and results indicated that there was no negative impact. Based on the above, the effectiveness and impact of the project is high because the envisioned project results were achieved. The systems, technology, finance, and maintenance management at Hohhot Chengfa Development & Management Co., Ltd. and Hohhot Futai Heating Supply Co., Ltd., both of which were responsible for operation and maintenance management under the project, were generally favorable, and the sustainability of effects brought by the project is high.

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

1. Project Description

Project Location

Boiler at Xinjiaying Power Plant B
(Hohhot Chengfa Development & Management Co., Ltd)

[1] The content of this project underwent substantial changes (For details refer to Section 3.1.4 "Appropriateness of the Project Plan and Approach"), and reappraisals were conducted in 2008 and 2012. In this ex-post evaluation, the content of the project after review was viewed as "the plan", and the project was evaluated by comparing the plan with results.

1.1 Background[2]

In early 2005, because it depended on coal for about 69% of energy consumed in the country, China was suffering from serious air pollution caused by sulfur oxides (SOx), smut, and other pollutants. In particular, SOx, which causes acid rain, had grave effects on the health of residents and the ecosystem. Taking these circumstances into account, the Chinese government set a goal of reducing emissions of principal pollutants, prohibited construction of new coal-burning thermal power plants in cities, and promoted construction of new co-generation equipment and intensive heat supply facilities.

In the IMAR covered by the project, energy consumption rose sharply as the economy grew rapidly, and the Region's dependence on coal for about 96% of its resources made it one of the country's districts where air pollution was particularly serious and improving the air environment was becoming an urgent issue to address. Especially in winter, most of the houses and public facilities used distributed, old small coal-burning boilers for district heating. However, because these boilers had low energy efficiency and lacked in equipment such as dust collectors and desulfurizers, they were a major source of air pollutants. As the city developed rapidly, it was feared that if this problem was left unsolved, small coal-burning boilers, which were installed in large numbers each year, would further aggravate air pollution in addition to pollution by existing ones. Taking this situation into consideration, the IMAR's government intended to improve the urban air environment by promoting intensive heat supply. To achieve this goal, it pushed forward with three policies: spreading intensive heat supply further, prohibiting installation of new small coal-burning boilers, and removing existing small coal-burning boilers. This project, which aimed at introducing intensive heat supply equipment to replace small coal-burning boilers, was expected to reduce emissions of SOx and other air pollutants.

1.2 Project Outline

The objective of this project is to mitigate the burden of air pollution through reduction in small-scale sources of pollutants in Hohhot City, IMAR, People's Republic of China, by developing energy-efficient intensive heat supply facilities that with lower pollution load, thereby contributing to the improvement of the living environment and stable heat supply in the city.

Loan Approved Amount / Disbursed Amount	Phase 1: 7,400 million yen / 7,375 million yen Phase 2: 6,300 million yen / 6,281 million yen	
Exchange of Notes Date / Loan Agreement Signing Date	Phase 1: June 2006 / June 2006 Phase 2: March 2007 / March 2007	
Terms and Conditions (Same terms and conditions for Phases 1 and 2)	Interest rate	0.75%
	Repayment period (Grace Period)	40 years (10 years)
	Conditions of Procurement	Phases 1 and 2: General untied
Borrower / Executing Agency	People's Republic of China/People's government of Inner Mongolia Autonomous Region (Finance Agency)	
Project Completion	September 2015	

[2] This section is based on materials provided by JICA and the ex-ante evaluation table.

Main Contractors	Shanghai Electric (Group) Corporation (People's Republic of China) and China National Precision Machinery Import & Export Corp. (People's Republic of China)
Main Consultants	—
Related Studies (Feasibility Studies, etc.)	Phase 1: North China Municipal Engineering Design & Research Institute, conducted in November 2004 and approved in June 2006/change in the scope of the project in 2008: conducted in November 2007, North China Municipal Engineering Design & Research Institute, conducted in November 2007 and approved in January 2006 Phase 2: North China Municipal Engineering Design & Research Institute, implemented March 2005 and approved in June 2007/change in the scope of the project in 2012: implemented in 2011; North China Municipal Engineering Design & Research Institute, implemented in 2011 and approved in April 2012
Related projects	Japanese ODA Loans: "Hohhot/Baotou Environmental Improvement Project" (December 1996) and "Hohhot/Baotou Environmental Improvement Project (2)" (September 1997) Other donors: Inner Mongolia Autonomous Region Renewable Energy-Related Project (World Bank, 2006–2011) and Hohhot City Local Low-Carbon Heat Supply Project (Asian Development Bank, 2013–2016)

2. Outline of the Evaluation Study

2.1 External Evaluator

Hiromi Suzuki S., IC Net Limited

2.2 Duration of Evaluation Study

This ex-post evaluation was conducted with the following schedule.

Duration of the Study: August 2017 to November 2018

Duration of the Field Studies: November 19-29, 2017 and June 10-18, 2018

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

3.1 Relevance (Rating: ③[4])

3.1.1 Consistency with the Development Plan of China[5]

A) Development plans

The national development plan being implemented at the time of the appraisal for the project was the *Eleventh Five-Year Plan (2006-2010)*. This plan, which continued to view taking actions such as stepping up environmental protection and protecting and repairing the natural ecosystem as its priority areas, set five major goals to achieve by 2010, including reducing new sources of environmental pollution and improving the environment in places designated as priority environmental protection regions and cities. In particular, the goal for the air environment was to reduce emissions of major pollutants by 10% compared to the results of the Tenth Five-Year Plan; to achieve the goal, the Chinese government announced that it would prohibit construction of new coal-burning thermal power plants in cities and promote efforts to build new co-generation equipment and intensive heat supply facilities. At the time

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

[4] ③: High, ②: Fair, ①: Low

[5] The evaluation was based on appraisal materials and the ex-ante evaluation at the time of the appraisal and on the 13th Five-Year Plan (2016-2020) at the time of the ex-post evaluation.

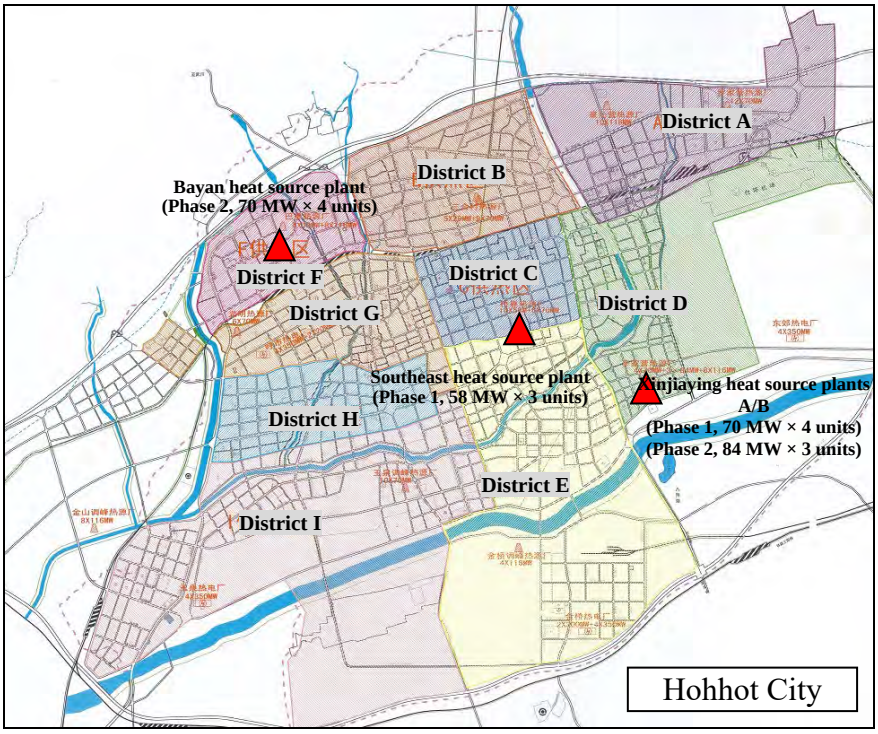
of the ex-post evaluation, the national development plan was the *Thirteenth Five-Year Plan (2016-2020)*. The plan set five goals to realize a moderately prosperous society, and two of them were related to this project: improving the overall quality of the environment and ecosystems and making the standards of living and quality of national life universally better. It clearly stated that environmental protection was an essential condition to ensure sustainable development and achieve high-quality national life and that the government would strive to save resources and protect the environment. The government established specific targets, including reducing energy consumption per unit of GDP by 15% by 2020 and cutting back emissions of carbon dioxide per unit of GDP by 18% by the same year. In terms of city planning, it aimed at building comfortable cities in harmony with the environment and considered it necessary to continue stepping up efforts to construct urban infrastructure facilities, including intensive heat supply; to achieve this goal, it announced its plan to build modern urban infrastructure systems. At the time of both the appraisal and the ex-post evaluation, this project was highly consistent with China's development plans.

At the time of the appraisal, the development plan for the IMAR was the *Eleventh Five-Year Plan for the Inner Mongolia Autonomous Region (2006-2010)*, and in this Plan, the regional government announced that it would improve the urban air environment by promoting intensive heat supply. The Region's development plan at the time of the ex-post evaluation was the *Thirteenth Five-Year Plan for the Inner Mongolia Autonomous Region (2016-2020)*. In this Plan, the government aimed at increasing the overall capacity to supply heat in the autonomous region, announcing that, to achieve this goal, each city government should step up efforts to build heat supply infrastructure facilities. As described above, at the time of both the appraisal and the ex-post evaluation, this project was consistent with the regional government's development plan.

B) Environmental protection plans

The national environmental protection plan at the time of the appraisal was the *Eleventh Five-Year Environmental Protection Plan (2006-2010)*, which announced five major goals that should be achieved by 2010. In particular, this project was in accord with three of the goals set in the plan: reducing new sources of environmental pollution, suppressing destruction of the environment and ecosystems, and improving the environment in places designated as priority environmental protection regions and cities. At the time of the ex-post evaluation, the environmental protection plan was the *Thirteenth Five-Year Environmental Protection Plan (2016-2020)*. This plan set major environmental protection goals, and this project was in agreement with two of them: establishing an ecological civilization construction model which combined the protection of ecosystems and urbanization and improving it continuously, and formulating guidelines to develop ecological civilization construction model districts and environmental protection model cities and guiding each region in building an ecological civilization model.

At the time of the appraisal, Hohhot City's environmental protection plan was the *Hohhot City Eleventh Five-Year Environmental Protection Plan (2006-2010)*. In this Plan, the city government announced that it would reduce the average annual concentration of SO_2 by spreading intensive heat supply facilities, prohibiting construction of new small coal-burning boilers, and promoting removal of existing small boilers. The city's environmental protection plan at the time of the ex-post evaluation was the *Hohhot City Thirteenth Five-Year Environmental Protection Plan (2016-2020)*. In this plan, in accordance with the principle of shifting from distributed heat use to intensive heat supply in phases, the government was adjusting the heat supply structure in urban areas, and its goal was to build a heat supply model with clean energy added to it by promoting cogeneration in city centers and shifting from small coal-burning boilers to intensive heat supply completely.



Source: Documents provided by the executing agency.

Figure 1. Map of Hohhot City's Heat Supply Districts and the Project's Undertakings

In addition to the environmental protection plan, the city government formulated the *Hohhot City Heat Supply Plan (2005–2020)*. This is a master plan for heat supply in the city, which sets targets for the area of heat supply and heat loads that should be achieved by 2020 by developing intensive heat supply facilities in a total of nine districts that constitute the city. This project is included in the facility development plan for three districts under the master plan (See Figure 1).

As described above, this project was consistent with goals at the time of the appraisal and the ex-post evaluation to reduce and improve air and environmental pollution, spread intensive heat supply, and develop urban heat supply infrastructure under (1) China and Inner Mongolia Autonomous Region's Five-Year Plan, (2) China and Hohhot City's Five-Year Environmental Protection Plan, and (3) Hohhot City's heat supply plan.

3.1.2 Consistency with the Development Needs of China

In 2005, environmental pollution in China remained serious, although efforts to step up environmental protection policy in the 1990s brought certain results. Hohhot, the project site, was a city of medium standing with a population of 1.1 million, an area of 2,100 km^2, and a heat supply capacity of 2,888 MW and ranked 36th among the country's 113 worst air-polluted cities designated as national priority environmental protection districts. Thus, improving the air pollution was becoming an urgent issue to address. In the project area, less energy-efficient small coal-burning boilers were used for heating in winter; because they lacked in dust collectors and desulfurizers, they were a major source of air pollution. As a result, the city failed to meet Grade 2 of the national air environment standards for SO_2, NO_2, and TSP, which should be satisfied in residential areas (See Table 1)[6].

[6] This is based on materials provided by JICA.

Table 1. Concentration of Air Pollutants in Hohhot City at the Time of Appraisal and Ex-post Evaluation

(Unit: μg/m^3)

At the Time of Appraisal						
	SO_2		NO_2		TSP	
	Yearly average	Winter maximum	Yearly average	Winter maximum	Yearly average	Winter maximum
2004	27	*182*	44	80	*353*	*763*
2005	53	*170*	40	*144*	92	*644*
2006	56	*380*	49	*187*	100	*1,713*
Grade 2 of the national air environment standards (1996) *	Yearly average	Daily average	Yearly average	Daily average	Yearly average	Daily average
	60 or less	150 or less	80 or less	120 or less	200 or less	300 or less

At the Time of Ex-post Evaluation								
	SO_2		NO_2		PM10		PM2.5	
	Yearly average	Winter maximum	Yearly average	Winter maximum	Yearly average	Winter maximum	Yearly average	Winter maximum
2015	34	*196*	39	*104*	*103*	*255*	*43*	*255*
2016	28	119	*42*	*94*	*95*	*318***	*41*	*296*
2017	29	141	*45*	*91*	*99*	*278***	*44*	*297*
Grade 2 of the national air environment standards (2012) *	Yearly average	Daily average	Yearly average	Daily average	Yearly average	Daily average	Yearly average	Daily average
	60 or less	150 or less	40 or less	84 or less	70 or less	150 or less	35 or less	75 or less

Source: Data for the period from 2004 to 2006 are based on materials provided by JICA. Those for 2015 and thereafter are based on materials provided by the executing agency.

Figures in italics indicate that they exceeded Grade 2 of the national air environment standards.

*: The National Air Environment Standards revised in 2012 (GB3095-2012), which applied at the time of the ex-post evaluation, were stricter than the standards applicable at the time of the appraisal (GB3095-1996) in terms of NO_2 emissions. In addition, instead of TSP, the revised standards required monitoring of PM2.5, fine inhalable particles with diameters that are generally 2.5 micrometers or less, and PM10, ones with diameters that are generally ten micrometers or less.

**: Excluding sandy-dust (yellow sand) weather

According to the latest information (2016) available at the time of the ex-post evaluation, the urban districts of Hohhot City had achieved remarkable growth; its population had increased to 3.09 million, and its land area had grown to 129,110,000 km^2. In 2017, the city had a capacity to supply 11,157 MW of heat (of which 986 MW of heat were provided by this project) with heat supply factories in operation at eleven locations. The overall number of small coal-burning boilers in the city decreased significantly, and the intensive heat supply penetration rate rose to 83%. As shown in Table 1, however, the city failed to achieve Grade 2 of the national air environment standards which should be satisfied in residential areas; in March 2017, it ranked 42nd among the country's 74 worst air-polluted cities designated as national priority environmental protection districts. Thus, Hohhot City's development needs for air environmental improvement continued to be high.

As described above, at the time of both the appraisal and the ex-post evaluation, there was a strong need to raise the intensive heat supply penetration rate, thereby reducing air pollution.

3.1.3 Consistency with Japan's ODA Policy

Japan's ODA policy at the time of the appraisal consisted of the *Economic Cooperation Plan for China (2001-2006)* as well as JICA's *Implementation Policy for Overseas Economic Cooperation Operations (2005-2007)* and the *FY2006 Implementation Policy for Operations*

by Country. The goal set by the *Economic Cooperation Plan for China (2001-2006)*[7] was to emphasize areas centered on protecting the environment and ecosystems as pollution and destruction became serious, improving the lives of people in inland areas and developing their societies, developing human resources, establishing systems, and transferring technology, and six priority areas were listed. In particular, in the priority area of cooperation to cope with environmental and other global problems, the plan clearly stated that Japan would support China's efforts to introduce new types of renewable energy and conserve energy consumption, and this was highly consistent with this project. The *Implementation Policy for Overseas Economic Cooperation Operations (2005-2007)* considered support for poverty reduction, infrastructure development for sustained growth, support for solving global issues and peace building, and support for human resource development as its four priority areas. In particular, it stated that Japan would actively use its technology to address global issues, cope effectively with environmental problems in developing countries, assist in improving the lives of people, and contribute actively to solution of problems such as global warming, and this was also highly consistent with this project. The *FY 2006 Medium-Term Strategy for Overseas Economic Cooperation*[8], which stressed environmental protection, stated that JICA would place emphasis on public projects such as supporting air pollution measures in which the government was required to play a part and provide intangible support such as improving environmental administration abilities. It also stated that JICA would work more closely with local governments in Japan to transfer their know-how in the environmental area. The goals set for the atmospheric sector were to install stack gas desulfurization systems in existing thermal power plants, develop intensive heat supply facilities, promote natural gas projects, introduce air environment monitoring equipment, and step up support in the intangible aspects of these undertakings. This was highly consistent with the project.

3.1.4 Appropriateness of the Project Plan and Approach

The scope of this project underwent changes in both Phase 1 and Phase 2. In Phase 1, in early 2008, because of low yen value and rises in the price of items such as construction materials, the upper limit to Japanese ODA loan made it difficult to build a northeast heat source plant, heat supply piping, and heat exchange stations as planned for Phase 1. Therefore, the executing agency decided to complete the heat source plant using its own funds and use the Japanese ODA loan to construct Xinjiaying heat source plant A, heat supply piping, and heat exchange stations in the eastern district, which was growing remarkably (See Table 2). In 2008, when JICA conducted intermediate supervision, it became clear that part of the construction work for the northeast heat source plant had already begun using domestic capital, and the cost and period of the project and its effects were reviewed through consultations with the executing agency (approved by JICA on January 23, 2008). As for Phase 2, in 2012, it was revealed that the Guangming heat source plant had already been completed using China's own capital and was currently in operation. On the other hand, an administrative, commercial, and financial center was built in the eastern district of Hohhot City on a full scale, and since this sharply increased heat supply demand in the district, it was decided that the Xinjiaying heat source plant B, heat supply piping, and heat exchange stations should be constructed using the Japanese ODA loan to meet the district's growing heat demand (approved by JICA on December 4, 2012). After the project was reviewed, there was no major difference between its plan and results, and the logic to lead the project to the achievement of its objectives was also reasonable. These changes were attributed to changes in external factors during the early stage of appraisal (such as rising commodity prices, low yen value, and the acceleration of urban development) and considered appropriate. However, because there was no project supervision such as strict control regarding the submission of progress reports among others, changes took place two years after starting the project, and another four years after that as well, thus

[7] Ministry of Foreign Affairs' *Economic Cooperation Plan for China (2001-2006).*

[8] This is based on materials provided by JICA.

attention needs to be paid to this point.

Based on the above, the implementation of the project was in full accord with the development policy and development needs of China, Inner Mongolia Autonomous Region, and Hohhot City as well as Japan's ODA policy, and its relevance is high.

3.2 Efficiency (Rating: ③)

3.2.1 Project Outputs

As mentioned earlier, the scope of this project was reviewed in 2008 for Phase 1 and in 2012 for Phase 2. The project was carried out as planned as shown in Table 2, and there was no difference in facility development and equipment procurement between the reviewed project and the project's results.

Table 2. Project Outputs (Facility Development and Equipment Procurement*)

Item	Description		
	At the time of the appraisal (2006; for reference)	After review (2008 and 2012)	Results
1. Heat supply equipment (boiler)	[Phase 1] a. Southeast heat source plant: 58 MW × 5 units b. Northeast heat source plant: 64 MW × 4 units, 29 MW × 1 unit c. Jinqiao heat source plant (new urban district): 64 MW × 4 units, 20 t/h × 2 units d. Non-planned	[Phases 1] a. 58 MW × 3 units b. Cancelled c. Cancelled d. Xinjiaying heat source plant A: 70 MW × 4 units	As planned
	[Phase 2] e. Bayan heat source plant: 70 MW × 4 units f. Guangming heat source plant: 70 MW × 4 units g. Non-planned	[Phase 2] e. 70 MW × 4 units f. Implemented using China's own fund g. Xinjiaying heat source plant B: 84 MW × 3 units	As planned
2. Heat supply piping	[Phase 1] a. Southeast heat source plant: 25.5 km b. Northeast heat source plant: 17.9 km c. Jinqiao heat source plant (new urban district): 17.4 km d. Non-planned	[Phase 1] a. 19.8 km b. Cancelled c. Cancelled d. Jinqiao heat source plant A (new urban district): 18.5 km	As planned
	[Phase 2] e. Bayan heat source plant: 19.26 km f. Guangming heat source plant: 18.25 km g. Non-planned	[Phase 2] e. 23.30 km f. Implemented using China's own fund g. Xinjiaying heat source plant B: 22.0 km	As planned
3. Steam piping	[Phase 1] a. Jinqiao plant (new urban district): 1.9 km	[Phase 1] a. Cancelled	As planned
4. Heat exchange stations	[Phase 1] a. Southeast heat source plant: 39 units b. Northeast heat source plant: 37 units c. Jinqiao heat source plant (new urban	[Phase 1] a. 29 units b. Cancelled c. Cancelled	As planned

	district): 31 units d. Non-planned Total: 107 locations	d. Xinjiaying heat source plant A: 31 units Total: 60 units	
	[Phase 2] e. Bayan heat source plant: 27 units f. Guangming heat source plant: 27 units g. Non-planned Total: 54 units	[Phase 2] e. Bayan heat source plant: 27 units f. Implemented using China's own fund g. Xinjiaying heat source plant B: 29 units Total: 56 units	As planned
5. Other	• Comprehensive dust usage plant • Automated control center	• Cancelled • Automated control center	As planned

Source: At the time of the appraisal and the review, materials were provided by JICA. For results, materials were provided by the executing agency.
*: The names of the heat source plants are all current ones: the Bayan Plant (former North Plant), Guangming Plant (former South Plant), Xinjiaying Plant A (former Jinqiao Plant, East District), and Xinjiaying Plant B (former Xinjiaying Plant).

A training program for the executing agency in Japan, which concerned measures to cope with air pollution, including comprehensive use of ashes, was planned but cancelled because the Chinese regulations for public officials leaving China became strict.[9]

3.2.2 Project Inputs

3.2.2.1 Project Cost[10]

A comparison of the planned and actual total project costs after the review of the project scope for Phase 1 indicates that the actual cost was 94% of the planned one, remaining within the range of the initial plan. Specifically, while the planned cost was 9,664 million yen (foreign currency: 7,872 million yen; domestic currency: 1,792 million yen; and the cost covered by Japanese ODA: 7,400 million yen), the actual one was 9,060 million yen (foreign currency: 7,368 million yen; domestic currency: 1,692 million yen; and the cost covered by Japanese ODA: 7,368 million yen) (please refer to Table 3).

Table 3. Project Cost (Phase 1)

(Unit: million yen)

Item	Planned cost (2008; after the review)			Actual cost			Planned/actual ratio
	Foreign currency (including ODA)	Domestic currency	Total	Foreign currency (including ODA)	Domestic currency	Total	
Intensive heat supply materials and equipment	6,325 (6,325)	0	6,325	7,368 (7,368)	0	7,368	116%
Civil engineering and installation	0	758	758	0	643	643	85%
Tax	0	226	226	0	0	0	0
Administrative expenses,	0	303	303	0	194	194	64%

[9] Among the project implementation units, Hohhot Futai Heating Supply Co., Ltd. sent personnel to the five-day training and field visits in Japan in March 2018. The participants consisted of four people at managerial positions, and all expenses were paid by the company.

[10] Reference information: The project cost at the time of the appraisal in 2006 was as described below. The total project cost for Phase 1 was 13,700 million yen (foreign currency: 7,931 million yen; domestic currency: 5,769 million; and the cost covered by Japanese ODA: 7,400 million yen (foreign currency only)), and that for Phase 2 was 10,094 million yen (foreign currency: 6,790 million yen; domestic currency: 3,304 million yen; and the cost covered by Japanese ODA: 6,300 million yen (foreign currency only)) (Source: Both are based on materials provided by JICA)

etc.							
Price escalation	431 (431)	0	431	0	0	0	0
Physical reserve funds	955 (955)	38	993	0	0	0	0
Training expenses	25 (25)	0	25	0	0	0	0
Interest during construction	136 (0)	210	346	0	450	450	130%
Land acquisition expenses*	0	257	257	0	405	405	158%
Total	7,872 (7,400)	1,792	9,664	7,368 (7,368)	1,692	9,060	94%

Source: For the review, materials were provided by JICA. For the results, materials were provided from the project information management sheet and by the executing agency.
* The land acquisition expenses for Phase 1 include those for Phase 2.
(Note 1) <After the review> Exchange rates: US$ 1.00 = 112 yen; US$ 1.00 = 7.52 yuan; 1 yuan = 14.90 yen
Price escalation rate: 2.4% for foreign currency and 0.0% for domestic currency
Reserve fund rate: 5.0%
Base time for cost calculation: January 2008 (The total project cost was reduced, and the cost covered by Japanese ODA was also reduced, and the difference is reported as part of the reserve fund)
<Actual> Exchange rate: 1 yuan = 13.30 yen (Based on the ex-post evaluation reference, IMF's average annual exchange rate for the period from 2008 to 2012 is used)
(Note 2) Because figures are rounded off, their sum does not necessarily correspond with the total at the bottom of the table.

In Phase 1, because of rising commodity prices, procurement expenses for intensive heat supply materials and equipment increased by 16% compared to the time of the appraisal. In addition, because loan interest in China went above that at the time of the appraisal, the interest rate during the construction grew by 30% compared to the initial plan. Owing to rising land prices, land acquisition expenses were 58% higher than initially planned. These increases in project cost were covered by physical reserve funds. On the other hand, administrative expenses were kept at 64% of the planned level because of cost management such as reduction in personnel expenses at the executing agency and the project implementation units, and this allowed the project cost to remain within the initially planned range.

In Phase 2, while, after the review of the project scope, the total project cost was 5,256 million yen (foreign currency: 2,868 million yen; domestic currency: 2,388 million yen; and the cost covered by Japanese ODA loan: 2,840 million yen), the actual one was 5,985 million yen (foreign currency: 2,814 million yen; domestic currency: 3,171 million yen; and the cost covered by Japanese ODA loan: 2,814 million yen). This was higher than planned, at 114% of the initially planned level (See Table 4).

Table 4. Project Cost (Phase 2)

(Unit: million yen)

Item	Planned cost (2012; after the review)			Actual cost			Planned/actual ratio
	Foreign currency (including ODA loan)	Domestic currency	Total	Foreign currency (including ODA loan)	Domestic currency	Total	
Intensive heat supply materials and equipment	2,637 (2,637)	0	2,637	2,814 (2,814)	0	2,814	107%
Civil engineering and installation	0	1,788	1,788	0	3,045	3,045	170%
Training expenses	19	0	19	0	0	0	0

	(19)						
Price escalation	50 (50)	158	208	0	0	0	0
Physical reserve funds	135 (135)	97	233	0	0	0	0
Interest during construction	28 (0)	296	324	0	0	0	0
Land acquisition expenses	0	0	0	0	3	3	—
Administrative expenses, etc.	0	49	49	0	123	123	251%
Total	2,868 (2,840)	2,338	5,256	2,814 (2,814)	3,171	5,985	114%

Source: For the planned cost, materials were provided by JICA, and for the actual cost, materials were provided by the executing agency.
(Note 1) <After the review> Exchange rates: US$ 1.00 = 77.50 yen; US$ 1.00 = 6.97 yuan; and 1 yuan = 12.20 yen
Price escalation rate: 1.64% for foreign currency and 6.0% for domestic currency
Base time for cost calculation: December 2011
<Actual> Exchange rate: 1 yuan = 17.40 yen (Based on the ex-post evaluation reference, IMF's average annual exchange rate for the period from 2013 to 2015 is used)
(Note 2) Because figures are rounded off, their sum does not necessarily correspond with the total at the bottom of the table.

In Phase 2, partly because of the effects of rising commodity prices and low yen value, civil engineering and installation expenses grew by 70% compared to the initial plan, and because of growing personnel expenses, administrative expenses were 251% of the initially planned level. In addition, tracts of land unexpectedly had to be expropriated in association with the laying of some parts of the heat pipe network. Both were covered by physical reserve funds.

As described above, the reason the project cost grew in both phases was that commodity prices and loan interest rates rose in China. In Phase 1, the project cost remained within the initially planned range through cost management, but in Phase 2, it slightly exceeded the planned cost because of low yen value and other effects. To derive a sub-rating for the total project cost for the two phases combined, a weighted average was used taking the percentage of the project cost for each phase to the actual total project cost into account in order to avoid bias. As a result, the total project cost remained within the initially planned range.[11]

3.2.2.2 Project Period[12]

For both Phase 1 and Phase 2, the planned period from the signing of the loan agreement to the completion of the project after the review of the project scope (defined as the completion of the compensation period) was compared with the actual one. As a result, the planned period for Phase 1 was from June 2006, when the loan agreement was signed, to October 2012, when the project was completed (77 months, or six years and five months), and the actual one was as planned. The planned period for Phase 2 was from March 2007, when the loan agreement was signed, to September 2015, when the project was completed (103 months, or eight years and eleven months), and the actual one was as planned. In both

[11] The percentage of the project cost for Phase 1 to the total project cost was 60% and that for Phase 2 was 40%. The sub-rating for Phase 1 was (3), and that for Phase 2 was (2), and therefore, the overall sub-rating (3) was derived taking the percentage of the project cost for each phase to the total project cost into account ((3) × 60% ＋ (2) × 40% ＝ 2.6; The sub-rating is (3) if the result is rounded off).

[12] For reference information, the completion of the project was defined as the "completion of receipt of equipment and installation work after inspection" at the time of the appraisal in 2006. The project period was as specified below. Phase 1 was planned to be from June 2006 (signing of the loan agreement) to the end of January 2011 (56 months, or four years and eight months), and Phase 2 from March 2007 (signing of the loan agreement) to October 2011 (56 months, or four years and eight months).

phases, appraisals leading up to bidding and planning were accelerated; in addition, the construction period was strictly controlled, and these efforts enabled the project to be completed within the planned project period.

As described above, project periods of both Phases 1 and 2 were 100% compared to plan, exactly as planned.

3.2.3 Results of Calculations for Internal Rates of Return (Reference Only)[13]

The Financial Internal Rate of Return (FIRR) for this project at the time of the appraisal was 5.38% for Phase 1 and 6.56% for Phase 2. At the time of the ex-post evaluation, FIRR was calculated by considering the two phases combined as a single project because available information on expenses and benefits was one that combined Phases 1 and 2. As a result, FIRR at the time of the ex-post evaluation was favorable, at 9.32%.

The project was implemented as planned because there was no difference between the planned outputs of the project after it was reviewed and actual ones. In Phase 1, the project cost remained within the initially planned range, but in Phase 2, it slightly exceeded the planned cost. In calculating the sub-rating for the total project cost in the two phases combined, the percentage of the project cost for each phase to the total project cost for the two phases combined was taken into consideration; as a result, the sub-rating for the project cost was as planned. In terms of project period, the project was carried out in both phases as planned.

Based on the above, the project was implemented as planned in terms of both project cost and project period. Therefore, the efficiency of the project is high.

3.3 Effectiveness and Impacts[14] (Rating: ③)

3.3.1 Effectiveness

3.3.1.1 Quantitative Effect (Operation and Effect Indicators)

The outcome of this project is to "mitigate air pollution through reduction in small-scale sources of pollutants" and is evaluated by using main indicators (such as (1) SO_2 emission reduction, (2) NO_X emission reduction, (3) TSP emission reduction) and auxiliary indicators (such as (4) reduction rate of compact coal boiler in the project target area, (5) penetration rate of centralized heat supply in the object area of the project, (6) number of beneficiaries, (7) number of heat supply households and (8) heat supply area.) With regard to the indicators (6) to (8), only the total value of Phase 1 and Phase 2 was available. Therefore, evaluation was conducted based on the total value.

[Main indicators]

During Phase 1, achievement of main indicators other than SO_2 emission reduction was 100% or more. SO_2 emission reduction achieved 90% or more in 2014 (2 years after completion.) During Phase 2, achievement of main indicators other than NO_X emission reduction was 100% or more. NO_X emission reduction achieved 90% and more in 2017 (2 years after completion.) It is recognized that both phases contributed to "mitigate the burden of air pollution" (See Table 5.)

[13] At the time of the appraisal, FIRR was calculated on the assumptions listed below. Costs consisted of the project costs and operation/maintenance management expenses, and benefits comprised fee incomes and subsidies. The project life was 30 years. The same assumptions were used at the time of the ex-post evaluation. However, because available data could not be divided into those for Phase 1 and Phase 2, FIRR for the two phases combined was calculated.

[14] Sub-rating for Effectiveness is to be put with consideration of Impacts.

Table 5. Operation Effect Indicators: Main Indicators

(A) Phase 1

Indicator name	Baseline 2007	Target 2 years after completion Note	Actual Achievement of targets are in parentheses				
			2013 1 year after completion	2014 2 years after completion	2015 3 years after completion	2016 4 years after completion	2017 5 years after completion
(1) SO_2 emission reduction (t/year)	0	3,100	2,505 (81%)	2,781 (90%)	3,359 (108%)	3,339 (108%)	3,233 (104%)
(2) NO_X emission reduction (t/year)	0	1,800	1,774 (97%)	1,930 (107%)	2,064 (115%)	2,062 (115%)	1,959 (109%)
(3) TSP emission reduction (t/year)	0	7,900	7,868 (99%)	8,599 (109%)	9,078 (115%)	9,070 (115%)	9,010 (114%)

(B) Phase 2

Indicator name	Baseline 2006	Target 2 years after completion Note	Actual (Achievement of targets are in parentheses)		
			2015 A year of completion	2016 1 year after completion	2017 2 years after completion
(1) SO_2 emission reduction (t/year)	0	2,094	1,628	1,736	2,270 (108%)
(2) NO_X emission reduction (t/year)	0	2,243	1,784	1,852	2,101 (94%)
(3) TSP emission reduction (t/year)	0	5,713	4,320	4,769	6,627 (116%)

Source: Baselines and targets are indicated in documents provided by JICA. Actual figures are indicated in documents provided by the executing agency

Note: The base year at the beginning of appraisal was 2005 for both Phase 1 and Phase 2, and the target was set to 1 year after completion. However, the base year for Phase 1 was changed to 2007 because of changes made to the 2008 project scope and the target was changed to 2 years after completion. Likewise, the base year for Phase 2 was changed to 2007 because of changes made to the 2012 project scope and the target was changed to 2 years after completion.

[Auxiliary indicators]

For both Phase 1 and Phase 2, all compact coal boilers were removed that were in the target area for the project and the penetration rate of centralized heat supply achieved 100%. In addition, as the economy of Hohhot City grows, the number of beneficiaries and beneficiary households tend to increase every year. The supply area also increases; in 2017, it achieved 126% compared to the plan (See Table 6).

Table 6: Operation Effect Indicator: Auxiliary Indicators (Total of Phase 1 and Phase 2)

Indicator name	Target at the time of completion	Actual (Achievement of targets are in parentheses)				
		2013	2014	2015	2016	2017
(4) Reduction rate of compact coal boilers in project target area (%)	100%	100%	100% (100%)	100%	100%	100%
(5) Penetration rate of centralized model of heat supply in project target area (%)	100%	100%	100% (100%)	100%	100%	100%
(6) Number of beneficiaries (1000 households)	—	430	460	580	660	720 (Upward trend)

(7) Number of beneficiary households (1000 households)	—	140	150	200	230	230 (Upward trend)
(8) Supply area (10,000 m^2)	1,844	1,425	1,526	1,991	2,278	2,327 (126 %)

Source: Targets are indicated in the document provided by JICA and actual figures were indicated in the document provided by the executing agency.

As stated above, the outcome of this project to "mitigate air pollution through reduction in small-scale sources of pollutants" achieved the target emission reduction of SO_2, NOx and TSP for both Phase 1 and Phase 2. In addition, all compact coal boilers in the target area were removed and the penetration rate of centralized heat supply achieved 100%. The number of beneficiaries and households, and the supply area increase steadily every year, which indicates that this project is effective.

3.3.1.2 Qualitative Effects (Other effects)

Qualitative effects of this project have been considered as "Improvement of the living environment of Hohhot residents and stable heat supply." As this can be understood as an effect at the impact level of this project, it is evaluated based on "3.3.2.1. Intended Impacts."

3.3.2 Impacts

3.3.2.1 Intended Impacts

The impact of this project is "to contribute to improving the living environment in Hohhot City and to ensure a stable heat supply." To grasp this impact, the External Evaluator conducted group interviews with beneficiaries to check (1) their level of satisfaction with the current heat supply service and (2) how life and people's health changed before and after the project because of the improvement of centralized heat supply capacity and service.[15] As shown in Table 7, satisfaction of residents regarding (1) is very high in all categories such as supply time, service stop time and number of days, customer correspondence and charge setting. With regard to (2), problems of soot and ash, etc. have been eliminated. The living environment is improved and temperature is always kept stable. Anxiety about the health of children and elderly people in particular has been greatly reduced, the risk of carbon monoxide poisoning is gone and it was confirmed that the "quality of life" has improved.

Table 7. Project Impact: Main Results Obtained from Group Interviews

[Satisfaction of current heat supply service]

- Project satisfaction: All categories such as supply time, service stop time and number of days, customer correspondence and charge setting are "highly satisfactory (30 people)" and "satisfactory to some extent (2 people)." The main reason for the latter is "temperature is slightly unstable" and "it is dusty because it gets dry."
- Heat supply service stop/customer correspondence: There is no interruption in the heat supply service due to incomplete management and maintenance. The heat supply service was scheduled to stop due to a blackout and suspension of water supply, etc. It is always notified beforehand. Any pipe clogging or damage in the building is notified to the hotlines of the heat supply company and heat exchange station. Companies handle the situation within 2 hours. Generally, the heat supply company provides good

[15] An overview of the group interviews is as follows. The executing agency called research target people from the project target area (3 areas), 12 people (8 men and 4 women), 10 people (3 men and 7 women) and 10 people (6 men and 4 women), 32 people in total (17 men and 15 women.) The age of targets ranged from 20s to 60s. As for resident status and heat supply method before the project, some residents lived in a one-story house and used a compact coal stove (19 people) and other residents lived in a multi-family dwelling house and use a compact coal boiler (13 people.) The executing agency made contact with resident committees and real estate owners in the target area, telling them the date of the group interview and asking residents to participate. The group interviews were held on November 22, 23 and 24, 2017, a total of 3 days.

facility management and service. There was a request to change the heat supply period according to the weather of that year as occasion may demand.

- Supply time and charge setting: Charge has been fixed to 22.08 yuan/m^2/year since the project started. Fuel expenses consume more of the income of households but it does not have influence on their life because income increases as well. When considering the living environment before the project, the charge is reasonable. Payment can be made conveniently through various methods such as bank, charge collection office and mobile phone, etc.

[Changes in lifestyle before and after the project because of the improvement of centralized heat supply capacity/service]

1. Changes in the usage situation of compact coal boiler, changes in lifestyle after shifting to centralized heat supply:

- As there is no need to burn coal, people were able to spend their time on other activities such as sleep, housekeeping, child care, work, pleasure and exercise, etc. (It took about 30 minutes to crush coal and burn, which was repeated several times in a day to maintain the temperature.)
- Living environment was improved. Centralized heat supply does not generate ash and smoke, which made the inside of the room clean. As the temperature is kept stable, health problems (such as sensitivity to the cold and joint pain of elderly people and colds, etc. that elderly people and children catch) caused by coldness was reduced, and people live a pleasant life. Therefore, people have peace of mind.
- The atmospheric environment in Hohhot City has improved. Before the project, as the emission standard of small-scale boilers that were used during winter was low, Hohhot City was generally dusty and the air quality was significantly worse. Since the project, the atmospheric environment has improved throughout the year.

2. Opinions on diseases caused by air pollution

- Many residents aged from 20 to 49 answered "there was no big problem in the first place." Before the project, children and elderly people often had a fit of coughing. Phlegm and nasal mucus were black and they felt unwell. After the project, these symptoms were significantly alleviated.
- Residents who were using a compact coal stove in a one-story building needed to turn off the stove when they slept. There was always a problem of carbon monoxide poisoning; however, this risk was completely cleared and people were able to spend time safely and securely.

Source: The External Evaluator summarized the results of the group interview.

Generally, positive opinions were collected related to the project "to contribute to improving the quality of life in Hohhot City and ensure a stable heat supply," and results that back up the certain effects of this project were obtained.

Southeast heat source plant: Chimney for dust collection and desulfurization
(Hohhot Chengfa Development & Management Co., Ltd)

3.3.2.2 Other Positive and Negative Impacts

(1) Impacts on the Natural Environment[16]

An Environmental Impact Assessment (EIA) of Phase 1 of this project was approved by the Inner Mongolia Autonomous Region Environmental Protection Agency in January 2006. This EIA includes Xinjiaying heat source plant B that was the object of this project after revision. With regard to Phase 2, EIA after revision was created in March 2007 after revision and was approved in April 2012. It was confirmed that records and hearing investigations related to exhaust gas, dust, waste treatment, muddy water and noise proved that measures were made. Moreover, in this project, a chimney 120m high was constructed in Phase 1 and a

[16] In this project, as a quantitative impact of relief of the atmospheric pollution burden in phase 1, it was estimated to reduce 150,000 tons of carbon dioxide emission by controlling small-scale pollutant emission sources. However, after the national atmospheric environmental standard was revised in 2012, it was heard from the executing agency that it does not have data because carbon dioxide is not monitored. Therefore, this impact was excluded from the ex-post evaluation.

chimney 100m high was constructed in Phase 2 for measures against exhaust gas and dust, and for dust collection and desulfurization due to coal combustion. The central government's environmental protection agency and Hohhot City environmental protection agency monitor pollutant emissions in real time and the emission standard of national atmospheric pollutants is strictly maintained. Environmental measures were properly implemented during construction and at the time of the ex-post evaluation, and negative impacts on the environment are not found.[17]

(2) Resettlement and Land Acquisition

Both Phase 1 and Phase 2 own the right to use the land where construction was conducted before the project started and it was planned not to acquire land or ask residents to relocate. It was actually necessary to acquire the right to use a total of 754 hectares of land to construct Xinjiaying factories A and B. The target land was owned by the government. The executing agency followed a procedure based on the "Urban real estate management act," paid the fee after appraisal by the Hohhot municipal government and acquired smoothly the right to use the land. In addition, it was necessary to relocate the poultry farm in Hohhot Agriculture University to another location in the university in order to construct a heat exchange station. Relocation expenses were paid to the university to relocate the poultry farm and there was no influence on lectures and exercises, etc. As described in "3.2.2.1 Efficiency: Project Cost," land necessary for Phase 2 was acquired during Phase 1 in advance. However, it was necessary to acquire the right to use the land temporarily in the process of laying additional piping in Phase 2. As this land was waste land which did not require relocating residents, the proper procedure was followed according to the preceding act and there was no particular problem.

(3) Unintended Positive/Negative Impacts

Before the project was reviewed, it was estimated that heat demand in the southeast area of Hohhot City increased by an amount equivalent to one boiler of heat supply capacity of 58 MW in winter, 2008. However, because of the changes in the project, heat supply was delayed one year and started in winter 2009. As a result, this project did not handle the increase in heat demand in winter 2008 and purchased the heat temporarily from a thermal power plant in the Jinqiao New Urban District to cover the shortfall amount. With regard to heat demand of 788,000 m^2 in 2008, it was handled by purchasing 360,100 Gigajoule temporarily from the thermal power plant as scheduled and there was no influence on residents.

With regard to the outcome of this project to "mitigate air pollution through reduction in small-scale sources of pollutants," reduction in emissions atmospheric pollutants, a major indicator, was achieved. All compact boilers were removed from the target area and the penetration rate of centralized heat supply achieved 100%. The beneficiary population, number of households and heat supply area increase every year and effectiveness is generally high. With regard to the impact "to contribute to improving the living environment in Hohhot City and to ensure a stable heat supply," compact coal stoves and small-scale boilers were replaced with centralized heat supply according to interviews with residents, and it was confirmed that the living environment was significantly improved and stable heat supply was secured. Land was obtained smoothly in accordance with the law and residents did not need to relocate. As for environmental measures and monitoring during the project and environmental monitoring

[17] As for the project target area of both phases at appraisal, it was assumed that the area did not cover regions such as national parks that may be influenced or surrounding areas, and undesirable influences on the natural environment should be minimal. When local observation was made for the ex-post evaluation, it was confirmed that the estimation made at the beginning of the plan was correct and that the estimation was maintained at the time of the ex-post evaluation. With regard to the group interview of residents, it was confirmed that this project did not have a negative influence during construction and operation.

after the operation started, the national environmental protection agency carries out strict management and negative impacts on the environment were not recognized.

This project has largely achieved its objectives. Therefore, effectiveness and impacts of the project are high.

3.4 Sustainability (Rating: ③)

3.4.1 Institutional / Organizational Aspects of Operation and Maintenance

The department in charge of operating and managing infrastructure facilities provided in this project (hereinafter referred to as "Project executing department") is Hohhot Chengfa Development & Management Co., Ltd. and Hohhot Futai Heating Supply Co., Ltd[18]. At the time of the ex-post evaluation, the preceding company covered approximately 30% of the heat supply area and in this project, and the company is in charge of operation and maintenance of the Southeast heat source plant (Phase 1) and Xinjiaying heat source plant A (Phase 1) and B (Phase 2). Likewise, the latter company covered approximately 17% of the heat supply area in Hohhot City and in this project, and the company is in charge of operation and maintenance of the Bayan heat source plant (Phase 2). Details of the institutional/organizational aspects of operation and maintenance of each executing department are as follows.

- Southeast Supply subsidiary of Hohhot Chengfa Development & Management Co., Ltd. This is one of four subsidiary companies of Hohhot Chengfa Development & Management Co., Ltd. The company is in charge of Southeast heat source plant and operation and maintenance of the pipeline and heat exchange station in the heat supply area of this plant. The company consists of 16 sections in total such as electricity, equipment, safety management, water examination, financial affairs, pipeline and heat exchange station of the heat source plant under the president and vice president. It has 791 employees in total.
- Xinjiaying supply subsidiary of Hohhot Chengfa Development & Management Co., Ltd: One of four subsidiary companies of Hohhot Chengfa Development & Management Co., Ltd. The company is in charge of operation and maintenance of Xinjiaying power plants A and B in Phase 1 and Phase 2 and operation and management of the pipeline and heat exchange station in the heat supply area. The company consists of 13 sections in total such as electricity, equipment, safety management, water examination, pipeline and heat exchange station of the heat source plant under the president and the vice president. It has 330 employees in total.
- Bayan subsidiary of Hohhot Futai Heating Supply Co., Ltd.: One of two companies affiliated to Hohhot Futai Heating Supply Co., Ltd. The company is in charge of operation and maintenance of the Bayan heat source plant in Phase 2 and operation and maintenance of the pipeline and heat exchange station in the target area. The company consists of 11 sections in total such as electricity, equipment, safety management, water examination, financial affairs, pipeline and heat exchange station of the heat source plant under the president and the vice president. It has 160 employees in total.

Bayan heat source plant: Boiler maintenance
(Hohhot Futai Heating Supply Co., Ltd.)

[18] Hohhot Chengfa Development & Management Co., Ltd is a state-owned enterprise into which Hohhot City invests 100%. Hohhot Futai Heating Supply Co., Ltd. is also a state-owned enterprise but 85% of stock is owned by the Hohhot City National Property Management Committee, 12% is owned by employees and 3% is owned by state-owned corporations at the time of the ex-post evaluation. Hohhot Chengfa Development & Management Co., Ltd has supervision of the Hohhot City National Property Management Committee.

Every project executing department has a clear organization chart, sufficient scale necessary for operation and management and a fully functional system of decision making/instruction system, guidance provision/supervision, etc. This system is sufficient to secure sustainability of this project.

3.4.2 Technical Aspect of Operation and Maintenance

Technical aspects of operation and maintenance of the department executing this project are evaluated based on the familiarity of technology adopted by the facility developed by this project, especially the number of people who acquire national certificates, maintenance of the training system, operation and maintenance manuals and usage situation.

Heat exchange station
(Hohhot Futai Heating Supply Co., Ltd.)

Training for personnel responsible for charge collection
(Hohhot Chengfa Development & Management Co.. Ltd)

With regard to technical standards and the training system of operation and maintenance personnel, if an occupation specifically requires the acquisition of a national certificate, each project executing department conducts a strict management, at the same time it actively advances the acquisition of national certification and secures sufficient human resources (See Table 8). The following occupations require national certification: boiler operator, chemical analysis worker, machine part repair/assembly worker, electric welding worker, thermal dynamics worker and plumbing worker. Occupations are classified as beginner, intermediate, advanced-level and special engineer according to years of experience and a written exam. In these occupations, training is mainly conducted at an outside training organization, but technical training is conducted inside the company on a regular basis by inviting instructors from outside. As for occupations that do not require national certification, there is a human resource development system and every project executing department grasps human resource needs of all personnel every year and creates and conducts a training plan for the next fiscal year. Training is intensively conducted during summer because the heat source plant is not in operation and all of the personnel get trained in some way to continually update their knowledge.[19] In addition, experienced engineers and young members always make teams to pass on techniques and know-how at workplaces. Turnover rates are low. Even if an employee leaves a job, he/she is likely to move and change to another heat supply company, so knowledge and experience are kept in the heat supply sector.

[19] Examples of training that Hohhot Chengfa Development & Management Co., Ltd conducted in 2017 are: “Theory and practice for boiler operators,” “Theory and practice of water treatment,” “Training of theory and practice of dust collection and desulfurization,” “Theory and practice of external network operation,” “Training of inspection theory and practice,” and “Training for personnel collecting charges,” etc. and 189 people including operation/inspection workers and collectors and personnel supervising collection were trained in total.

Table 8. Number of People Acquiring National Certification Related to Operation and Maintenance of the Project Executing Department in This Project

Institution/facility	Hohhot Chengfa Development & Management Co., Ltd		Hohhot Futai Heating Supply Co., Ltd. Bayan subsidiary
	Southeast supply subsidiary	Xinjiaying supply subsidiary	
Heat source plant	98	38	21
Heat supply piping/ Heat exchange station	49	38	23
Dust integration use plant	5	4	5
Automatic control center	9	21	9

Source: Documents provided by the executing agency.

As for improvement and use of operation and maintenance manuals, in addition to confirmation by local observation on manual and operation and maintenance records, a survey was conducted on operators in charge of operation and maintenance of heat supply factories/heat exchange stations and maintenance of heat supply piping. It was confirmed that these were sufficiently maintained and used, and a manual of emergency measures was prepared. Moreover, important points in the manual related to each piece of equipment were summarized in a poster and installed on the wall of each facility, which enables personnel to always check it. During the heat supply period, personnel visit each house once a month, check equipment to confirm that the proper temperature is maintained, and give advice on maintenance if necessary.

Overall, employees in charge of operation and maintenance in every project executing department have a sufficient level of technical skill. The training system is well organized, the company always works on maintaining and improving technical proficiency, and the technology for sustainability of this project is secured.[20]

3.4.3 Financial Aspect of Operation and Maintenance

In this project, it was assumed at the time of the appraisal that operation and maintenance expenses would be covered by income from heat supply charges. The heat supply charge is calculated based on the site area of the user and users are required to pay the charge by November 15 every year. The charge at the time of the ex-post evaluation is 22.08 yuan/m^2/year for residents and 30.18 yuan/m^2/year for public facilities[21]. The collection rate of both Hohhot Chengfa Development & Management Co., Ltd. and Hohhot Futai Heating Supply Co., Ltd. in the past three years from 2015 to 2017 is high at around 91% to 95%. However, the operating profit is in the red, which means that operation and maintenance expenses cannot be covered only by the charge income of heat supply (See Table 9). According to the executing agency, price and labor costs are increasing in China, so it is planned to revise the charge in the near future. The Chinese government is taking measures to enforce privatization. However, regarding companies related to foundation infrastructure including heat supply etc., it is defined by law that these companies are subject to receive preferential treatment (such as subsidy, tax exemption, loan, etc.) from the government, autonomous region

[20] In this project, it was not possible to conduct training in Japan, but activities to develop human resources in China are making progress. Therefore, operation and management have no problem.

[21] As for heat supply charges in Hohhot City, the committee of Hohhot City development and reorganization has a right to decide on a revision. In response to a request from the project executing department, it is stipulated that the committee holds a public hearing to reflect opinions from users and decides whether to revise the charge. Charges have not been revised since 2008.

and Hohhot City.[22] For that reason, government subsidy is invested in Hohhot Chengfa Development & Management Co., Ltd, which is why the company could make a profit for three years from 2015 to 2017. On the other hand, Hohhot Futai Heating Supply Co., Ltd. is in the red because of delays in investment of the government subsidy. However, according to the company, the preceding law has been applied to improve the situation in one or two years.

Table 9. Profit and Loss Statement of Project Executing Department

(Unit: million yuan)

	Hohhot Chengfa Development & Management Co., Ltd			Hohhot Futai Heating Supply Co., Ltd.		
	2015	2016	2017*	2015	2016	2017*
Sales (rate income)	711,9	774,8	826.7	344.3	382.1	414.1
General administrative expenses/selling expenses etc. including operation and maintenance expenses	845,6	896,2	947.1	402.2	446.4	473.5
Operating profit	***-133,6***	***-121,4***	***-120.4***	***-57.9***	***-64.3***	***-59.4***
Non-operating income	144,1	141,8	143.3	42.1	51.4	33.3
Government subsidy	*143,7*	*141,8*	*140.3*	*NA*	*42.4*	*34.1*
Non-operating expense	1.4	0.4	1.2	0.9	1.6	0.2
Ordinary profit	**9.0**	**20.1**	**21.7**	**-16.7**	***-14.9***	***-26.3***

Source: Documents provided by executing agency.
*: Based on the pre-audit profit and loss statement.

As mentioned above, because the two companies are unable to cover operation and maintenance with income from charges, a revision of the charges is desirable. However, as the government has committed to continuously investing in various subsidies, financial sustainability is secured.

3.4.4 Status of Operation and Maintenance

It was confirmed through local observation that operation and maintenance statuses of facilities constructed by this project and the installed equipment were appropriate. As there is an agency of a manufacturer that manufactures spare parts in China, problems such as delays in delivering parts do not occur. The operators manage to partially expand facilities and to make operation work effectively and also upgrades equipment necessary for environment conservation such as desulfurization and collecting dust.[23] Control centers in each heat source plant can grasp all processes of heat supply in real time. In addition, detailed information about the weather that is indispensable for a proper heat supply service is also sent from a weather bureau in real time and the load on boilers is decided based on this information. Furthermore, the central government's environmental protection agency and municipal government conduct strict management of atmospheric pollutant

Maintenance of a heat exchange station
(Hohhot Chengfa Development & Management Co., Ltd)

[22] Based on "Request to conduct marketing operation of centralized heat supply facility in east area of Hohhot City" (National Property Document [2006] No. 75 issued by Hohhot City), General office of Hohhot City People's Government issued on September 6, 2006, "Notification related to preferential treatment of tax increase in heat supply company, real estate tax and urban city land use tax" (Property and tax [2016] No. 94) and Inner Mongolia Autonomous Region Government Finance National Tax Bureau issued on August 24, 2016.

[23] At the time of the ex-post evaluation, installation of a more effective desulfurization device is under consideration with financing from Denmark.

emissions. A heat exchange station is operated and maintained to keep the water temperature sent to each household around 38 to 41 degrees, and temperature and pressure are properly adjusted according to the number of stories and type of heating. Daily maintenance is conducted three times a day. Five senses are used to check the smell in a heat exchange station, the sound of the motor and circular pump and water leakage and temperature, and numerical values of temperature and pressure are checked on a control panel and recorded. Simple water examination is also conducted. As mentioned above, operation and maintenance of facilities constructed in this project and installed equipment are conducted properly and sustainability of this project is guaranteed.

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

4 Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

This project was implemented under the objective to mitigate the burden of air pollution through reduction in small-scale sources of pollutants in Hohhot City, Inner Mongolia Autonomous Region, People's Republic of China, by developing energy-efficient intensive heat supply facilities with less environmental load, thereby contributing to the improvement of the living environment and stable heat supply in the city. This project was fully consistent with the development, environmental protection, heat supply plans, and the development needs of China, the Inner Mongolia Autonomous Region, and Hohhot City at the time of the appraisal and the ex-post evaluation as well as Japan's ODA policy at the time of the appraisal; therefore, the relevance of the project is high. The outputs of the project underwent substantial review from the time of the appraisal. However, after the review, in both Phases 1 and 2, it was carried out as planned. The efficiency of the project is high because its total cost and period were as planned. The outcome expected as the primary effect of the project was to "mitigate the air pollution burden through reduction in small-scale sources of pollutants," and the impact was the "improvement of the living environment and stable heat supply in Hohhot City." Regarding outcome, in both phases, the project was highly effective because it achieved the goal of reducing emissions of SO_2, NO_2 and TSP, its three major indicators, and all auxiliary indicators showed a tendency toward improvement. Therefore, the effectiveness of the project is high. With regard to impact, the project contributed to improvement of residents' living environment by prompting all small coal-burning stoves and small boilers to shift to intensive heat supply. Necessary land acquisition was implemented appropriately, forcing no resettlement of residents. Regarding impact on the natural environment during the construction and at the time of the ex-post evaluation, appropriate measures were taken, and monitoring was conducted properly, and results indicated that there was no negative impact. Based on the above, the effectiveness and impact of the project is high because the envisioned project results were achieved. The systems, technology, finance, and maintenance management at Hohhot Chengfa Development & Management Co., Ltd and Hohhot Futai Heating Supply Co., Ltd., both of which were responsible for operation and maintenance management under the project, were generally favorable, and the sustainability of effects brought by the project is high.
In light of the above, this project is evaluated to be highly satisfactory.

4.2 Recommendation

4.2.1 Recommendations to the Executing Agency

None.

4.2.2 Recommendations to JICA

None.

4.3 Lessons Learned

Enforcement of appropriate project management by local office (Completeness of submitting progress reports, etc. described in the Loan Agreement)

This project was significantly revised in both Phase 1 and Phase 2. Contents of the project after being revised were conducted as planned and the project effect has been realized. However, as the executing agency and project executing department do not have sufficient experience in Japanese ODA loans, etc., enforcement of mid-term supervision has been reported since the appraisal in 2006 and supervision including project monitoring was considered important. However, it was in 2008, the second year since the project started, that the mid-term supervision made clear that the contents of the project need to be reviewed. This mid-term supervision proved that a part of the project scope subject to Japanese ODA loans had already started work with domestic funding. On this occasion, the project was appraised again, including a revision of project scope that matched the project objective, funding and project period and resetting of operation/effect indicator targets. Consequently, there is no problem, but the executing agency is supposed to submit a project progress report every time a loan contract is agreed, and JICA needs to be thorough in having the executing agency submit such reports. If the executing agency and the project executing department do not have sufficient experience in Japanese ODA loans and if domestic sources of funds diversify because of sudden economic growth and external factors, submission of progress reports, etc. needs to be thorough and project management reinforced more than usual so that prevention of significant changes in the contents of the project would become possible.

END

Comparison of the Original and Actual Scope of the Project

Item	Plan (after revision)	Actual
1. Project Output [Facility / procurement device] (1) Heat supply equipment (boiler) (2) Heat supply piping (3) Heat exchange station (4) Other (1) Heat supply equipment (boiler) (2) Heat supply piping (3) Heat exchange station (4) Other [Training]	[Phase 1] Southeast heat source plant: 58 MW x 3 units Xinjiaying heat source plant A: 70 MW x 4 units Southeast heat source plant: 19.8 km Xinjiaying heat source plant A: 18.5 km Southeast heat source plant: 29 units Xinjiaying heat source plant A: 31 units Automatic control center [Phase 2] Bayan heat source plant: 70 MW x 4 units Xinjiaying heat source plant B: 84 MW x 3 units Bayan heat source plant: 23.3 km Xinjiaying heat source plant B: 22.0 km Bayan heat source plant: 27 units Xinjiaying heat source plant B: 29 units Automatic control center [Phase 1, Phase 2] Training in Japan related to atmospheric pollution measures including ash integration use	[Phase 1] As planned As planned As planned As planned As planned As planned As planned [Phase 2] As planned As planned As planned As planned As planned As planned As planned As planned [Phase 1, Phase 2] Cancel
2. Project Period	[Phase 1] June 2006–October 2012 (77 months, 6 years and 5 months) [Phase 2] March 2007–September 2015 (103 months, 8 years and 11 months)	[Phase 1] As planned [Phase 2] As planned
3. Project Cost Amount Paid in Foreign Currency Amount Paid in Local Currency Total ODA Loan Portion Exchange Rate Amount Paid in Foreign Currency Amount Paid in Local Currency Total ODA Loan Portion Exchange rate	[Phase 1] 7,872 million yen 1,792 million yen (120 million yuan) 9,664 million yen 7,400 million yen 1 yuan = 14.9 yen (As of January 2008) [Phase 2] 2,868 million yen 2,388 million yen (196 million yuan) 5,256 million yen 2,840 million yen 1 yuan = 12.2 yen (As of December 2011)	[Phase 1] 7,368 million yen 1,692 million yen (127 million yen) 9,060 million yen 7,368 million yen 1 yuan = 13.3 yen (Average between January 2008 and December 2012) [Phase 2] 2,814 million yen 3,171 million yen (182 million yuan) 5,985 million yen 2,814 million yen 1 yuan = 17.4 yen (Average between January 2013 and December 2015)
4. Final Disbursement	[Phase 1] October 2013 / [Phase 2] September 2015	

People's Republic of China

FY2017 Ex-Post Evaluation of Japanese ODA Loan Project

"Guizhou Province Environment Improvement and Education Project"

External Evaluators: Toshihiro Nishino/Ayako Nomoto,

International Development Center of Japan Inc.

0. Summary

The project aimed to improve environment and hygiene, and to develop human resources in local farming villages and suburban cities in 12 national poverty-stricken counties in Guizhou Province by constructing or improving facilities for (i) environmental measures such as methane gas facilities, waste and disposal facilities, and reforestation; (ii) hygiene measures such as roads for daily use, water supply, and medical services; and (iii) senior high school buildings. The project has been consistent with China's development plans and development needs as well as with Japan's ODA policy. Therefore, the relevance of the project is high. Although the project cost was within the plan, the project period significantly exceeded it. Therefore, the efficiency of the project is low. The effectiveness/impact is high. Indicators set to measure quantitative effects such as culling of forests, flooded area, volume of soil erosion, percentage of population served water, number of patients, volume and percentage of waste disposed, and senior high school enrollment rate have largely achieved targets or improved. As to qualitative effects, improvements in the environment (including living environment) such as the decrease in the collection of firewood and charcoal, improvement of medical services, improvement of hygiene as well as effects of education have been observed. As for impacts, a decrease in the population of rural poverty, regional economic development, sustainable environmental and social development, and a reduction in the women's household workload have been observed. The sustainability is high, as no major problems have been observed in the institutional, technical, and financial aspects of the operation and maintenance systems, as well as in the status of operation and maintenance.

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

1. Project Description

Project locations

Tianzhu Provincial Chinese Medicine Hospital

1.1 Background

Guizhou Province had the lowest per capita income among China's 31 provinces, and the 12 counties, the target counties under the project, were designated as national poverty-stricken counties[1] by the central government.

In the targeted province's farming villages, excessive logging to acquire fuel, combined with particular soil conditions in the province, such as the existence of many slopes and a karst topography that had low water-retaining ability, reduced the land's water retention capacity and brought serious soil erosion, thus causing increasingly extensive flood damages. The hygiene conditions of these villages had deteriorated. Due to the lack of water supply facilities, prevalence of infectious diseases was high and people were not able to receive proper medical service because of the lack of medical facilities. Thus, the target areas of the project needed to improve the natural environment, secure alternative fuel supplies, develop flood control facilities, and improve hygiene.

Furthermore, in the target areas, the population of students advancing to senior high schools remained low compared to the national average due to the lack of capacity for accommodating students. In order to nurture human resources capable of sustainable environmental and social development in the regions, construction of senior high school facilities was needed.

1.2 Project Outline

The objective of this project is to improve environment and hygiene, and to develop human resources in local farming villages and suburban cities in 12 national poverty-stricken counties in Guizhou Province by constructing or improving facilities for (i) environmental measures such as methane gas supply, waste treatment, and reforestation; (ii) hygiene measures such as roads for daily use, water supply, and medical services; and (iii) senior high school building, thereby contributing to the sustainable environmental and social development in the target areas

(Target areas)

- Tongren Prefecture: Jiankou County, Yinjiang Tujia and Miao Autonomous County , Shiqian County, Songtao Miao Autonomous County, Dejiang County, Yanhe Tujia Autonomous County, Sinan County
- Qiandongnan Miao and Dong Autonomous Prefecture: Shibing County, Sansui County, Cengong County, Tianzhu County, Jinping County

[1] Counties designated by the central government based on the poverty incidence and other factors. A total of 832 counties across the country were designated as of 2017.

Loan Approved Amount/ Disbursed Amount	9,173 million yen / 9,149 million yen	
Exchange of Notes Date/ Loan Agreement Signing Date	June 2006 /June 2006	
Terms and Conditions	Interest Rate Repayment Period (Grace Period Conditions for procurement	1.5% (0.75% for training component) 30 years (40 years for training component) 10 years) General untied
Borrower / Executing Agency(ies)	The Government of the People's Republic of China/ Guizhou Provincial People's Government	
Project Completion	December 2015	
Main Contractor(s) (Over 1 billion yen)	—	
Main Consultant(s) (Over 100 million yen)	—	
Related Studies (Feasibility Studies, etc.)	F/S: Guizhou Province International Engineering Consulting Center, February 2005 JICA "Special Assistance for Project Implementation (SAPI)", 2007	
Related Projects	- The Village-based Integrated Poverty Alleviation Model Project in Daozhen County and Leishan County, Guizhou Province, 2005—2010 - Southwest Poverty Reduction Project (World Bank), 1995—2005	

2. Outline of the Evaluation Study

2.1 External Evaluators

Toshihiro Nishino/Ayako Nomoto (International Development Center of Japan Inc.)

2.2 Duration of Evaluation Study

This ex-post evaluation study was conducted with the following schedule.

Duration of the Study: August 2017–November 2018

Duration of the Field Study: December 17, 2017– December 30, 2017, May 1, 2018–May 12, 2018

2.3 Constraints during the Evaluation Study

In the target areas and surrounding areas of the project, similar programs and projects[2] were implemented around the same time with the help of Chinese domestic funds. The quantitative indicators measure the effects not only of this project but also of these programs and projects; therefore, it was not possible to assess the effects of this project alone.

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

3.1 Relevance (Rating: ③[4])

3.1.1 Consistency with the Development Plan of China

The objective of this project has been consistent with the development plan. Environmental issues and poverty alleviation have been one of the priority areas under the five-year plans for economic and social development and the Guizhou Province five-year plans both at the times of appraisal and ex-post evaluations of this project.

(1) Development plans at the time of appraisal

Under the *11th Five-Year Plan for National Economic and Social Development (2006–2010)*, the Government of China planned to invest approximately 17 trillion yen in environment conservation for five years. The main objectives included (i) prevention of new environment pollution, (ii) prevention of destruction of ecological environment, (iii) improvement of environment in the designated areas and cities for environmental conservation, and (iv) conservation of ecological environment in the natural reserves. The *Guizhou Province 10th Five-Year Plan (2001-2005)* listed (i) conservation of forest resources through reforestation and others, (ii) environment improvement through promotion of detoxifying of waste, (iii) improvement of basic sanitation service and improvement of hygiene in villages by constructing drinking water facilities and sanitary toilet facilities, (iv) improvement in living environment by developing water supply facilities, and (v) increase in enrollment rate by constructing senior high school facilities.

As for poverty alleviation, the *China Rural Poverty Alleviation Program (2001-2010)* focused on the poverty alleviation of approximately 30 million people living below the poverty line as well as approximately 60-70 million people living barely above the poverty line who could drop below the poverty line if they faced problems such as illness or disasters. The program specifically set main principles including (i) increasing financial assistance and efficient use of financial

[2] As written in "3.1.1. Consistency with the development plan", the *13th Five-Year Plan (2016-2020)* set programs on (i) building of ecosystem and environmental conservation, (ii) poverty alleviation and improvement of living conditions, and (iii) reinforcing support for infrastructure development.
[3] A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory
[4] ③: High, ②: Fair, ①: Low

resources; (ii) promoting the construction of rural infrastructure in poor areas; (iii) encouraging migrant works; (iv) promoting education, health, culture, science and technology, planned childbirth in poor areas, especially in areas where ethnic minority groups live; and (v) implementing poverty alleviation activities basically at the township and administrative village levels[5].

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

At the time of ex-post evaluation, under the *13th Five-Year Plan for Economic and Social Development of the People's Republic of China (2016-2020)*, in order to achieve the goal of building a moderately prosperous society in all respects by 2020, major objectives such as poverty alleviation, improvement of public services including education and medical care, overall improvement of environment and ecosystem were set. Especially, part 13 of the plan, "the Fight against Poverty", lists measures such as (i) realization of effective improvement through appropriate planning and inputs, (ii) support for accelerating development of poor areas (basic infrastructure development and improvement of public services), and (iii) improvement of the poverty reduction system. As for the overall improvement of the environment and ecosystem, which is one of the objectives, (i) promoting environment governance and (ii) reduction in pollutant emissions and others are being prioritized.

Under the *Guizhou Province 13th Five-Year Plan (2016-2020)*, the goal of building a moderately prosperous society has been prioritized in accordance with the central government plan, and (i) building of ecosystem and environmental conservation, (ii) poverty alleviation and improvement of living conditions, and (iii) reinforcing support for infrastructure development are set as objectives.

3.1.2 Consistency with the Development Needs of China

The project has been consistent with development needs of China both at the time of appraisal and ex-post evaluation.

At the time of appraisal, the project target areas were classified as national poverty-stricken counties, and their living conditions were extremely poor because of a lack of basic infrastructure for living. In addition, poverty resulted in excessive logging for fuel, which resulted in a burden on the environment and ecosystem. Under these circumstances, realizing sustainable social and environmental development in the region through conservation of the environment and ecosystem, development of infrastructure for living, and promotion of human resource development was an urgent need. Thus, the project was consistent with the development needs.

[5] The township is one of the four tiers of local administration (province, prefecture, county and township). Among townships, there is a category of town, where commerce and industry are the main economic activities and the population density is relatively high. The administrative village is a community organization below the township.

At the time of ex-post evaluation, Guizhou Province was one of the provinces that had a large population of poor people (3.72 million; poverty rate: 10.6% in 2016), and therefore, the demand for poverty alleviation was still high. Partly because of the support from this project as well as the increasing support from the central government since 2008, an improvement in the living environment of people in the target areas and an improvement in the environment as well as a reduction in the population of poor people (as in Table 8 below) have been observed. However, the target 12 counties under the project continued to be classified in the national-level extreme poverty list, and thus, they need to be lifted out of the poverty list through further improvements in their living conditions, and the demand for poverty alleviation is still extremely high.

3.1.3 Consistency with Japan's ODA policy

The project was consistent with Japan's ODA policy at the time of appraisal; the *Japan's Official Development Assistance Charter* prioritized addressing global issues (environmental problems), and the mid-term ODA policy prioritized freeing individuals from fears such as environmental destruction from the perspective of human security.

In addition, the *Economic Cooperation Program for China*, the *Basic Strategy of Japan's ODA Loan*, and the *Country-Specific Action Policy* at the time of appraisal focused on environmental protection and human resource development. Further, the *Economic Cooperation Program for China* and the *Basic Strategy of Japan's ODA Loan* prioritized assistance for poverty alleviation.

Thus, this project has been highly relevant to China's development plan and development needs, as well as to Japan's ODA policy. Therefore, its relevance is high.

3.2 Efficiency (Rating: ①)

3.2.1 Project Outputs

The comparison of planned and actual outputs is shown in Table 1 below. The actual production of project outputs relative to the plan varies depending on sectors. The outputs of "methane gas facility", "reforestation", "roads for daily use", "drinking water facilities", and "domestic training" achieved 90% or more of the planned outputs. On the other hand, the outputs of "flood controls," "water supply facility," "medical facility", "waste treatment and disposal facility", "senior high school facility" and "overseas training" were 40%-75% of the plan.

The main reasons for shortfall in the outputs are as follows: (i) Prices of domestically procured materials and seedlings escalated due to inflation; (ii) The project was affected by a change in government policies (change in earthquake-resistance standards after the Great Sichuan Earthquake, change in standards for leachate treatment at a waste management facility, restriction of overseas training for government officials and others); (iii) The scope of procurement was

reduced due to the depreciation of the yen at the later stage of project implementation; (iv) The project cost fell short and additional input was needed in some subprojects as the cost was underestimated at the time of planning. Also, part of the planned senior high schools were amalgamated, and therefore the construction was canceled. As some planned subprojects needed urgent implementation, they were constructed with own funds. As a result, an adjustment in outputs (including adjustment among sectors in accordance with the progress of own projects and availability of own resources) was made.

Economic forest in Shiqian County

Leachate treatment facility at a waste treatment and disposal facility

A dormitory at Dejiang First High School

Table 1 Comparison of the Plan and Actual Project Outputs

	Plan	Actual	Change
1． Activities to improve hygiene and the environment in local farming villages			
①methane gas facility	Installation (58,664 sites) (Portion from 11 of 12 counties: 53,704 sites)	Installation (50,369 sites: Portion from 11 of 12 counties)	Number of sites installed: 94% (Portion of 11 counties)
②flood controls	(41 sites): Development of embankments (Total length: 50 km), development of drainage (Total length: 370 km)	(23 sites): Development of embankments (17.5 km), drainage (36 km), channel improvement (5.7km), etc.	Number of sites developed: 56% Total lengths of embankments: 35% Total length of drainage: 10%
③reforestation	(46,000 ha): Protection forest; 35,000 ha; Economic forest: 11,000 ha (Portion from 11 of 12 counties: (42,047 ha): Protection forest: 32,313 ha; Economic forest: 9,733 ha)	(38,736ha): Protection forest: 28,749ha; Economic forest: 9,986ha (Portion from 11 of 12 counties)	Planted area: 92% (Portion of 11 counties)
④roads for daily use	(Total length: 3,547 km): Low-cost pavements for daily use, procurement of equipment: (Portion from 11 of 12 counties:	(Total length: 2,952km): Low-cost pavements for daily use, procurement of equipment:	Total length: 92% (Portion of 11 counties)

	3,212 km)	(Portion from 11 of 12 counties)	
⑤drinking water facilities	(86 sites): Construction of reservoirs, procurement of equipment, development of water distribution network (Portion from 11 of 12 counties: 70 sites)	(73 sites): Same as planned (Portion from 11 of 12 counties)	Number of sites installed: 104% (Portion of 11 counties)
2. Activities to improve hygiene and the environment in suburban cities			
①water supply facility	(24 sites): Expansion and construction of a purification plant, procurement of equipment, development of water distribution network	(16 sites): Same as planned	Number of facilities: 67%
②medical facility	Expansion and construction of county hospitals (18 sites), maternal health centers (7 sites), health monitoring stations (2 sites), procurement of medical equipment 97,488 ㎡	Expansion and construction of county hospitals (8 sites), maternal health centers (4 sites), procurement of medical equipment 27,915 ㎡	Number of facilities: 44% Area: 29%
③waste treatment and disposal facility	(3 sites): Construction of landfill waste treatment and disposal facilities	(2 sites): Construction of landfill waste treatment and disposal facilities	Number of sites: 67%
3. Education			
high school facility	(47 sites): Expansion and construction of school buildings and dormitories, procurement of education equipment Area: 277,717 ㎡	(31 sites): Same as planned Area: 138,365 ㎡	Number of sites: 66% Area: 50%
4. Training			
①domestic training	Training on health for government officials of counties and below, staff of hospitals and maternal health centers. Number of participants: 420,800 persons	Same as planned 376,204 persons	Number of participants: 89%
②overseas training	Training on health and environmental education for government officials of province, municipalities, and counties as well as senior high school teachers (16 persons x 3 times=48 in total)	19 persons	Number of participants: 40%

Source: Documents provided by JICA, response to questionnaires, and interviews with executing agency

3.2.2 Project Inputs

3.2.2.1 Project Cost

Total project cost slightly exceeded the plan (the ratio against the plan: 116%). Although the ratio against the plan, if simply compared, would have been 78%, the decrease in the actual outputs needed to be taken into consideration. As there are many sectors, it is difficult to accurately calculate the degree of reduction of the project output; however, the ratio against the plan would be approximately 67% after multiplying the ratio of actual outputs relative to the plan in each sector (refer to Table 1) and the weighted planned inputs. Thus, when comparing the 8,854 million yen, which is 67% of the planned total cost of 13,216 million yen and actual project cost of 10,309 million yen, the ratio against the plan would be 116%. Therefore, although the project cost was smaller than the plan, the actual project cost to produce the actual outputs was judged to have exceeded the plan after taking into account the decrease in the scope.

The actual inputs in accordance with the above-mentioned changes in the outputs exceeded the plan because of the factors mentioned in "3.2.1 Project Outputs" above. Among them, the biggest factors are (i) escalation of prices for materials and labor costs necessary for the construction due to inflation, and (ii) depreciation of the yen. The average exchange rate during the project period was 1 yuan =14.9 yen while the rate at the time of appraisal was 1 yuan=13.7 yen. The yen depreciated 8.8% and resulted in an increase in the yen-based project cost.

Table 2 Planned and actual project cost

(Units: million yen)

	Plan (at the time of appraisal)						Plan (after revision)						Performance					
	Foreign currency portion		Local currency portion		Total		Foreign currency portion		Local currency portion		Total		Foreign currency portion		Local currency portion		Total	
		ODA loan		ODA loan		ODA loan		ODA loan		ODA loan		ODA loan		ODA loan		ODA loan		ODA loan
methane gas	0	0	2,176	1,038	2,176	1,038	343	343	163	0	506	343	363	363	63	0	426	363
flood controls	0	0	948	829	948	829	949	949	0	0	949	949	744	744	0	0	744	744
reforestation	0	0	2,380	1,915	2,380	1,915	2,217	2,217	720	0	2,937	2,217	2,351	2,351	682	0	3,033	2,351
roads for daily use	0	0	483	415	483	415	480	480	15	0	495	480	525	525	14	0	539	525
drinking water	0	0	354	323	354	323	329	329	33	0	362	329	348	348	31	0	379	348
water supply	0	0	461	431	461	431	323	323	108	0	431	323	342	342	102	0	444	342
medical facility	0	0	1,111	1,038	1,111	1,038	3,383	3,383	0	0	3,383	3,383	3,586	3,586	0	0	3,586	3,586
waste treatment	0	0	530	497	530	497	372	372	0	0	372	372	393	393	0	0	393	393
education	0	0	2,940	2,447	2,940	2,447	463	463	0	0	463	463	373	373	0	0	373	373
training, etc.	38	38	201	201	239	239	32	32	6	0	38	32	40	40	0	0	40	40
price escalation	1	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
contingency	2	0	609	0	611	0	96	96	0	0	96	96	0	0	0	0	0	0
interest during construction	384	0	0	0	384	0	0	0	0	0	0	0	0	0	268	0	268	0
others	0	0	599	0	599	0	94	94	0	0	94	94	84	84	0	0	84	84
Total	426	40	12,790	9,133	13,216	9,173	9,081	9,081	1,045	0	10,126	9,081	9,149	9,149	1,160	0	10,309	9,149

Source: Based on documents provided by JICA and the executing agency

Note: 1) The exchange rates applied were: (planned) 1 yuan=13.7 yen; (planned-after revision) 1 yuan=15.8 yen (2013); (actual) 1 yuan=14.9 yen (Average of 2006-2015). 2) No data on breakdown of local currency portion and foreign currency portion for the ODA loan amounts for plan (after revision) and actual. The local currency portions in the table are domestic funds from China. 3) Total amount may not be consistent because of rounding down to million yen.

3.2.2.2 Project Period

The project period significantly exceeded the plan (the ratio against plan: 192%), as the actual period was 115 months while 60 months was planned. The project period exceeded the plan mainly due to the following reasons: (i) It took a long time to appoint a procurement/tender management company required for a Japanese ODA loan project (appointed in 2008 and tender started in 2010); (ii) Adjustment and approval for the scope of the project were required due to inflation and other reasons; (iii) Change of design was necessary after the change in standards; (iv) Management and adjustment were necessary as other similar projects by own funds were implemented at the same time. (v) There were some problems on implementation procedure (such as a delay in opening of bank accounts necessary for procurement, delay in the disbursement process of funds from the Japanese ODA loan, and others).

Due to the delay in the project period, the project was influenced by external factors such as adjustment of plans by the Government of China. As a result, the project needed further time for responding to external factors, revision of project scope (designs were changed and needed to be approved), and others.

Table 3 Planned and actual project period

	Plan (Appraisal)	Actual
Signing of loan agreement	June 206	June 206
Activities to improve hygiene and the environment in local farming villages	July 2006-May 2011 (59 months)	July 2006-December 2015 (114 months) (the ratio against the plan: 193%)
Activities to improve hygiene and the environment in suburban cities	September 2006-May 2010 (45 months)	May 2009-December 2015 (80 months) (the ratio against the plan: 178%)
Education	September 2006-May 2010 (45 months)	December 2009-December 2015 (73 months) (the ratio against the plan: 162%)
Training	July 2006-May 2011 (59 months)	May 2009-September 2015 (77 months) (the ratio against the plan: 131%)
Project completion (project period)	May 2011 (60 months)	December 2015 (115 months) (the ratio against the plan: 192%)

Source: Documents provided by JICA and the executing agency, response to questionnaires by the executing agency

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

At the time of appraisal, Financial Internal Rate of Return (FIRR) of the entire project and FIRR and Economic Internal Rate of Return (EIRR) of each sector were calculated based on the following conditions.

Table 4 Internal rates of return at the time of appraisal

Item	FIRR/EIRR	Benefits	Costs	Project life
Entire project	FIRR: 3.26%	Cash income	Project cost, operation and maintenance (O&M) cost	40 years
Water supply facility	FIRR: 13.5%	Income from water rates and others	Project cost, O&M cost	20 years
Medical facility	FIRR: 6.2%	Income from medical charges and others	Project cost, O&M cost	20 years
Methane gas facility	EIRR:19.7%	Savings of fuel cost, decrease in workload of firewood and charcoal collection	Project cost, O&M cost	20 years
Flood controls, reforestation	EIRR:16.0%	Income from forest products, decrease in flood damages	Project cost, O&M cost	40 years

Source: Documents provided by JICA

Internal Rate of Return (IRR) at the time of ex-post evaluation were not recalculated due to the following reasons. (i) As this project consists of various subprojects in 12 counties, it was difficult to collect information within the duration of this ex-post evaluation study; (ii) It is difficult to precisely compare the IRR before and after the project, as factors at the time of appraisal were not known. For reference, EIRR of “methane gas facility” and “flood controls and reforestation” based on the actual results and the above-mentioned conditions in Dejiang County were recalculated, as relatively detailed information was obtained. This is for reference only as the IRR below are of a part of the subprojects in one county.

- Methane gas facilities in Dejiang County: 22.68%
- Flood controls and reforestation in Dejiang County: 5.92%

In light of the above, the project cost exceeded the plan and the project period significantly exceeded the plan. Therefore, efficiency of the project is low.

3.3 Effectiveness and Impacts[6] (Rating: ③)

3.3.1 Effectiveness

3.3.1.1 Quantitative Effects (Operation and Effect Indicators)

Operation and effect indicators set at the time of appraisal have largely achieved the targets or improved, and therefore, the intended effects have been produced.

(1) Activities to improve hygiene and the environment in local farming villages

At the time of appraisal, (i) reduction in culling of forests for "methane gas facility", (ii) decrease in maximum flooded area and maximum number of households flooded for "flood controls", and (iii) planted area for "reforestation" were set as operation and effect indicators.

As for "methane gas facility", although the data collected has not reached the target, culling of forests has significantly decreased, and interviews with the executing agency and farmers who introduced the facilities at the site surveys (refer to footnote 7) support this trend.

Among the indicators set to measure the effects of "flood controls", the reduction in maximum flooded area has surpassed the planned figures. There are many cases where even once-in-50-years heavy rain that hit the area resulted in no damage. On the other hand, maximum number of households flooded has not achieved the target as the actual results exceeded the plan by 148%. Significant transformation of agricultural land to residential land and population growth accordingly in the centers of counties, where the flood controls were mainly implemented, is deemed to influence this result.

Reforestation was implemented mostly as planned, and therefore, reforested land area has been achieving the target, with the significant improvement in soil erosion.

Thus, effects of activities to improve hygiene and the environment in local farming villages have been attained mostly as planned or improved significantly compared to the status before the project. The improvement of indicators has been brought about by this project as well as the similar projects implemented by the domestic fund in the target areas and surrounding areas.

[6] Sub-rating for Effectiveness is to be put with consideration of Impacts.

Table 5 Operation and effect indicators for activities to improve hygiene and the environment in local farming villages (Total)

		Baseline	Target	Actual	Ratio against the plan
		2004	2013	2017	
			2 Years after Completion	2 Years after Completion	
Methane gas facility	Culling of forests (10,000 tons/year)	450 (Average: 37.5)	52 (Average: 4.3)	63(6 counties) (Average: 10.5)	Increase by 121%
Flood controls	Maximum flooded area (km^2)	399	244	134	Decrease to 55%
	Maximum number of households flooded (1,000 households)	19.3	9.5	14.1	Increase by 148%
Reforestation	Planted area (1,000 ha)	31	77	70	91%
	Volume of soil erosion ($10,000m^3$/year) *1	3,964	2,704	618	Decrease to 23%

Source: Documents provided by JICA, responses to questionnaires from the executing agency and others
Note: Volume of soil erosion was set as an indicator for reference at the time of appraisal.

(2) Activities to improve hygiene and the environment in suburban cities

At the time of appraisal, (i) increase in population served with water and percentage of population served with water for "water supply facility"; (ii) increase in the number of in-patients, out-patients and emergency patients for "medical facility"; and (iii) increase in volume and percentage of waste disposed for "waste treatment and disposal facility" were set as operation and effect indicators.

In the case of "water supply facility", the ratio of the actual result of population served water against the plan was 74% in accordance with the scaling down of the scope. However, the use of water has shown an increasing trend, and the volume of water supply has been mostly the same as planned. Percentage of population served with water significantly exceeded the plan.

All indicators for "medical facility" have surpassed the plan significantly. As the target medical facilities are core hospitals in each county, in addition to this project, expansion of the scale and procurement of equipment has been actively implemented by the domestic financial resources. These efforts resulted in this significant improvement. Also, introduction of a new health insurance for farmers (approximately 65% of the premium is covered by the central and local governments; as of 2014, almost 100% of the farmers participated in the program nationally) is one of the reasons for this increase in number of patients.

Development of waste treatment and disposal facility was implemented in two counties, though it was planned in three. However, the volume of waste disposed has been significantly larger than the plan. In addition to the increase in the quantity of refuse per person and

increase in the population in urban areas, measures for waste treatment in villages have also progressed, resulting in an increase in the volume of waste disposed. The percentage of waste disposed has been as planned.

Table 6 Operation and effect indicators for activities to improve hygiene and the environment in suburban cities

		Baseline	Target	Actual	Ratio against the plan
		2004	2013	2017	
			2 Years after Project Completion	2 Years after Project Completion	
Water supply	Population served with water (1,000 people)	706	1,016 (Target of 7 counties for which data for the actual results was collected: 854.5)	751 (7 out of 12 counties)	74%
	Volume of water supply (m^3/day)	n.a.	122,074	113,869	93%
	Percentage of population served with water (%)	40	50	79	158%
Medical	In-patients (1,000 people)	102	125	193	154%
	Out-patients (1,000 people)	255	303	1,257	414%
	emergency patients (1,000 people)	20	32	154	481%
	Infant mortality rate (per 1,000 live births)	31	24	9	15p improvement from the plan
	Maternal mortality rate (per 100,000 live births)	118	90	46	44p improvement from the plan
	Mortality rate from diseases (per 100,000 population)	281	226	n.a.	n.a.
Waste disposal	Volume of waste disposed (1,000t/year)	0	96	225	234%
	Percentage of waste disposed (%)	0	86	86	100%

Source: Documents provided by JICA, responses to questionnaires from the executing agency and others
Note: 1) Among the above indicators, percentages indicate average figures and the other figures represent total figures. 2) “Infant mortality rate”, “maternal mortality rate” and “mortality rate by diseases” for medical were set as indicators for reference. 3) “Volume of water supply” for water supply is for reference only.

(3) Education

Enrollment rate for senior high school was set as an operational and effect indicator at the time of appraisal, and the actual results significantly surpassed the plan. In the target schools, construction of dormitories and school buildings under the project have contributed to the increase in the number of enrolled students. In China, various measures to improve

the enrollment rate of senior high schools such as construction of facilities and assistance for poor households have been implemented. Those measures and implementation of this project have led to the improvement in the indicator.

Table 7 Operation and effect indicator for education

		Baseline	Target	Actual	Ratio against the plan
		2004	2013	2017	
			2 Years after Project Completion	2 Years after Project Completion	
Education (Senior high school)	Enrollment rate of senior high schools	37	54	86	Improvement of 32p from the plan

Source: Documents provided by JICA, responses to questionnaires from the executing agency and others
Note: The figures are average.

3.3.1.2 Qualitative Effects (Other Effects)

At the time of appraisal, "improvement of environment", "improvement of hygiene", "improvement on education" were expected as qualitative effects of the project. The effects observed during the site surveys[7] were as follows:

(1) Improvement of environment

Regarding "improvement of environment (including living environment)", the following effects have been observed under the category of "methane gas facility", "roads for daily use" in local farming villages as well as "medical facility" in suburban cities.

Under the category of "methane gas facility", by utilizing the facilities, use of fuelwood decreased from 40-50 kg to 5-10 kg in the villages visited during the site surveys. People used fuelwood for cooking previously; however, they cook with mainly methane gas currently. Therefore, there was a problem whereby in the past people cut trees in the land other than that owned by them; however, they no longer need to cut trees even in their land, and they only use tree branches and fallen leaves for fuel. As a result, the burden on the environment and ecosystem has significantly reduced.

As for roads for daily use, in areas where the roads were developed under the project,

[7] Site surveys were conducted in eight counties among the target 12 counties. Sites visited are as follows: (i) activities to improve hygiene and the environment local farming villages: 18 sites (three sites for methane gas facilities, four sites for flood controls, three sites for roads for daily use, five sites for reforestation, and three sites for drinking water facilities); (ii) activities to improve hygiene and the environment in suburban cities: 10 sites (three sites for water supply facilities, five sites for medical facilities, and two sites for waste treatment and disposal facilities). (iii) Education: seven sites. Among the sites visited, individual interviews with beneficiaries (farmers) and key informant interviews were conducted for activities to improve hygiene and the environment local farming village (methane gas facilities, flood controls, roads for daily use, reforestation and drinking water facilities), and key informant interviews were conducted for activities to improve hygiene and the environment in suburban cities and education.

when it rained in the past, because of the unpaved surface, roads completely got muddy and people were not able to use roads for transportation. However, after the construction of the roads under the project, such problems have been solved and vehicles can be used because of the widening of the roads. Thus, the living environment has significantly improved.

As a result of facility construction and equipment installation under the medical facility, the following improvements have been observed in the medical services. Although improvements in facilities were also implemented by other projects, the project helped some hospitals upgrade their status to come under the national system to the category of secondary A hospital[8].

- Many of the medical equipment items including color ultrasound diagnostic equipment introduced under the project were one of the first advanced equipment items in the target hospitals, which allowed them to provide medical services in the counties appropriately and promptly. As a result, the hospitals have become able to provide more detailed examination and diagnosis. Also, they used to send patients to hospitals in other counties because they were incapable of treating certain cases (such as difficult delivery); however, the hospitals are now providing such treatment. Thus, the quality of medical services has improved a lot.
- The target hospitals used to have small building areas and faced difficulty in setting up necessary medical equipment and even in providing treatment. As a result of the expansion of building areas under the project, the hospitals were able to secure spaces for examination rooms (including enhancement of equipment after securing the spaces for equipment), nurse stations, and training rooms. With the increase in staff members in some hospitals, medical services have improved. In one hospital, there was no other department than obstetrics and gynecology before the project because of the lack of space; however, the hospital has now set up various departments such as an outpatient department for pediatrics, an outpatient department for high-risk maternal care, all of which provide appropriate treatment respectively. Examples of effects of expansion of areas and improvement of medical services in accordance with the appropriate institutional setup accordingly include (i) one of the hospitals is able to conduct hearing checkups for all newborns; (ii) another hospital provides health checkup services; and (iii) yet another hospital is able to provide hemodialysis service as a part of the building constructed under the project has been allocated to a hemodialysis center.

[8] Hospitals in China are classified into three levels in accordance with their infrastructure and functions. Further, they are labeled A or B within the above-mentioned three levels (The third A hospitals are the highest-ranked hospitals).

(2) Improvement of hygiene

Before the project, there were problems with the quality of water: it was smelly and cloudy, and coliform was detected. After the development of water supply and drinking water facilities under the project, safe water was provided, which has met the domestic water quality standard-2 (There is a case where the quality has significantly improved from 4 to 2). As a result, although there is no statistical data, water-borne diseases such as diarrhea are not as prevalent as before, according to interviews with executing agency and beneficiaries. Also, the problem of cuts in water supply in some areas have been solved. The Government of China has currently implemented a policy of building elementary schools in each town, and as a result, the demand for water in towns has increased. The project has responded to these increased demands.

In accordance with the development of waste treatment and disposal facilities and leachate treatment facilities under the project, the burden on the surrounding environment from the final disposal has been eased. Further, as appropriate final disposal of garbage has become possible, collection of garbage has progressed. As a result, the situation of garbage-strewn litter bins in streets has improved.

(3) Education

As for the construction of senior high schools, effects such as the ability to accept students from rural and mountain areas because of the dormitory construction and improvement in the number of students per class have been observed.

- The project constructed senior high school buildings and dormitories were included in many sites. As it is difficult for students in rural and mountain areas to commute, they need to rent a room in a dormitory or a private apartment nearby after enrollment. However, if a student cannot afford the rent for the apartment, which is about 100 yuan per month, he/she needs to rent a bed in a dormitory (30 yuan per month). However, dormitories were not able to accept all candidates, which was an obstacle for enrollment in the senior high schools. Following the construction of dormitories under the project, the senior high schools are able to increase the number of students for recruitment, and students from rural and mountain areas now have a chance to enroll themselves in senior high schools.
- Because of the lack of the classrooms, the number of students per class in a target school was 60 before the project. As the number of classrooms has increased after the project, the number of students per class has improved to 45. Thus, the education environment has improved a lot.
- As a result of improvement of education through this project and through other projects, enrollment to universities and vocational schools has improved. In a target

school under the project, the number of students enrolled in universities has increased significantly from 100 students in 2004 to 500 in 2017.

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3.3.2 Impacts

3.3.2.1 Intended Impacts

At the time of appraisal, “reduction of the number of the rural poor”, “regional economic development”, “sustainable environmental and social development”, and “decrease of workload of housework for women (collection of firewood and charcoal and fetching of water)” were expected as impacts. Based on statistical data provided by the executing agency and the site surveys as mentioned above, the following impacts have been observed.

(1) Reduction of the number of the rural poor and regional economic development

The Government of China revised the poverty standard in 2011 from its own standard to a standard that incorporates international norms, in order to further strengthen the measures against poverty. In order to target a larger poor population, the standard of net per capita income of the poor was set higher, and as a result, the number of the rural poor has increased. Therefore, it is difficult to compare the status before the project (2006) and after. However, according to the statistical data and the responses to questionnaires from the executing agency, the number of the poor in the target 12 counties dropped from approximately 1.47 million in 2012, the year in which the new standard[9] was introduced, to approximately 780,000 (reduced by half) in 2016. Therefore, it is judged that the overall reduction in the number of poor has shown steady progress.

Table 8 Poor population in the target 12 counties

(unit: 10,000 persons)

	2012	2013	2014	2015
Total of 12 counties	147	119	100	78

Source: Documents provided by the executing agency

According to documents provided by the executing agency, the GDP in the target counties and farmer’s net per capita income have significantly increased. GDP has increased from 29.3 billion yuan in 2013 to 37.5 billion yuan in 2017 (1.3 times higher with 6% annual growth). Farmer’s net per capita income also has increased from 5,500 yuan in 2013 to 8,613 in 2017 (1.6 times higher and 12% annual growth).

[9] The standard of net per capita income for rural poverty have varied from 668 yuan in 2004, 1,196 yuan in 2008, and 2,300 yuan in 2012.

Improvements in GDP, net income, and poverty are greatly influenced by macroeconomic trends and measures against poverty by the domestic fund, and therefore, it is judged that the improvements in the above indicators have been achieved through various poverty measures including this project and economic conditions.

(2) Sustainable environmental and social development

According to interviews with beneficiaries, staff of counties and townships, impacts related to revenue increase, protection of farmland, and promotion of migration have been observed as a result of construction of facilities and installation of equipment.

Table 9 Impacts on sustainable environment and social development

Facilities and equipment	Impacts
Roads for daily use	**Increase of income in accordance with the improvement of transportation of agriculture products, etc.** As a result of road construction, transportation of people and goods has become smooth. Many cases wherein such improvements have led to the increase of income of the residents and farmers have been observed. ・ In a village where the main product is mandarin oranges, people used to carry the products on their shoulders to a middleman. After the road was constructed, they have been able to carry the product in carts. The workload has decreased and at the same time sales have expanded. In response to the increase in sales, the cultivated area in the village has expanded from 1,000 mu[10] (approximately 6.67 are) to 3,000 mu. Income per mandarin orange-producing household has increased by about 2,000 yuan. ・ In another village, after the construction of roads, some farmers opened farm-restaurants from 2012 onward, targeting tourists who visit a lake nearby. Also, sales of citrus fruit targeting tourists and sales of mandarin oranges in urban areas by using road have expanded, and as a result, cultivated areas have increased. ・ Improvement of access through road development was a key factor in the success in attracting a company from another province in another village. In 2014, the company started producing herbal medicine from the plum trees in the village and hired 100 villagers, paying them wages. Also, part of the profit has been shared among the residents every year.
Embankment	**Increase of agriculture production as a result of construction of embankments with irrigation functions** In some areas, embankments with irrigation functions were constructed. After the construction, irrigation in the areas has been utilized and as a result, agricultural production and crops have progressed in a more sophisticated manner including the transformation of crops from corn to rice. Agricultural income has also increased.
	Protection of important farmland in a poor mountain area In a mountain area where poor ethnic minorities live, the farmland is limited. Cultivated area per person is 0.4 mu for paddy fields near the river

[10] Unit of measurement for area in China.

	and 0.4 mu for farmland on the slope (though principally farming is not allowed there). Among these, high-yielding paddy fields account for most of the agricultural production and have been an important source of people's food. However, when the river flooded in the rainy season, the paddy field was submerged and people lost most of their agricultural produce, and as a result, they became distressed. After the construction of the embankment under the project, the river has not flooded, and people are able to avoid this distressed situation.
Reforestation	**Increase of income and expansion of marketing channels for products from economic forest** Production of camellia oleifera (a kind of camellia from whose fruit oil is extracted) from economic forests will be fully scaled up in the coming years. Some of the villages visited have already experienced an increase in income from this project. ・ In a village where 43 households planted trees in their own land of 320 mu in 2010, fruit was harvested in 2013 for the first time, and in 2017, with the production of approximately 100,000 kg of fruit, approximately 500,000 yuan was obtained from its sales, from which 10,000 yuan was distributed to each household. Before the project, the villagers gained little income from the land, as they were wastelands; however, their income has significantly increased after the project. A county-processing factory is being constructed, and it is expected that selling the product to the factory would further increase the income. ・ In another village, increased income includes (a) income from labor for maintenance of camellia oleifera, 5,000-10,000 yuan; and (b) dividends from a processing company supported by the World Bank in 2017, 1,000 yuan/household (3 persons on average). As a result, the number of poor households has decreased from 53 households before the project to 20 after the project. The company sells the processed product (food oil) through an antenna shop in Suzhou and through the internet.
Drinking water facilities	**Promotion of migration of those in inferior living environments to the center of counties/townships** In order to improve the inferior living environments of those live in small villages with less than 30 households, the Government of China has promoted migration of those households in a group to the center of counties/townships. One of the conditions for accepting those groups is securing drinking water. After the development of drinking water facilities under the project, there is a township that accepted the migration of 20 poor households by meeting this condition. As a result, the living environment of the immigrants has improved a lot.

Source: Interviews with residents and staff of counties and townships during the site surveys

A drinking water facility installed at home

Cooking using methane gas

(3) Decrease of workload of housework for women (collection of firewood and charcoal and fetching of water)

The installation of methane gas facilities and drinking water facilities in the farming villages significantly decreased the workload of collecting fuelwood and charcoal and fetching of water. In villages where the interviews were conducted, people used to spend 20-30 days per year for collecting fuelwood and charcoal; however, they only collect fuelwood during the break in farming nowadays. People also mentioned that the workload of house work such as collection of fuelwood and charcoal as well as fetching of water has been eased with the time spent decreasing from one hour per day to 10-20 minutes. In the areas where drinking water facilities were developed, the workload of fetching water was heavy. People used to go to a well to fetch water (once or twice per day with a tank for water), as there were no drinking water facilities or the quality was low even if they had facilities. The workload of these tasks was heavy in rural areas that turned grey; however, the workload was eased through the project. These household tasks do not necessarily have to be performed by women; however, since men usually work away from home, these tasks have been mainly undertaken by women and children. Thus, the project led to a decrease in the heavy workload of women and children. Also, provision of a stable water supply has improved the lives of rural people as they are now able to use showers and washing machines.

3.3.2.2 Other Positive and Negative Impacts

(1) Impacts on the natural environment

No negative impacts on the natural environment have been observed. Monitoring using the existing equipment based on the environmental impact assessment has been carried out on the waste treatment and disposal facilities. Online monitoring on leachate, regular monitoring on the quality of water of the nearby rivers, etc., and unannounced inspections were carried out for the final disposal facility based on the national standard. As a result, no negative impacts have been observed.

(2) Resettlement and land acquisition

Land acquisition and resettlement did not occur, and no negative impacts on social aspects have been observed.

(3) Expansion of urban areas as a result of significant decrease in flood damage on account of the construction of an embankment

Among the other impacts, expansion of urban area as a result of significant decrease in flood damage on account of the construction of an embankment has been observed. In a village visited during the site surveys, a river that flows near the center of the county flooded once in several years and approximately 2,000 mu of farm land in the surrounding area were damaged previously. After the embankment was constructed under the project, even in a case where the village experienced its heaviest rainfall in a 100-year period (130 mm/day) in July 2014, the river did not flood and future concerns for damage by the flood was mitigated. The target county was in the mountain area and therefore the plain filled is very valuable. As a consequence of the increased safety in the area around the embankment, housing land development has shown progress since then. Thus, the development of the embankment has promoted the urban development.

(4) Human resource development for promoting poverty alleviation measures

Training for staff members of counties, townships, and villages who are responsible for the poverty alleviation measures was conducted under the project. The training especially provided them a chance to learn project operations based on fair rules and fund (for projects outsourced) management (procurement based on rules on use of funds). Thus, the project has contributed to human resource development for poverty alleviation measures. “Guizhou Rural Development Project”, which targets 16 counties in the province is currently implemented with the support of the World Bank. The target counties include five counties targeted under this project. According to the Guizhou Province, the implementing capacity of a county is one of the important criteria for county selection, and the counties under this project that demonstrated a high level of implementing capacity were selected preferentially.

Thus, this project has largely achieved its objectives. Therefore, effectiveness and impacts of the project are high.

3.4 Sustainability (Rating: ③)

3.4.1 Institutional/Organizational Aspect of Operation and Maintenance

As the project covered multiple sectors in the national poverty-stricken counties, an organizational structure for operation and maintenance (O&M) in each sector was set at the time of appraisal. At the time of ex-post evaluation, O&M has been carried out mostly as planned, and no problems have been observed regarding the institutional/operational aspects. The organizational structure for O&M in each sector is as follows:

Table 10 Organizational structure for O&M

1. Activities to improve hygiene and the environment in local farming villages	
Methane gas facility	Under the guidance of county departments of agriculture and rural energy and agriculture stations in townships, residents who installed the facilities carry out maintenance. In some counties, as there are many households made up of senior people, village-level teams were set up to promote maintenance of the methane gas facilities.
Flood controls	・ Under the guidance of county water departments and water stations in townships, residents carry out maintenance (in case of large-scale facilities, county water departments are responsible). ・ For small facilities, residents check the facilities (such as small cracks) regularly, and report to the village governments if needed. Then, village governments take action. As residents are highly aware that embankments are important facilities and they are motivated to safeguard them, no problems have been observed.
Reforestation	・ Under the guidance of county forest departments and forest stations in townships, participants in the project carry out maintenance. Also, forest protection workers hired by the forest stations are responsible for protection from damages from disease and harmful insects. ・ No problems have been observed as people are very motivated because the economic forest is a source of income. It was anticipated that people would not be very motivated to carry out O&M of protection forest. Hence, species that do not need much care, or species that would produce some income were selected. Also, county forest departments regularly monitor the situation by collaborating with residents.
Roads for daily use	・ Residents carry out maintenance. ・ In case of any damage, maintenance was conducted with materials provided by village governments and labor provided by residents. People cooperate well as they are aware that the roads are basic and important infrastructure.
Drinking water	Under the guidance of county water departments and water stations in townships, residents carry out maintenance
2. Activities to improve hygiene and the environment in suburban cities	
Water supply	Water supply companies are responsible for O&M.
Medical	Medical institutions are responsible for O&M.
Waste treatment and disposal	County construction departments carry out maintenance.
3. Education	
Senior high schools	Senior high schools are responsible for O&M.

Source: Documents provided by JICA, interviews and responses to questionnaires with/by the existing agency

and counties

At the time of ex-post evaluation, staff was allocated for this ODA loan project at the county and township government levels. As many similar projects have been implemented, O&M of each sector under this project have been conducted together with similar projects. The number of staff has increased in response to the recent increase of the social infrastructure projects in poor counties.

As to the sectors that need to involve residents for O&M, institutional setup to support residents has been arranged when necessary, and therefore, no problems have been observed.

3.4.2 Technical Aspect of Operation and Maintenance

No major problems have been observed regarding the technical aspect of O&M. As envisaged at the time of appraisal, at the provincial, prefectural, county, and township levels, the government sectors of agriculture and rural energy, forestry, water resources, education, and health have conducted maintenance activities directly or provided technical guidance and monitoring. As described above, many similar projects utilizing domestic funds have been implemented, and no sophisticated skills have been required in the case of most of the subprojects; thus, there have been no technical issues on O&M under each governmental sector. Operation of equipment items that require sophisticated skills have been outsourced to expertise companies, and also staff has acquired skills through training by expertise institutes. As for the sectors that need to involve residents for O&M, no problems have been observed either, as they do not require sophisticated skills, and necessary information sharing and guidance have been given. In the case of methane gas, manuals for use of methane gas facilities have been distributed, and in the case of reforestation, regular checkups have been carried out by residents with the collaboration of county departments of forestry.

3.4.3 Financial Aspect of Operation and Maintenance

No problems have been observed regarding the financial aspects of O&M to sustain the effects produced by the project. Support from the central and provincial governments toward the poverty-stricken counties, the target of this project, have been strengthened in order to achieve a policy goal of realizing a moderately prosperous society. Especially, financial support has further increased after the State Council issued “Opinion on further promoting sound and rapid economic and social development” (2012) (regulation by the State Council).

The budget of the provincial government for poverty alleviation increased from 3 billion yuan in 2006 to 13.5 billion yuan or more in 2017 (60% from the central government and 40% from the provincial government). Also, a special fund of 86.1 billion yuan

(approximately 14 trillion yen) was allocated in the budget proposal of 2017, which was 30% higher than the previous year. According to interviews with the target governments, financial support for poverty alleviation rapidly increased from 10-30 million yuan in 2006 (at the beginning of this project) to 100 million yuan or more in recent years, though the figures vary depending on counties. O&M budget has been secured at the village level and necessary materials have been purchased.

Among the costs to be borne by residents, the water rates have been in the rage of 1-3.5 yuan/t depending on counties. As there has been a system in place whereby poor households are exempted, there have been no problems. Operation of methane gas facilities has been affected by the price of pigs to some extent; however, even in the period of low prices, there have been no problems in the continuous use of the facilities, as (i) farmers do not have to spend money for purchasing animal feed, as they usually raise one pig that can be fed with the scraps, (ii) the farmers obtain sufficient gas from one pig, and (iii) use of methane gas is free and the farmers experience a benefit in terms of cost.

3.4.4 Status of Operation and Maintenance

No problems have been observed in the status of O&M, as O&M has been carried out appropriately based on O&M rules of facilities and equipment under each sector.

The utilization rates of the facilities and equipment constructed/installed under the project have been high as most of them are basic essential infrastructures. The conditions of main facilities and equipment has been generally good, and they have been repaired promptly in case of any breakdown. The facilities and equipment that require the involvement of residents have been managed well with support from the governments when needed, and a clear demarcation among the governments and residents has been in place.

Personal computers purchased at education facilities and some of the equipment installed at medical institutions have become outdated; however, they continue to be used and will be replaced when needed. According to interviews, there have been no problems with the purchase and stocks of consumables as long as they are in production. As for education, there have been some adjustments in the use of the school buildings. For example, there is a case where some of the buildings have been converted to vocational training schools after the target schools constructed and moved their campus to other locations.

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

4. Conclusion, Lessons Learned and Recommendations

4.1.1 Conclusion

The project aimed to improve environment and hygiene, and to develop human resources in local farming villages and suburban cities in 12 national poverty-stricken counties in Guizhou Province by constructing or improving facilities for (i) environmental measures such as methane gas facilities, waste and disposal facilities, and reforestation; (ii) hygiene measures such as roads for daily use, water supply, and medical services; and (iii) senior high school buildings. The project has been consistent with China's development plans and development needs as well as with Japan's ODA policy. Therefore, the relevance of the project is high. Although the project cost was within the plan, the project period significantly exceeded it. Therefore, the efficiency of the project is low. The effectiveness/impact is high. Indicators set to measure quantitative effects such as culling of forests, flooded area, volume of soil erosion, percentage of population served water, number of patients, volume and percentage of waste disposed, and senior high school enrollment rate have largely achieved targets or improved. As to qualitative effects, improvements in the environment (including living environment) such as the decrease in the collection of firewood and charcoal, improvement of medical services, improvement of hygiene as well as effects of education have been observed. As for impacts, a decrease in the population of rural poverty, regional economic development, sustainable environmental and social development, and a reduction in the women's household workload have been observed. The sustainability is high, as no major problems have been observed in the institutional, technical, and financial aspects of the operation and maintenance systems, as well as in the status of operation and maintenance.

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

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

None

4.2.2 Recommendations to JICA

None

4.3 Lessons Learned

Importance of setting an appropriate implementation structure for a poverty alleviation project that consists of numerous multi-sector subprojects in various sites

In response to the feature of this poverty alleviation project that consists of numerous multi-sector subprojects in various sites, measures such as setting up an implementing

mechanism through SAPI and providing training to government officials have been conducted, which were effective for the implementation of the project to some extent. On the other hand, the project was not necessarily implemented efficiently, as stakeholders did not have experience of implementing projects supported by development partners, and therefore, a full understanding of the procedure of the Japanese ODA loan project was not obtained. In addition, an agreement to hire a consultant was not reached. As a result, there were problems such as delays in selection of a tender/procurement management company, in opening of bank accounts necessary for procurement, and in the disbursement procedure of the ODA loan, which affected the efficient implementation of the project (delay in the project period).

As implementation of a poverty alleviation project that consists of multi-sectoral small subprojects in various locations is very complicated, and in many cases, stakeholders have some problems in implementing capacity, it is important to pay attention to the implementation structure. Capacity development and setting up of an institutional structure by utilizing SAPI and training are effective. In addition, providing frequent guidance and prompt responses when a problem occurs are essential during the project implementation. According to the executing agency, communication with JICA has been smooth, as JICA provides the executing agency frequent advice and guidance. However, the communication has been mainly on an ad hoc basis and through e-mail and verbal communication, instead of being continuous and regular. Conducting regular operation monitoring and guidance and confirming the content of the guidance using minutes would have led to more prompt identification and solution of problems with issues such as delays in procedures as mentioned above. Therefore, at the implementation stage, it is necessary to fully examine whether it is effective to allocate a consultant with an additional budget, to conduct operation monitoring and guidance, as well as setting up a necessary institutional structure for operation monitoring and guidance.

END

Comparison of the Original and Actual Scope of the Project

Item	Plan	Actual
1. Project Outputs (1) Activities to improve hygiene and the environment in local farming villages		
a. methane gas facility	58,664 sites (Portion from 11 of 12 counties: 53,704 sites)	50,369 sites (Portion from 11 of 12 counties)
b. flood controls	41 sites	23 sites
c. reforestation	46,000 ha (Portion from 11 of 12 counties: 42,047ha)	38,736ha (Portion from 11 of 12 counties)
d. roads for daily use	Total extension 3,547km (Portion from 11 of 12 counties: 3,212km)	Total extension 2,952km (Portion from 11 of 12 counties)
e. drinking water facilities	86 sites (Portion from 11 of 12 counties: 70 sites)	73 sites (Portion from 11 of 12 counties)
(2) Activities to improve hygiene and the environment in suburban cities		
a. water supply facility	24 sites	16 sites
b. medical facility	27 sites	12 sites
c. waste treatment and disposal facility	3 sites	2 sites
(3) Education	47 sites	31 sites
(4) Training	Domestic training: 420,800 persons Overseas training: 48 persons	Domestic training: 376,204 persons Overseas training : 19 persons
2. Project Period	June 2006–May 2011 (60 months)	June 2006–December 2015 (115 months)
3. Project Cost Amount Paid in Foreign Currency Amount Paid in Local Currency Total ODA Loan Portion Exchange Rate	 426 million yen 12,790 million yen (933 million yuan) 13,216 million yen 9,173 million yen 1 yuan=13.7 yen (As of September 2005)	 9,149 million yen 1,160 million yen (77 million yuan) 10,309 million yen 9,149 million yen 1 yuan =14.9 yen (Averages between June 2006 to December 2015)
4. Final Disbursement	December 2015	

People's Republic of China

FY 2017 Ex-Post Evaluation of Japanese ODA Loan Project

"Xinjiang Environmental Improvement Project (I) (II)"

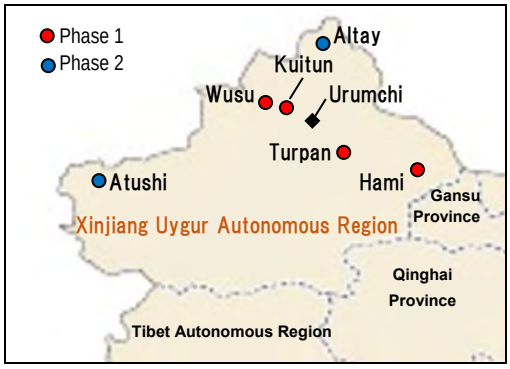
External Evaluator: Hiromi Suzuki S., IC Net Limited

0. Summary

This project was conducted with the aim to improve sewage treatment and water supply capacity and reduce water and air pollutants in a total of six cities, namely Hami, Turpan, Wusu, and Kuitun (Phase 1), and Altay and Atushi (Phase 2) in the Xinjiang Uygur Autonomous Region (hereinafter referred to as "XUAR"), China, by developing sewage, water supply, centralized heat supply, and city gas (Altay City only) facilities, thereby contributing to the improvement of the environment and living standards of residents in the six cities. This project was fully consistent with the development and environmental protection plans and development needs of China and XUAR at the time of the appraisal and the ex-post evaluation as well as Japan's ODA policy toward China at the time of the appraisal, therefore the relevance of the project is high. The outputs of the project were partially reduced in Phase 1 but were as initially planned in Phase 2. In both phases, the total project cost remained within the initially planned range, but the project period exceeded the initial plan. Thus, the efficiency of the project is fair. The outcome expected as the project's effect was to improve sewage treatment and water supply capacity and reduce water and air pollutants, and its impact was to contribute to the improvement of the environment and living standards of residents in the six cities. In both phases, with regard to outcome, the project achieved major indicators' targets set for each sector at the time of the appraisal; therefore, the effectiveness of the project is high. Regarding impact, it was confirmed through interviews with groups of beneficiaries that in the project area of each city, water service /sewage, centralized heat supply, and city gas facilities had been developed and that this contributed to improvement of the environment and the living standards of residents. Land acquisition was carried out appropriately, and no resettlement of residents occurred. During the construction work and at the time of the ex-post evaluation, impacts on the natural environment were monitored appropriately with environmental measures taken properly, and no negative impact was confirmed. As described above, the effects of the project manifested themselves as planned, and the effectiveness and impacts of the project are high. The current statuses of the institutional, technical, and financial aspects at the 15 units that were responsible for the operation and maintenance management of the project implementation are generally favorable, and the sustainability of effects brought by the project is high.

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

1. Project Description



Project Location

Kuitun Sewage Treatment Plant
(activated sludge tank)

1.1 Background[1]

In China, the sewage treatment rate in urban areas in 2006 was low at 56%. In the country's rural areas, sewage facilities were underdeveloped, making water contamination in rivers and freshwater lakes increasingly serious. With regard to water service, there were factors for local water shortages such as the concentration of water sources mainly in the southwestern part. In addition, many of the cities had problems such as water intake and supply from water sources, the quality of whose water was poor, and water leaks from the network of water pipes. Regarding the atmospheric environment, about 70% of its energy consumption derived from coal, and acid rain, dust, and other nuisances due to emissions of sulfur oxides that had serious effects on the health of residents and ecosystems. To address this situation, the Chinese government announced in its national development plan that it would work to take measures such as preventing water pollution, giving priority to protecting sources of drinking water for urban residents, and mitigating air pollution. Located along the national border in western China, the Xinjiang Uygur Autonomous Region, covered by the project, was one of the priority areas under the western development plan. In particular, the six project cities (Hami, Turpan, Wusu, Kuitun, Altay, and Atushi) occupied an important place for the development of XUAR. However, while water service and energy demand grew because of urbanization and population increase, the improvement of water service /sewage and centralized heat supply facilities were insufficient, coping with environmental problems such as water contamination and air pollution was becoming an urgent issue to address. Taking these circumstances into consideration, the Autonomous Region's government requested Japanese ODA loans to improve water quality and the air environment. In FY 2006, such a request was made for all the six cities so that the project was carried out in Phases I and II, and it was decided that Phase 1 covered four of them (Hami, Turpan, Wusu, and Kuitun) in FY 2006 and that Phase 2 covered the remaining two (Altay and

[1] This section is based on materials provided by JICA and the ex-ante evaluation table.

Atushi) in FY 2007.

1.2 Project Outline

The objective of this project is to improve sewage treatment / water supply capacities and reduce water and air pollutants in six cities--Hami, Turpan, Wusu, and Kuitun (Phase 1), Altay and Atushi (Phase 2) in XUAR, by developing sewage, water supply, centralized heat supply, and city gas facilities, thereby contributing to the improvement of the environment and living standards of residents in the six cities.

Loan Approved Amount / Disbursed Amount	Phase 1: 12,998 million yen / 12,853 million yen Phase 2: 3,802 million yen / 3,596 million yen	
Exchange of Notes Date / Loan Agreement Signing Date	Phase 1: March 2007 / March 2007 Phase 2: December 2007 / December 2007	
Terms and Conditions	Interest rate	Phase 1: 1.5% (water service) and 0.75% (sewage, heat supply, and training) Phase 2: 1.4% (water supply) and 0.65% (sewage, heat supply, city gas supply, and training)
	Repayment Period (Grace Period)	Phase 1: 30 years (water supply) and 40 years (sewage, heat supply, and training) (Ten years for all sectors) Phase 2: 25 years (water supply) and 40 years (sewage, heat supply, city gas supply, and training) (Seven years (water supply) and ten years (sewage, heat supply, city gas supply, and training))
	Conditions for Procurement	General Untied
Borrower / Executing Agency (ies)	People's Republic of China / People's Government of XUAR	
Project Completion	June 2015	
Main Contractor (s) (Over 1 billion yen)	Hubei International Trade Investment & Development Co., Ltd. (People's Republic of China)	
Main Consultant (s)	-	

(Over 100 million yen)	
Related Studies (Feasibility Studies, etc.)	[Phase 1] Hami City: Xinjiang Urban Planning and Design Research Institute Co., Ltd., January 2007; Turpan City: Xinjiang Design & Research Co., Ltd., January 2007; Wusu City: China Northeast Municipal Engineering Design & Research Institute, December 2006; and Kuitun City: China Northeast Municipal Engineering Design & Research Institute, January 2007 [Phase 2] Altay City: Xinjiang Urban Planning and Design Research Institute Co., Ltd., March 2007; and Atushi City, Xinjiang Urban Planning and Design Research Institute Co., Ltd., March 2007
Related Projects	Projects by other organizations: Asian Development Bank "Xinjiang Region Infrastructure and Environmental Improvement Project" (2006-2008)

2. Outline of the Evaluation Study

2.1 External Evaluator

Hiromi Suzuki S., IC Net Limited

2.2 Duration of the Evaluation Study

This ex-post evaluation was conducted with the following schedule.

Duration of the Study: August 2017-November 2018

Duration of the Field Studies: November 29-December 22, 2017 and June 18-27, 2018

2.3 Constraints during the Evaluation Study

During this ex-post evaluation, the evaluator was notified just before the second field study that, because of new regulations by XUAR's government to strengthen safety measures, it was essential for foreign visitors to XUAR to obtain permission from the Region's committee of the Communist Party when traveling there. The evaluator filed an application, but permission was not granted. These sudden regulations were unavoidable for safety management, but the range of information that was planned to obtain during the second field study had to be narrowed down to a necessary minimum for the ex-post evaluation and gathered remotely. Because of these constraints, regarding effectiveness for example, when the evaluation policy was formulated, it was planned to gather not only collecting information on major indicators but also information on auxiliary indicators that supported the effects of the project. However, it was limited to only information on major indicators, and as a result, analyzing indicators could not be performed in detail initially planned. In addition, one situation peculiar to the Autonomous

Region was that all public officials were required to engage in work related to countermeasures against poverty in rural areas over a long period of time; during the field study, lack of personnel at the executing agency and the frequent changes of personnel in charge at project implementation units made it difficult and inefficient to obtain accurate information about the period of project implementation and the moment of the ex-post evaluation. Furthermore, project progress reports were not compiled as required by Japanese ODA loan projects. Project completion reports were submitted only by some of the cities. In most of the cities, personnel involved in this project were not available at the time of the ex-post evaluation. These and other circumstances prevented the collection of information on the period during which the project was carried out.

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

3.1 Relevance (Rating: ③[3])

3.1.1 Consistency with the Development Plan of China[4]

A) Development Plans[5]

The national development plan at the time of the appraisal was the *Eleventh Five-Year Plan* (2006-2010). This Plan considered it as its priority areas to step up environmental protection and protect and repair natural ecosystems. It set five major goals that should be achieved by 2010, and this project was especially relevant to "improving the environment in regions and cities designated as priority environmental protection areas". The *Xinjiang Uygur Autonomous Region Eleventh Five-Year Construction Project Development Plan* (2006-2010), which XUAR's government worked out following the five-year national plan, announced a goal for each sector (achieving a sewage treatment rate of 65% and a water service penetration rate of 96% and increasing the heat supply service area by 60 million m^2 through centralized heat supply) that should be attained in urban areas by 2010 by promoting infrastructure development for water supply /sewage and the air environment. The national development plan at the time of the ex-post evaluation was the *13th Five-Year Plan* (2016-2020). In particular, the project was in accordance with one of the Plan's major goals, namely the overall

2 A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory

3 ③: High, ②: Fair, ①: Low

4 At the time of the appraisal, results were based on appraisal materials and the ex-ante evaluation. At the time of the ex-post evaluation, they were based on the *13th Five-Year Plan* (2016–2020).

5 For Altay and Atushi Cities in Phase 1I, in addition to the national development plan and the autonomous region development plan, the consistency between the project and the cities' development plan was also confirmed at the time of the appraisal. Therefore, at the time of the ex-post evaluation, too, the two cities' development plan was confirmed. The two cities' development plan at the time of the appraisal was the *Eleventh Five-Year Plan* (2006-2010) and that at the time of the ex-post evaluation was the *13th Five-Year Plan* (2016-2010). In each development plan, the city government announced that it would work to increase the water supply and sewage penetration rate, the sewage treatment rate, and the area of centralized heat supply as well as reduce emissions of pollutants by stepping up infrastructure development in the water supply/sewage, energy supply, and air environment sectors and set specific targets. The consistency between the two cities' development plan and the project at the time of the appraisal and the ex-post evaluation was high.

improvement of the quality of the ecological environment. In this goal, the government set specific numerical targets that should be achieved by 2020 for the quality of the air and surface water as well as emissions of major pollutants. The *Xinjiang Uygur Autonomous Region Eleventh Five-Year Construction Project Development Plan* (2011-2020), which XUAR's government formulated following the five-year national plan, established a goal that should be achieved for each sector in urban areas by 2020 (achieving a sewage treatment rate of 90% and a water supply penetration rate of 100% and stepping up construction and expansion of city gas and heating equipment). As described above, the consistency between the project and the national and regional development plans both at the time of the appraisal and the ex-post evaluation was high.

B) Environmental Protection Plans

The environmental protection plan at the time of the appraisal was the *Xinjiang Uygur Autonomous Region Eleventh Five-Year Environmental Protection Plan* (2006–2010), which indicated specific goals for environmental protection. The government aimed at reducing the amount of high chemical oxygen demand (COD) sewage discharged in the Autonomous Region in 2010 to 271,000 tons. With regard to water supply, it aimed at raising the National Category III Standard[6] achievement rate for the sources of drinking water in urban areas to 90% in 2010. Regarding the air, it aimed at improving the air environment by maintaining the quantitative and qualitative levels set by the National Air Environmental Standards[7] and promoting wider use of renewable energy such as shifting fuel to centralized heat supply and natural gas in urban areas. The environmental protection plan at the time of the ex-post evaluation was the *Xinjiang Uygur Autonomous Region 13th Five-Year Environmental Protection Plan* (2016-2020). With regard to sewage, this Plan aimed at achieving a sewage treatment rate of 90% and a treated water reuse rate of 30% in urban areas by renewing and expanding existing sewage treatment stations, drainpipes, and other facilities. As for water service, it aimed at a National Standards Category III achievement rate of 91% for the water sources of drinking water in urban areas. The specific goals for the air environment include

[6] Category I of the *Surface Water Environmental Quality Standards* (promulgated by the State Environmental Protection Administration on April 28, 2002) mainly covered water at water sources and national nature reserves; Category II first-class surface water source conservation areas for centralized domestic drinking water, habitats for rare aquatic life, spawning grounds for fish and crustaceans, feeding grounds for fries, etc.; Category III second-class surface water source conservation areas for centralized domestic drinking water, wintering places for fish and crustaceans, migration routes, fishing waters such as nurseries of marine products, and bathing places; Category IV general industrial waters and amusement waters where the human body does not directly touch water; and Category V agricultural waters and general landscape waters.

[7] The *National Air Environmental Standards* revised in 2012 (GB3095-2012), which applied at the time of the ex-post evaluation, were stricter than the standards applicable at the time of the appraisal (GB3095-1996) with regard to NO_2 emissions. In addition, instead of TSP, the revised standards required monitoring of PM2.5, fine inhalable particles with diameters that are generally 2.5 micrometers or less, and PM10, ones with diameters that are generally ten micrometers or less.

lowering the concentration of particulate matter (PM 2.5 and PM 10; refer to Footnote 7) in urban areas by 15% on a cumulative basis. As described above, the consistency between the project and the environmental protection plans at the time of the appraisal and ex-post evaluation was high.

Based on the forgoing, at the time of the appraisal and ex-post evaluation, this project agreed with the goals in the development plans and environmental protection plans of China and XUAR.

3.1.2 Consistency with the Development Needs of China[8]

At the time of the appraisal, because of remarkable population increase and rapid progress in industrialization and urbanization, the six cities in XUAR saw water supply and energy demand grow rapidly and environmental problems, including the contamination of water sources such as surface and underground water and air pollution, become increasingly serious, and developing water supply and sewage treatment infrastructure as well as centralized heat supply and city gas supply facilities was an urgent issue to address. At the time of the ex-post evaluation, the six cities covered by the project were expected to see further population growth, industrialization, and urbanization though the rate of growth therein was slowing down. In addition, as the national environmental standards became stricter, it was necessary to continue to work on infrastructure development to minimize environmental impacts. Development needs in each sector are as follows:

- Sewage: The area covered by the project had only a small amount of rain and a small number of rivers, and at the time of the appraisal, treated water was released directly to deserts, causing environmental pollution. The sewage penetration rate for the six cities was 75% for Hami (urban districts only), 70% for Wusu, 60% for Kuitun, and 75% for Altay (no information for Turpan and Atushi), and the amount of sewage was expected to grow because of population increase, making sewage infrastructure development an urgent issue to address. At the time of the ex-post evaluation, partly because of the project's contribution, the sewage penetration rate improved, at 100% for Hami (urban districts only), 90% for Turpan, 92% for Wusu, 90% for Kuitun, 90% for Altay, 98% for Atushi. Hami and Turpan, where the project helped build sewage treatment facilities, achieved Class 2 of the National

[8] At the time of the appraisal, development needs were based on materials provided by JICA, and at the time of the ex-post evaluation, they were based on materials provided by the executing agency.

Sewage Treatment and Discharge Standards[9] and Kuitun, Altay, and Atushi attained Class 1 B. On the other hand, owing to urban development and population increase, the amount of sewage is expected to grow in the future, and it is necessary to increase the treatment rate and the penetration rate. Therefore, development needs continue to be high.

- Water service: At the time of the appraisal, the water service penetration rate was 73% for Hami, 80% for Turpan, 72% for Wusu, 67% for Kuitun, 85% for Altay, and 0% for Atushi (only the western urban area where distribution pipes were not installed), all lower than the average water service penetration rate of 87% in China's urban areas. It was predicted that the water supply capacity of the existing water purification plants was unable to meet the growing water demand as the population increased and expanding the water purification plants and improving water pipe networks were urgent issues to address. At the time of the ex-post evaluation, partly because of this project's contribution, all cities achieved a penetration rate of 100% except Turpan whose rate was 98%. The quality of groundwater improved from Class 5 at the time of the appraisal to Class 2. But population growth and urbanization are expected to continue to progress in the future, and if this is taken into consideration, there will continue to be needs for equipment renewal and expansion to maintain the water service penetration rate at 100% in the future.
- Air: At the time of the appraisal, residents used less energy-efficient small coal-burning boilers without a dust collector and a desulfurization system for winter heating. With regard to the concentration of sulfur dioxide (SO_2), nitrogen dioxide (NO_2), and total suspended particles (TSP) in the air, the six cities failed to meet the national Class 2 standard, which should be satisfied in residential areas mainly during winter. In addition, Altay City had a city gas penetration rate of 56%, much lower than the average rate of 89% for cities in XUAR, and coal used in the civilian sector was also a source of air pollution, making it an urgent issue to address to develop centralized heat supply and city gas facilities. By the time of the ex-post evaluation, because of the progress made in developing centralized heat supply facilities, the number of small coal-burning boilers had decreased substantially, and the six cities met the national standard with regard to the average annual amount of SO_2, NO_2, and other major air pollutants emitted. But in 2016, the monitoring of PM10 instead of

[9] In the *Discharge Standard of Pollutants for Municipal Wastewater Treatment Plants* (GB18918-2002), the basic principle of Class 1 Standard A is to turn treated water into water to be reused. This applies when treated water is used for urban landscape water and general reuse water by letting it into rivers and lakes whose dilution ability is low. Class 1 Standard B applies when treated water is allowed to flow into surface water Category III functional waters, etc. Class 2 Standard applies when treated water is allowed to flow into surface water Category IV and V functional waters. Class 3 Standard applies if, in areas other than priority management valleys and water source reserves, sewage is treated based on local economic conditions and water pollution control requirements. Class 1 Standard A is applicable if water treated at urban sewage treatment stations is discharged to closed or half-closed waters such as priority valleys, lakes, and dams designated by the state and provinces. In the case of GB3838 surface water Category III functional waters (water source reserves for drinking water and swimming areas) and GB3097 seawater Category II functional waters, Class 1 Standard B is applicable (Source: The Sino-Japan Friendship Centre for Environmental Protection).

TSP became mandatory, and Turpan and Kuitun Cities failed to meet the national standard for the fine inhalable particles. The number of small coal-burning boilers used was not reduced to zero, and there continued to be high development needs for environmental improvement.

As explained above, development needs related to water service, sewage, and the air were high both at the time of the appraisal and the ex-post evaluation.

3.1.3 Consistency with Japan's ODA Policy

Japan's ODA policy toward China at the time of the appraisal was *the Economic Cooperation Plan for China* (2001–2006) as well as *the Implementation Policy for Overseas Economic Cooperation Operations* (2005-2007) and *the FY 2006 Implementation Policy for Operations by Country* of the Japan International Cooperation Agency (JICA) (former Japan Bank for International Cooperation or JBIC). In t*he Economic Cooperation Plan for China* (2001-2006)[10], the goal of Japanese ODA for China was to place emphasis on the protection of the environment and ecosystems whose pollution and destruction had become serious, as well as the improvement of people's livelihood and social development in inland regions, and six priority areas were listed. Particularly, with regard to "cooperation towards coping with global issues such as environmental problems", the Plan clearly stated that Japan would support China's efforts to introduce new types of renewable energy and energy conservation, which is consistent with the project. *The Implementation Policy for Overseas Economic Cooperation Operations* (2005-2007) stated that JICA would help cope effectively with environmental problems and improve the lives of people in developing countries and that it would also contribute actively to solution of problems such as global warming, and this indicated that the Policy was consistent with the project. *The FY 2006 Implementation Policy for Operations by Country*[11] emphasized environmental protection. This is aiming at improving the overall water use efficiency in water service and sewage treatment, including infrastructure development and human resource development. In terms of the air environment, the Policy aimed at developing centralized heat supply facilities, implementing a natural gas project, introducing the monitoring of the air environment, and stepping up support in the intangible aspects of these undertakings, and all these were highly consistent with the project.

3.1.4 Appropriateness of the Project Plan and Approach

In this project, with the revision of the national sewage discharge standards in 2016, all sewage treatment plans in urban areas were newly required to meet the National Standard

[10] Ministry of Foreign Affairs' *Economic Cooperation Plan for China* (2001-2006)
[11] This is based on materials provided by JICA.

Class 1 A[12]. In Turpan City, mainly because of an unexpected increase in industrial wastewater, it became difficult to meet the national water quality standard using the technology provided by the project, and the treatment plant built under the project discontinued its operation in March 2017. During the on-site inspection at the time of the ex-post evaluation, the evaluator found that the treatment plant was not in operation and that the construction of a new treatment plant capable of achieving to meet the National Standard Class 1 A using the anaerobic-oxic (AO) process[13] was under way. The sewage treatment plant built under the project, which used the lagoon treatment method[14], comprised three oxidation ponds where the oxidation process was performed and one sedimentation basin, and it can be said that appropriate technology was selected to meet the nature of sewage expected at the time of the appraisal. Although the treatment plant installed by the project, including aeration equipment etc., were not in operation at the moment of the ex-post evaluation, these will be used in the new treatment plant. Especially the oxidation pond built under the project will be used as a sedimentation basin for the new treatment plant, and it is planned that treated water will be reused for irrigation through natural filtration in this sedimentation basin. Therefore, this does not lower the evaluation of the project.

As described above, both at the time of the appraisal and the ex-post evaluation, the project was relevant to China's national development plan as well as XUAR's construction project development plan and environmental protection plan, which aimed at developing infrastructure for the livelihood of people to improve the overall quality of water service, sewage, centralized heat supply, and city gas service, as well as the natural environment, including water and the air. In addition, it also fully relevant to the development needs of China and XUAR at the time of the appraisal and the ex-post evaluation and Japan's ODA policy toward China at the time of the appraisal. Therefore, its relevance is high.

3.2 Efficiency (Rating:②)

3.2.1 Project Outputs

This project involved construction of sewage, water supply, centralized heat supply, and city

[12] This National Standard required all sewage treatment plants in urban areas to uniformly meet the Class 1 A requirements, but since May 2018, they have been allowed to meet only the Class 1 B requirements according to the nature of sewage in the city concerned.

[13] The anaerobic-oxic process refers to a high-level treatment method aimed mainly at removing phosphorus, and the reactor consists of two tanks: an anaerobic one and an aerobic one. The former has a churning machine to mix activated sludge (Source: Yokohama City Environmental Planning Bureau's website: http://www.city.yokohama.lg.jp/kankyo/).

[14] In the lagoon treatment method, sewage and wastewater are retained for five to 30 days in a pond called the "oxidation pond" where they are treated through self-purification using algae, bacteria, etc. It incurs less treatment and maintenance costs than the AO process but requires a huge site area and causes problems such as the generation of offensive smells because water is retained for a long period of time (Source: National Institute for Land and Infrastructure Management)

gas supply facilities, repair of existing ones, and procurement of materials and equipment for them, as well as provision of training in the six cities of XUAR. In Phase 1, facilities were built and equipment was procured for four cities (Hami, Turpan, Wusu, and Kuitun) as a separate project using domestic funds, and for this and other reasons, the project outputs were mainly reduced. In Phase 2, the project was carried out for Altay and Atushi Cities as planned (Table 1).

Table1 Output: Development of facilities and procurement of equipment

City /Sector	At the moment of appraisal		Actual	Existence of difference (±10%) and reason
	Content	Quantity		
Hami City				
Sewage	Construction and repair of drainage pipe system	74.8km	49.8km	Pipe diameter was expanded, and length was shortened*
Water supply	Construction of water conveyance system	26.5km	31.4km	No changes to the conveyance system from the water source to the water plant. From the plant to the water supply pipe network, length was increased from 9.7km to 14.3km in line with the actual situation
	Construction of new water treatment plant	50,000m^3/day	As planned	—
	Construction of supply pipe system and repair of existing one	94.3km	99km	Total length was increased in line with the actual situation
Central heating supply	Construction of heating supply plant	3×29MW	As planned	—
	Construction of new heating power supply pipe network	56.4km	21.3km	The project constructed only the primary pipe network
	Construction of heat exchange stations	31 places	As planned	—
Turpan City				
Sewage	Construction and repair of drainage pipe system	50.4km	40.4km	Pipe diameter was expanded, and length was shortened*
	Construction of new sewage treatment plant	20,000m^3/day	As planned	—
	Repair of existing sewage treatment plant	No detailed information	No detailed information	No detailed information was provided
Water supply	Construction of water conveyance system	51.7km	46.9km	
	Construction of supply pipe system and repair of existing one	77.7km	69.8km	Pipe diameter was expanded, and length was shortened*
Central heating supply	Construction of heating supply plant	3×46MW	As planned	—
	Construction of new heating power supply pipe network	26.0km	22.63km	Quantity was adjusted as demand was slightly lower than expected
	Construction of heat exchange stations	25 places	21 places	
Wusu City				
Sewage	Construction and repair of drainage pipe system	71.3km	71.6km	—
Water supply	Construction of supply pipe system and repair of existing one	73.9km	67.4km	Adjusted according to the existing situation at the moment of the detailed design
Kuitun City				
Sewage	Construction and repair of drainage pipe system	73.2km	50.1km	The difference was conducted as a separate project
	Construction of new sewage	60,000m^3/day	As planned	—

	treatment plant Expansion of existing sewage treatment plant	 The existing sewage plant with a capacity of 40,000m^3/day was expanded by adding an activated sludge tank	As planned	—
Water supply	Construction of supply pipe system and repair of existing one	81.0km	82.0km	—
Central heating supply	Construction of heating supply plant Construction of new heating power supply pipe network Construction of heat exchange stations	3×46MW 45.5km 30 places	2×72MW 47.4km 32 places	Increased but difference within ±10% Increased but difference within ±10% Increased but difference within ±10%
Altay City				
Sewage	Construction and repair of drainage pipe system Construction of new treatment pond	59.8km 4.86 million m^3	As planned As planned	— —
Water supply	Construction of new water intake facility Construction of water conveyance system Construction of new water treatment plant Construction of supply pipe system and repair of existing one	16,000m^3/day 19.8km 16,000m^3/day 20.0km	As planned As planned As planned As planned	— — — —
Central heating supply	Construction of heating supply plant Construction of new heating power supply pipe network Construction of heat exchange stations	4×14MW 14.2km 14 places	As planned As planned As planned	— — —
City gas supply	Construction of LNG gasification facility Construction of gas supply pipe network	3.6 million Nm^3/year 15km	As planned As planned	— —
Atushi City				
Sewage	Construction and repair of drainage pipe system Construction of new sewage treatment plant Expansion of existing sewage treatment plant	67.86km 3,500m^3/day 8,000m^3/day	As planned As planned As planned	— — —
Water supply	Construction of supply pipe system and repair of existing one	22.7km	As planned	—
Natural gas heating supply	Construction of heating supply plant Construction of new heating power supply pipe network Construction of medium pressure fuel gas supply network	28×1.4MW 25×2.8MW 8×4.2MW 41.6km 17.23km	As planned As planned As planned As planned As planned	— — — — —

Source: JICA provided documents for the time of appraisal. Actuals were provided by the executing agency.

*: According to the Executing Agency, the water supply and sewage pipes that were constructed with the project were primary pipes, even though the diameter was widened, and the length shortened, the planned and actual water distribution area (water supply) and swage collection area (sewage) did not differ significantly.

Training for the executing agency in water supply and sewage business, heat supply business, and city gas supply business was planned in Japan. In Phase 1, technical training in water supply, sewage, waste disposal, and heating supply was provided in Hokkaido and Tokyo from October 18 to 27, 2008, and a total of eleven people from four cities participated in the program. In Phase 2, training was not provided because the regulations for the departure of public officials from China became stricter.

3.2.2 Project Inputs

3.2.2.1 Project Cost

The planned total project cost at the time of the appraisal was 18,712 million yen (foreign currency: 14,144 million yen; domestic currency: 4,568 million yen; and the cost covered by ODA loan: 12,998 million yen). The actual total project cost was 15,408 million yen (foreign currency: 10,586 million yen; domestic currency: 4,822 million yen; and the cost covered by ODA loan: 10,586 million yen), 82% of the initially planned level, and this means that the cost remained within the initially planned range (Refer to Table 2). This was because for Turpan City, the actual cost exceeded the initial plan, at 127% of the initially planned level, but for the other three cities, the actual cost went below the initial plan because of reduced outputs.

Table 2 Project Cost: Phase 1

(Unit: million yen)

Item		Appraisal			Actual		
		Foreign Currency	Domestic Currency	Total	Foreign Currency	Domestic Currency	Total
Hami City	Total	3,992	839	4,831	1,964	849	2,813 (60% compared to plan)
	ODA loan portion	3,992	0	3,992	1,964	0	1,964
Turpan City	Total	3,151	616	3,767	3,301	1,477	4,778 (127% compared to plan)
	ODA loan portion	3,151	0	3,151	3,301	0	3,301
Wusu City	Total	921	153	1,074	858	176	1,034 (96% compared to plan)
	ODA loan portion	921	0	921	858	0	858
Kuitun City	Total	4,299	1,328	5,627	4,447	819	5,266 (94% compared to plan)
	ODA loan portion	4,299	0	4,299	4,447	0	4,447
Total 4 cities	Total	12,363	2,936	15,299	10,570	3,321	13,891 (91% compared to plan)

	Sewage	4,089	925	5,015	3,893	753	4,647
	Water Supply	4,137	778	4,934	3,123	1,225	4,347
	Centralized heat supply	3,571	1,073	4,644	2,959	1,184	4,894
	ODA loan portion	12,363	0	12,363	10,570	0	10,570
Training	Total	16	0	16	16	0	16
	ODA loan portion	16	0	16	16	0	16
Price escalation	Total	607	0	607	0	0	0
	ODA loan portion	607	0	607	0	0	0
Contingencies	Total	649	147	796	0	0	0
	ODA loan portion	13	0	13	0	0	0
Interest rate during construction	Total	508	109	617	0	832	832
	ODA loan portion	0	0	0	0	832	832
Land acquisition cost	Total	0	233	233	0	0	0
	ODA loan portion	0	0	0	0	0	0
Administration cost	Total	0	1,143	1,143	0	670	670
	ODA loan portion	0	0	0	0	670	670
Total Project Cost		14,144	4,568	18,712	10,586	4,822	15,408 (82% compared to plan)
ODA loan portion		12,998	0	12,998	10,586	0	10,586

Source: JICA provided documents for Appraisal. Executing agency and JICA provided documents for Actuals.
Note 1: Exchange rate at the moment of appraisal: 1 USD=117 yen, 1USD=7.93 yuan, 1 yuan=14.8 yen / price escalation rate: foreign currency 1.7%, domestic currency 0.0% / contingency: 5.0% /Period of cost calculation: December 2006. Exchange rate at the moment of the ex-post evaluation 1yuan=14.47yen (monthly average rates for March 2007 to June 2015).
Note 2: Due to rounding numbers do not necessarily add up to totals.

The planned total project cost for Phase 2 was 6,158 million yen (foreign currency: 4,043 million yen; domestic currency: 2,115 million yen; and the cost covered by ODA loan: 3,802 million yen). The actual total project cost was 5,355 million yen (foreign currency: 3,185 million yen; domestic currency: 2,170 million yen; and the cost covered by ODA loan: 3,596 million yen), remaining within the initial planned range, at 87% of the initially planned level (Table 3). One major reason was that particularly in Atushi City, which was in a tighter financial situation compared to other cities, conducted strict project cost control such as labor cost control, thus the actual cost went well below the initial planned level, at 63%.

Table 3 Project Cost: Phase 2

(Unit: million yen)

Item		Appraisal			Actual		
		Foreign Currency	Domestic Currency	Foreign Currency	Domestic Currency	Foreign Currency	Domestic Currency
Altay City	Total	2,002	827	2,829	2,335	1,737	4,072 (150% compared to plan)
	ODA loan portion	2,002	0	2,002	2,335	0	2,335
Atushi City	Total	1,559	464	2,023	839	433	1,272 (63% compared to plan)
	ODA loan portion	1,559	0	1,559	839	0	839
Total 2 cities	Total	3,561	1,291	4,852	3,174	2,170	5,344 (110% compared to plan)
	Sewage	No detailed information available			1,566	924	2,490
	Water Supply				514	351	865
	Centralized heat supply				853	518	1,371
	City gas				241	377	618
	ODA loan portion	3,561	0	3,561	3,174	0	3,174
Training	Total	4	0	4	0	0	0
	ODA loan portion	4	0	4	0	0	0
Price escalation	Total	214	0	214	0	0	0
	ODA loan portion	214	0	214	0	0	0
Contingencies	Total	177	65	242	0	0	0
	ODA loan portion	11	0	11	0	0	0
Interest rate during construction	Total	75	0	75	0	0	0
	ODA loan portion	0	0	0	0	0	0
Commitment Charge	Total	12	0	12	11	0	11
	ODA loan portion	12	0	12	11	0	11
Land acquisition cost	Total	0	232	232	0	0	0
	ODA loan portion	0	0	0	0	0	0
Administration cost	Total	0	527	527	0	0	0
	ODA loan portion	0	0	0	0	0	0
Total Project Cost		4,043	2,115	6,158	3,185	2,170	5,355 (87% compared to plan)
ODA loan portion		3,802	0	3,802	3,185	411	3,596

Source: JICA provided documents for Appraisal. Executing Agency provided documents for Actuals.

Note 1: Exchange rate at the moment of appraisal: 1USD=121yen, 1USD=7.74 yuan, 1yuan=15.6 yen /price escalation rate: foreign currency 2.4%, domestic currency 0.0% / contingency cost rate: 5.0% / Cost calculation period: June 2007. Exchange rate at the moment of the ex-post evaluation 1yuan=13.59 yen (monthly average rates for December 2007 to September 2013).
Note 2: Due to rounding numbers do not necessarily add up to totals

As described above, the project cost for Phase 1 remained within the initially planned range, at 82% of the initially planned level, and this corresponded with the decrease in project outputs. Phase 2 saw no change in project outputs, but mainly because of project cost control by Atushi City, the cost remained at 86% of the initially planned level.

3.2.2.2 Project Period[15]

At the time of the appraisal, the planned project period for Phase 1 was 68 months (five years and eight months) from May 2007 to December 2012. The actual project period was 98 months (eight years and two months) from March 2007 to June 2015. If the sewage development in Kuitun City is excluded, the project period remained within the initially planned range. However, because Kuitun's sewage development took about two years and six months longer than initially planned, the project period for Phase 1 exceeded the initial plan, at 144% of the initially planned level.

At the time of the appraisal, the planned project period for Phase 2 was 66 months (five years and six months) from January 2008 to June 2013. The actual project period was 70 months (five years and ten months) from December 2007, when the loan agreement was signed, to September 2013. Because the development of centralized heat supply facilities in Altay City took three months longer than initially planned, the actual project period for Phase 2 exceeded the initial plan, at 106% of the initially planned level.

As explained above, in Phase 1, the project remained within the initial plan except the sewage development project in Kuitun City, and this corresponded with the decrease in project outputs. But since the project period exceeded the initial plan despite decreased outputs from sewage development in Kuitun, the overall project period for Phase 1 exceeded the initial plan. In Phase 2, the project outputs were as planned, but the actual project period slightly exceeded the initial plan.

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

In this project, at the time of the appraisal, Financial Internal Rates of Return (FIRR) were calculated by city and by project, and they were recalculated at the time of the ex-post evaluation. The results of calculations for projects on which information could be collected are as described below.[16] In Phase 1, a recalculation of FIRR for the centralized heat supply

[15] The completion of the project was defined as the expiration of the guarantee period.
[16] The assumptions for calculations of FIRR at the time of the appraisal were as described below. Costs consisted of

project in Hami at the time of the ex-post evaluation indicated that it was minus 0.02% while it was 6% at the time of the appraisal. This was attributed to the slowdown of revenue growth because the project cost was kept lower than at the time of the appraisal since the executing agency could not expect fare revisions. For Turpan, FIRR for the centralized heat supply project was recalculated. The project cost was larger than at the time of the appraisal, but while FIRR was 9.6% at the time of the appraisal, it was more favorable at the time of the ex-post evaluation, at 17% because more revenue was anticipated owing to growth in the number of users. Similarly, while FIRR for the centralized heat supply project in Kuitun was 6.3% at the time of the appraisal, it was 19% at the time of the ex-post evaluation. On the other hand, FIRR for the sewage project was 4.7% at the time of the appraisal but was minus 8% at the time of the ex-post evaluation because there was no plan for fare revisions, meaning that revenue would remain sluggish. For Phase 2, FIRR for Altay's centralized heat supply and city gas projects and that for Atushi's sewage project were recalculated. While FIRR for Altay's centralized heat supply project was 6.2% at the time of the appraisal, it was minus 2% at the time of the ex-post evaluation. The reason was that as the growth in maintenance management costs exceeded the growth in fare revenue, initial investments would not be recovered unless the fares were revised. Regarding city gas, while FIRR was 4.4% at the time of the appraisal, it was favorable at the time of the ex-post evaluation, at 19%, because revenue was expected to grow as the number of users increased in the future. FIRR for Atushi's sewage project was 10.4% at the time of the appraisal, but it was minus 9% at the time of the ex-post evaluation because the executing agency could not expect fare revisions for more revenue, and in addition, because additional investments were planned to upgrade the treatment plant in 2019.

The project outputs for Phase 1 were reduced mainly because, by the time of detailed design, demand had not increased more than projected at the time of the appraisal. In addition, since in some projects it took more time to follow fund-raising procedures based on ODA loans than

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project costs and operation/maintenance management costs, and benefits comprised fee revenue, and the project life was 20 years. At the time of the ex-post evaluation, the evaluator attempted to use the same assumptions, but available information was not that which focused on the project, but which was collected for the executing agency as a unit (same as one that was obtained from its financial statements). In the first place, there was no information on the project's revenue, nor was there any information on renewal costs. For these and other reasons, it was difficult to recalculate FIRR at the time of the ex-post evaluation, and the project's FIRR at the time of the appraisal was 4.4% for sewage and 6.0% for water supply in Hami; 10.3% for sewage and 7.5% for water supply in Turpan; 4.5% for sewage and 6.2% for water supply in Wusu; 6.3% for sewage in Kuitun; 4.5% for sewage in Altay; and 9.4% for water supply and 8.9% for centralized heat supply in Atushi. In Turpan, the sewage treatment plant built under the project discontinued operation in 2017, and in addition, since it will be used as a final reservoir for a new purification plant in the future, FIRR was not recalculated for the city's sewage project at the time of the ex-post evaluation. For Wusu, FIRR was not calculated at the time of the ex-post evaluation because information was not provided. For Atushi's centralized heat supply project, the evaluator tried to recalculate FIRR using information that she obtained from the executing agency, but as a result, she found FIRR incalculable. The maintenance management costs obtained were extremely high, suggesting that they might include maintenance management costs for projects other than the present one. Therefore, the result was probably that if the maintenance management cost obtained applied, it would be extremely difficult to recover initial investments in 20 years.

when funds were domestically procured, some facilities were built under separate projects using domestic funds, and this led to reduced project outputs. Moreover, the project cost was strictly controlled in Phase 2 as described under "3.2.2.1 Project Cost", enabling the project cost to remain within the initially planned range in both phases. In the two phases, the project period exceeded the initial plan : in Phase 1, the sewage project in Kuitun was prolonged, and in Phase 2, the centralized heat supply development project in Altay was slightly delayed.

As described above, although the project cost remains within the plan, its period exceeded the plan. Therefore, efficiency of the project is fair.

3.3 Effectiveness and Impacts[17] (Rating:③)

3.3.1 Effectiveness

3.3.1.1 Quantitative Effects (Operation and Effect Indicators)

The outcome of this project is "to improve sewage treatment /water supply capacity and reduce water and air pollutants." In regard to targets of the major indicators for water and sewer service, centralized heat supply and city gas (Phase 2 only), a total of four cities was set in Phase 1 and a total of two cities was set in Phase 2. In addition, the target year for both phases was set at the time of the project completion. Evaluation was carried out in the ex-post evaluation based on the definition at the time of the appraisal.[18]

A) Sewage Works (Table 4)

During Phase 1, among five major indicators, (1) sewage treatment population, (2) sewage treatment amount and (3) sewage treatment rate in 2012, which was the time of project completion, achieved more than 80% of the target, and actual from 2015 to 2017 tended to increase every year. However, as (2) sewage treatment amount achieved 86% of the target at the time of the project completion, the target reached 88% as of 2017, and has not reached 100%. That is because Hami City is the only city that achieved a low rate, 54%. In Hami City, the number of residents on industrial estates that was estimated at the time of the appraisal is decreasing, which means that the sewage treatment amount is not increasing as much as expected. As for (4) Biochemical Oxygen Demand[19] (hereinafter referred to as BOD) density

[17] Sub-rating for Effectiveness is to be put with consideration of Impacts.
[18] In addition to the main indicators, the ex-post evaluation is made for the purpose of further detailed operation effects of project; therefore, supplementary indicators of each sector were also set. However, the 15 company units (in total) that took responsibilities of the project operation were undisciplined, and the evaluation was made exclusively on the main indicators.
[19] Biochemical oxygen demand is the amount of oxygen consumed when organic substances in water are dissolved by activity of aerobic microorganisms. A higher value means water pollution is significant. (Source: Japan Society on Water Environment)

of effluent related to water quality and (5) COD[20] density of effluent, Hami City, Wusu City and Kuitun City achieved the target; however, Turpan City achieved BOD density at the time of the project completion but density increased between 2015 and 2017. In regard to COD density of effluent, Turpan City has failed to achieve the target since the time of project completion. According to the sewage company in Turpan City, the city used its geographic superiority to promote the construction of economic development areas, which change sewage properties and it is difficult to treat sewage with existing treatment methods. This is why BOD and COD density of effluent did not reach the target. The company took this situation seriously and constructed a new treatment facility with an intention of starting to operate at the end of 2008. (Refer to "3.1.4. Appropriateness of the Project Plan and Approach" for details) Regarding sewage works of Phase 1 in general, project effect has been realized since the time of project completion and effectiveness is high.

Table 4 Operation and Effect Indicators: Sewage

(a) Phase 1

Indicator	Reference Value 2007	Target Value Moment of project completion	Actual Target achievement rates between parenthesis			
			2012 Project Completion	2015 3 years after project completion	2016 4 years after project completion	2017 5 years after project completion
(1) Population with sewage treatment (10,000 persons)	42.3	78.8	73.0 (93%)	82.4 (105%)	83.1 (104%)	87.6 (111%)
(2) Amount of sewage treated (10,000 m^3 /day)	10.1	23.5	20.1 (86%)	20.2 (86%)	20.2 (87%)	20.6 (88%)
(3) Sewage treatment rate (%)	63.0	97.9	98% (100%)	99% (101%)	100% (101%)	100% (101%)
(4) BOD concentration of effluent (mg /L)	18-121	≦20-36	20-35 (100%)	21-*38* 3 out of 4 cities achieved the target	20-*41* 3 out of 4 cities achieved the target	20-*58* 3 out of 4 cities achieved the target
(5) COD concentration of effluent (mg /L)	59-226	≦60-100	40-*110* 3 out of 4 cities achieved the target	42-101 3 out of 4 cities achieved the target	41-*124* 3 out of 4 cities achieved the target	40-*141* 3 out of 4 cities achieved the target

[20] Chemical oxygen demand is the amount of oxygen consumed when organic substances in water are oxidized with oxidizing agent. A higher value means water contains lots of organic substances, etc. and the pollution burden is high. (Source: Japan Society on Water Environment)

(b) Phase 2

Indicator	Reference Value 2007	Target Value Moment of project completion	Actual Target achievement rates between parenthesis			
			2013 Project Completion	2015 2 years after project completion	2016 3 years after project completion	2017 4 years after project completion
(1) Population with sewage treatment (10,000 persons)	9.7	19.0	*13.9 (73%)*	*14.7 (77%)*	*15.0 (79%)*	15.1 (80%)
(2) Amount of sewage treated (10,000 m^3 /day)	2.3	5.5	*3.5 (63%)*	4.4 (80%)	4.2 (76%)	4.3 (77%)
(3) Sewage treatment rate (%)	70.0	98.0	90.0% (92%)	95.0% (103%)	97.5% (103%)	99.0% (102%)
(4) BOD concentration of effluent (mg /L)	70-90	≦40-80	30-68 (100%)	29-65 (100%)	32-69 (100%)	28-60 (100%)
(5) COD concentration of effluent (mg /L)	80-150	≦80-150	15-130 (100%)	26-128 (100%)	19-115 (100%)	16-120 (100%)

Source: Reference and target values from JICA provided documents. Actuals from documents provided by the Executing Agency.
Note: Italics indicate that target achievement rate is fair (more than 50%, less than 80%).

In regard to Altay City and Atushi City in Phase 2, (1) sewage treatment population and (2) sewage treatment amount among five indicators achieved more than 50% and less than 80%, which is the level of fair. According to the executing agency, this was because prediction of population increase was overestimated at the time of the appraisal. In particular, Atushi City delayed its development the most among the six cities and the population did not reach the population increase at the time of the appraisal; therefore, sewage treatment population and sewage treatment amount did not grow as much as expected. As for (3) sewage treatment rate, (4) BOD density of effluent and (5) COD density of effluent, targets were achieved, and it is confirmed that some effect was realized at the time of the project completion.

In general, the sewage project for both phases demonstrated its expected effect.

B) Waterworks project (Table 5)

The major indicators of the waterworks project are (1) service coverage ratio of water supply system, (2) population served and (3) water supply amount. As of 2012, all indicators of Phase 1 achieved more than 90% of target values and project effect was evident. The reason why the achievement of population served in 2012 was 90% is because three cities, Hami City, Wusu City and Kuitun City reached 100% of the target as of 2012, while the population of Turpan

Hami Water Treatment Plant No.4: High-speed Flocculation and Sedimentation Pond

City alone increased more slowly than estimated; therefore, the achievement of the target was 57%, which is the level of fair. However, the achievement increased to 97% in 2017.

Table 5 Operation and Effect Indicators: Water Supply

(a) Phase 1

Indicator	Reference Value 2007	Target Value Moment of project completion	Actual Target achievement rates between parenthesis			
			2012 Project Completion	2015 3 years after project completion	2016 4 years after project completion	2017 5 years after project completion
(1) Water supply coverage rate (%)	72.7	99.6	99.7 (100%)	100 (100%)	100 (100%)	100 (100%)
(2) Population served (10,000 persons)	46.0	79.3	71.6 (90%)	85.6 (108%)	90.7 (114%)	97.0 (122%)
(3) Water supply amount (10,000 m^3 /day)	18.2	30.0	39.9 (111%)	43.4 (121%)	44.9 (125%)	46.9 (131%)

(b) Phase 2

Indicator	Reference Value 2007	Target Value Moment of project completion	Actual Target achievement rates between parenthesis			
			2013 Project Completion	2015 2 years after project completion	2016 3 years after project completion	2017 4 years after project completion
(4) Water supply coverage rate (%)	85	100	100 (100%)	100 (100%)	100 (100%)	100 (100%)
(5) Population served (10,000 persons)*	6.7	10.7 (out of which 8.5 is Altay)	*5.6 (52%) (Only Altay 66%)*	*5.5 (51%) (Only Altay 65%)*	*5.7 (53%) (Only Altay 67%)*	*5.8 (54%) (Only Altay 68%)*
(6) Water supply amount (10,000 m^3 /day)	2.1	4.1	4.7 (114%)	5.1 (123%)	5.2 (128%)	5.3 (130%)

Source: Reference and target values from JICA provided documents. Actuals from documents provided by the Executing Agency.

Note: Italics indicate that target achievement rate is fair (more than 50%, less than 80%).

*: Actual values of population served in Atushi City were not provided even in the second field study. Therefore, the only actual values for Altay City are indicated in the Table.

As for Phase 2, (1) service coverage ratio of water supply system and (3) water supply amount at the time of the project completion in 2013 reach more than 100% of the achievement. As Atushi City did not submit the actual figures of (2) population served,[21] Table 5 (b) mentioned actual figures of Altay City only. As the target of the same indicator in Altay City is 85,000, even Altay City alone, the achievement of the target value was 66% as

[21] When the second local survey was conducted, there were circumstances where resubmission of indicators of this ex-post evaluation was postponed because of labor shortage and frequent replacement of personnel in Atushi City.

of 2013 and 68% at the time of the ex-post evaluation, which is the level of fair[22]. According to the executing agency, this is because the rate of population increase in the feasibility study was overestimated. Among the three major indicators, only achievement of population served is at the level of fair, which proves that Phase 2 demonstrates its effect.

Overall, both water and sewer service demonstrated their expected effect.

C) Centralized heat supply and city gas (Table 6)

As Phase 1 included centralized the heat supply project only, the major indicators were (1) number of beneficiaries, (2) SO_2 emission reduction, (3) nitrogen oxides (herein after referred to as NO_X) emission reduction and (4) TSP emission reduction. As for the achievement of targets at the time of the project completion in 2012, all indicators achieved more than 100%. Likewise, the achievement of targets by city is 100% and project effectiveness is high in all four cities.

Table 6 Operation and Effect Indicators: Central Heating Supply and City Gas

(a) Phase 1

Indicator	Reference Value 2007*	Target Value Moment of project completion			
		2012 Project Completion	2015 3 years after project completion	2016 4 years after project completion	2017 5 years after project completion
(1) Beneficiary Population (10,000 persons)	28	280 (101%)	36 (120%)	38 (126%)	41 (147%)
(2) SO_2 emission reduction amount (t/year)	1,186	1,258 (106%)	1,586 (129%)	1,587 (134%)	1,539 (130%)
(3) NO_X emission reduction amount (t/year)	619	642 (104%)	895 (132%)	866 (144%)	797 (129%)
(4) TSP emission reduction amount (t/year)	20,834	21,871 (105%)	26,543 (129%)	27,825 (127%)	26,253 (126%)

(b) Phase 2

Indicator	Reference Value 2007	Target Value Moment of project completion			
		2013 Project Completion	2015 2 years after project completion	2016 3 years after project completion	2017 4 years after project completion
(1) Population served with heat supply (10,000 persons)	Approx. 9.2	13.02 (142%)	14.1 (153%)	14.4 (157%)	14.6 (158%)
(2) Population served with city gas (10,000 persons) (only Altay City)	Approx. 5.5	*4.2 (77%)*	4.6 (84%)	4.8 (88%)	5.0 (92%)
(3) SO_2 emission reduction amount (t/year)**	480	402 (84%)	472 (98%)	*No information*	*No information*
(4) NO_X emission reduction amount (t/year)**	845	636 (75%)	783 (93%)	*No information*	*No information*

[22] Assuming Atushi City achieves 100% of the target that is 22,000 people, achievement in 2013 was 73% and effectiveness is fair.

(5)	TSP emission reduction amount (t/year)**	3,530	*1,890 (54%)*	*2,367 (67%)*	*No information*	*No information*
(6)	Coal usage reduction amount (t/year)	49,050	45,600 (93%)	45,705 (93%)	46,400 (95%)	46,500 (95%)

Source: Reference and target values from JICA provided documents. Actuals from documents provided by the Executing Agency.
Note: Italics indicate that target achievement rate is fair or low.
*: When target values for Phase 1 were checked in the Detailed Design, it was found that the values differed to those indicated in the Ex-ante Evaluation Table. Therefore, these were corrected after discussions with the Executing Agency.
**: Actual values for 2016 and 2017 were not provided based on the reason that these are not included in the New National Emission Standards.


City Gas Project (Altay City)


Boiler from the Central Heating Supply (Natural Gas) (Atushi City)

As for Phase 2, in addition to development of centralized heat supply facilities, city gas facilities are developed. (1) number of beneficiaries, (2) beneficiaries of city gas supply, (3) SO_2 emission reduction, (4) NO_X emission reduction, (5) TSP emission reduction and (6) coal use reduction are set as the major indicators. Looking at the achievement of target values at the time of the project completion in 2013, (1), (3) and (6) achieved more than 80% but (2), (4) and (5) achieved more than 50% and less than 80%, which is the level of fair. However, as for (2) beneficiaries of city gas supply, the number tended to increase after the project completion, increasing to 92% at the time of the ex-post evaluation. As for (3), (4) and (5) which indicate effect of improvement in the atmospheric environment, these achieved more than 90% in 2015 except (5), and the effectiveness of the central heat supply and city gas project of Phase 2 can be recognized.

In general, effectiveness of the centralized heat supply project in both phases and city gas project in Phase 2 emerged generally as planned.

Overall, in regard to the sewage project, waterworks project and centralized heat supply project of Phase 1 and Phase 2 and the city gas project of Phase 2, the achievement of targets for the major indicators is moderate or high. Although the achievement is moderate, it has tended to increase every year since 2015 and achieved more than 80% at the time of the ex-post evaluation in 2017; therefore, it is recognized that the project in both phases is generally effective as expected.

3.3.1.2 Qualitative Effects (Other Effects)

The qualitative effects of this project are "to improve the living environment of residents and living standard by improving sewage treatment capacity and water supply capacity in the six target cities." As this can be understood as effectiveness at the impact level of this project, it is evaluated in "3.3.2.1 Intended Impacts."

3.3.2 Impacts

3.3.2.1 Intended Impacts

The impacts of this project are "to contribute to improvement of the environment in six cities and improvement of residents' living standards."

As the indicator to grasp this impact quantitatively, it is estimated in Phase 2 alone that approximately 110,000 tons of carbon dioxide (hereinafter referred to as CO_2) per year are reduced as a total of the two cities. As actual figures, 113,000 tons were reduced in 2015 and 2016 and 114,000 tons were reduced in 2017, which slightly exceeds the plan of CO_2 emission effect.[23]

In regard to the impact above in this ex-post evaluation, as it was difficult to obtain statistics except CO_2 emission reduction, qualitative analysis was conducted through group interviews with beneficiaries. In the group interviews, the following were confirmed: (1) satisfaction with this project and the current water and sewer service, heat supply and city gas service and (2) changes in living and health condition before and after the project by improving water and sewer service, centralized heat supply and city gas service.[24] Examination results by city and sector are indicated in Table 7. In regard to (1), all survey respondents of all cities and sectors answered "highly satisfactory." Satisfaction was extremely high. In particular, in regard to sewage and centralized heat supply that were maintained badly before the project, these were improved significantly after the project; therefore, the level of satisfaction among survey respondents was remarkably high. In regard to sewage, residential wastewater was discharged before the project but was significantly improved. Hygiene environment, living environment and urban environment were improved after the project. In regard to centralized heat supply, there were many opinions that room

[23] Four cities in Phase 1 did not set CO_2 emission reduction as a quantitative effect. In addition, new emission standards in heat supply projects in China are limited to emission of SO_2, NO_x and soot. Thus, none of the cities monitored CO_2 emission reduction because there was no regulation related to the emission of CO_2 and it was difficult to obtain the actual figures. Therefore, in this ex-post evaluation, only the effect of CO_2 emission was evaluated in Phase 2 as it was planned at the time of the appraisal.

[24] Following is an outline of the group interviews. Survey respondents were called by the executing agency; they comprised at least 10 beneficiaries in six cities. The executing agency asked residents committees and real estate companies in target areas to call survey respondents, tell them the date of the group interview and ask residents if they could participate in the group interview. The group interview was held for six days in total between December 3 and 19, 2017. Beneficiaries subject to survey were 73 people in total in six cities (40 men and 33 women.) They ranged in age from 20s to 80s.

temperature was kept stable compared to compact coal stoves and small-scale coal boilers used before the project and that improvement of the atmospheric environment in each city brought a significant change to the living environment. As waterworks were already developed before the project in each city with the exception of some parts of the cities of Wusu, Kuitun and Atushi (western urban area) that were using water from wells before the project, there were no significant changes to the living environment and living standards compared to sewage and heat supply. However, water supply has been further stabilized owing to the improvement of water pressure through improved service. The living standards of residents that used to consume water from wells have improved, as they do not need to use time and labor to carry water anymore.

Table 7 Project Impact: Main Results from the Group Interviews

Sector	Result
Sewage	**(1) Degree of satisfaction regarding the project and the current services** • All six cities answered "highly satisfactory". Main reasons being that the content of services have diversified and quality has improved (clogged drainage pipelines have diminished dramatically). Time to respond has quickened. **(2) Changes in living standards because of improved services before and after the project** • Residents that were not connected to the drainpipe before the project, needed to dig holes outside their one-storied houses, or had to use nearby public toilets among other measures. However, after the project, these houses also were connected to the drainpipe, flush toilets inside the house were built, significantly improving the living and hygienic environment. As for the residents that lived in apartment houses since before the project, and were connected to the drainpipe, suffered from bad smell because before the project, domestic wastewater was discharged without treatment in the roads and rivers. Also, the diameters of the drainpipes were narrow resulting in constant clogging. After the project, the city in general is clean and the townscape has improved. With regards to water-borne illness, they do not feel a big change before and after the project.
Water Supply	**(1) Degree of satisfaction regarding the project and the current services** • All six cities answered "highly satisfactory". Water supply cutoff are limited to planned cutoffs after the project. Information on water quality is now provided every month and water pressure is stable. There are different alternatives to pay as well. They take care to do the maintenance works during the night time when there is less use of water. Significant improvement in services was the main reason. **(2) Changes in living standards because of improved services before and after the project** • With the exception of some respondents from Wusu City, Kuitun City and Atushi City, that used water from wells before the project, the rest already had water supply services. In addition, since water quality of the water source was good, they relatively do not feel a big change in their living standards because of the project compares to other sectors. • Those residents that used water from wells before the project, used to carry water enough for 2 to 3 days from the wells to water jugs with the help of the whole members of the family. In average they had to make 3 to 4 roundtrips to wells located in 5 to 10 minutes of walking distance. After the project, time and labor to carry water is no longer necessary and quality of life has improved.
Central Heat Supply	**(1) Degree of satisfaction regarding the project and the current services** • All five cities answered "highly satisfactory". Main reason being that content of services is complete, and response of the heat supply company's hotline is quick among others. **(2) Changes in living standards because of improved services before and after the project** • Air environment before the project was extremely bad, with dust flying all the time, causing symptoms such as black nasal cavities, coughs and aching of eyes and sore throat. Room temperatures would not stabilize with compact coal stoves and small-scale coal boilers, and children and elderly persons tend to easily get sick, catching cold or with joint pains. Residents that used compact coal stoves, had a permanent risk of carbon monoxide intoxication. After the project, room temperature is kept stable 24 hours, and health condition has generally stabilized.
City Gas	**(1) Degree of satisfaction regarding the project and the current services**

(Only Altay City)	• All respondents answered "highly satisfactory". **(2) Changes in living standards because of improved services before and after the project** • Before the project, each household had to change their gas cylinder, but after the project this labor is no longer required. There are no concerns of air pollution and they are highly convenient. It is now possible to take a warm bath any time, and have a secure and comfortable life.

Source: Summary made by the evaluator based on the results of the group interviews.

Generally, it is confirmed that this project contributes somewhat to the (1) improvement of residents' living environment and living standards, (2) improvement of water and sewer service, centralized heat supply and city gas supply capacity, and the improvement of service in project target cities.

3.3.2.2 Other Positive and Negative Impacts

(1) Impacts on the Natural Environment[25]

The Environmental Impact Assessment (hereinafter referred to as "EIA") related to this project obtained approval from the environmental protection agency of Xinjiang Uygur Autonomous Region.[26] At the time of the appraisal, emphasis was put on the following pollution control common to six cities: (1) Drainage from sewage treatment plants and centralized heat source factories is treated to satisfy drainage standards of China and discharged to rivers and deserts, etc. Some sewage treatment drainage is used as irrigation water for tree planting. (2) Sludge generated in sewage treatment plants is partially used as fertilizer for tree planting. Highly-polluted sludge is properly treated at the existing waste landfill disposal plant. (3) In regard to atmospheric pollution, etc., after the launch of the project, dust-collecting devices and desulfurization devices are installed to satisfy environmental standards in China. In regard to (1), it has been argued that drainage from the sewage treatment plant in Phase 2 is mainly used for tree planting irrigation around the treatment plant which in the long-term it could result in greening and purification of atmosphere, because the water treated in the oxidation pond which will be used for irrigation can have an improving effect on alkaline soil. In regard to environmental measures and monitoring at construction, an environmental observation station that has jurisdiction over each city planned to monitor noise, water quality, atmospheric pollution and drainage etc. for both phases. It was confirmed that proper measures were implemented according to the plan at the time of the appraisal based on the records and interviews

[25] As a quantitative impact of relief on atmospheric pollution burden in Phase 1 in this project, approximately 150,000 tons of CO_2 was estimated to be reduced because of control of small-scale pollution emission sources. However, the executing agency replied that they did not have any information of CO_2 because it was no longer monitored since national atmospheric environmental standards were revised in 2012. This impact was excluded in the ex-post evaluation.

[26] As for approval from the environmental protection agency of Xinjian Uygur Autonomous Region, Turpan received this in January 2007, Hami City, Wusu City, and Kuitun City in February 2007 and Altay City and Atushi City in December 2006 and August 2007.

confirmed during observation, and monitoring and instruction were conducted by the environmental protection agency of each city. Moreover, monitoring of water quality and sewer service and atmospheric pollutants at the time of the ex-post evaluation was strictly conducted in real time by the health and environment bureau and environmental protection agency of each municipality. Overall, the impact on the environment at construction and at the time of the ex-post evaluation is minimal, and negative impact on the environment is not confirmed.[27]

(2) Resettlement and Land Acquisition

At the time of the appraisal, approximately 52 ha land was set to be obtained in total in Hami City and Turpan City in Phase 1. The actual figure was 51.6 ha, which was mostly as planned and the land was acquired according to the procedure in China. In Phase 2, the right to use approximately 148 ha of state-owned land was already acquired at the time of the appraisal according to the domestic procedure in order to maintain sewage facilities in Altay City and Atushi City. As these lands were waste land allocated by the government, residents did not have to relocate and the company did not need to pay compensation etc.

(3) Other Positive and Negative Impacts

Acceleration of poverty reduction was expected as "other positive and negative impacts" at the time of the appraisal. The poverty rate in the six cities at that time was more than 2.8% of the national average in five cities except Kuitun City, whose poverty rate was 1.2%. As consideration to the poor in all six cities, there is a system to reduce charges for water and sewer service and heat supply. It was expected to contribute to reducing poverty by continuously applying this system after the project completion. The latest available poverty rate at the time of the ex-post evaluation was the rate in 2016. According to this rate, the poverty rate in four cities decreased in Phase 1 to below the national average, but the poverty rate of Altay City and Atushi City in Phase 2 became worse, which is 15.6% and 35.3% respectively. Partial exemption from public utility charges is conducted for households living in poverty in all cities, but there is no clear basis for relationship between this project

Ex-site of small-scale coal boiler: Park in Hami Citv

[27] At the time of the appraisal, project target areas of both phases do not correspond to areas that are easily influenced such as national park etc. or surrounding areas, so it is estimated that undesirable influence on the natural environment is minimal. When on-site investigation of this ex-post evaluation was conducted, it is confirmed that the estimation made at the beginning of the plan was correct and no particular problem has occurred.

and acceleration of poverty reduction.

As “other positive and negative impacts” that are not assumed in this project, the following two impacts are indicated. (1) Developing centralized heat source factories enables the removal of existing small-scale coal boilers, and the site can be reused. When local observation was conducted, it was confirmed that a heat exchange station was developed on some former sites of small-scale coal boilers. On the other hand, there were some cases where the site was reused as a new public facility such as green space, park and place for sharing bicycles and cafeteria for government officials, which led to more a convenient and comfortable life of residents. (2) In the process of sewage disposal in Altay City, treated drainage is discharged to a regenerated water pond and is used as circulating water. By doing this, water is not discharged to Kelan River, which is a drainage destination and helps to improving the surrounding ecology. In 2013, the company was selected as a company of outstanding achievement in the achievement evaluation of national urban sewage treatment plant energy saving /emission reduction. Overall, positive impact that was not estimated is confirmed.

The outcome of this project is “improvement of sewage treatment capacity and water supply capacity and reduction of water pollution and atmospheric pollutants” and impact is set to “contribute to improving the environment and residents living standards in six cities.” In regard to the outcome, major indicators of effectiveness prove that it achieves the target in Phase 1 and Phase 2. In regard to quantitative impact, CO_2 emission reduction achieves impacts expected at the time of the appraisal. As qualitative impact, evaluation based on the group interview with beneficiaries showed that the level of satisfaction in project content and service is high in every sector and living environment, living standard and natural environment are improved significantly after the project, which shows that the contribution of this project is high. Environmental monitoring and environmental pollution measures during construction and at the time of the ex-post evaluation were conducted based on the plan and negative impact on the environment was kept low. In regard to land acquisition, as state-owned waste land is allocated, there was no need to relocate residents nor pay compensation, etc. As for other positive and negative impacts, there is no confirmed direct relationship regarding the acceleration of poverty reduction, but a system to reduce charges for the poor that was planned at the time of the appraisal continues to apply, and measures for the poor are carried out. In addition, unintended positive impacts such as the following are recognized: the sites of small-scale coal boilers were reborn as facilities that contribute to improving residents’ living environment.

From the above, this project has mostly achieved its objectives. Therefore, effectiveness and

impacts of the project are high.

3.4 Sustainability (Rating:③)

3.4.1 Institutional / Organizational Aspects of Operation and Maintenance

Table 8 shows the project implementation unit that is in charge of operation and maintenance of infrastructure facilities developed in this project. Through observation and interviews with employees in local observation, it was confirmed that the organization chart and the decision-making process of operation and maintenance are clear in all project implementation units. In all sectors of water and sewage service, centralized heat supply and city gas and human resources are secured to ensure proper operation and maintenance. In regard to the working situation of employees, a reasonable shift system of employees is secured to conduct operation safely and effectively.

Table 8 Project implementation units and Their Organization at the Moment of the Appraisal and the Ex-post Evaluation*

City	Sector	Name of the Project implementation units at the moment of Appraisal *	Changes in the name of the Project implementation units at the moment of the Ex-post Evaluation / new names / type of entity / number of employees, number of technicians **
Hami City	Sewage	Hami City Sewage Treatment Plan	No change /State-owned enterprise 136 persons (out of which 81 technicians)
	Water Supply	Xinjiang Hami Water Works Limited Liability Company	Hami Water Works Limited Liability Company / State-owned enterprise 110 persons (out of which 44 technicians)
	Central Heating Supply	Hami Míngzhū Heat Supply Limited Liability Company	Changed / State-owned enterprise 141 persons (out of which 96 technicians)
Turpan City	Sewage	Xinjiang Turpan City Wanquan Water Supply and Sewage Company	No change / State-owned enterprise No information on total was provided (14 technicians)
	Water Supply		
	Central Heating Supply	Turpan City Heat Supply Company	No change / State-owned enterprise 79 persons (out of which 57 technicians)
Wusu City	Sewage	Wusu Sewage Treatment Plant	Wusu City Water Supply and Sewage Limited Liability Company / State-owned enterprise 108 persons (out of which 23 technicians)
	Water Supply	Wusu Water Supply Company	
Kuitun City	Sewage	Kuitun Sewage Treatment Plant	No change / State-owned enterprise No information on total was provided (33 technicians)
	Water Supply	Kuitun Water Supply Company	No change / State-owned enterprise 65 persons (out of which 24 technicians)
	Central Heating Supply	Kuitun Heat Supply Company	Kuitun Dzungar Heat Supply Limited Liability Company / Private company 65 persons (out of which 22 technicians)
Altay City	Sewage	Altay City Sewage Treatment Plan (38 persons)	No change / State-owned enterprise 75 persons (out of which 68 persons)
	Water Supply	Altay City Jinshan Water Supply Company (88 persons)	No change / State-owned enterprise 71 persons (out of which 59 persons)
	Central Heating Supply	Altay City Central Industrial Heat Supply Limited Liability Company (89	No change / State-owned enterprise 89 persons (out of which 71 persons)

		persons)	
	City Gas	Huali Gas Investment Limited Liability Company (38 persons)	Altay Guanghui Natural Gas Limited Liability Company / Private company 168 persons (out of which 118 persons)
Atushi City	Sewage	Atushi City Water Supply and Sewage Company (80 persons)	Atushi City Quankang Water Supply and Sewage Limited Liability Company / State-owned enterprise 64 persons (out of which 44 persons)
	Water Supply		
	Central Heating Supply (Natural Gas)	Atushi City Heat Supply Public Company (104 persons)	Atushi City Guang Zheng Heat Supply Limited Liability Company / Private company 44 persons (all technicians)

Source: Information regarding the appraisal moment is based on JICA provided documents. Information regarding ex-post evaluation moment is based on documents provided by the Executing Agency
*: There was no information regarding number of persons in each of the project implementation units for Phase 1. In addition, all project implementation units were state-owned enterprises.
**: Technicians refer to personnel with national qualifications and professional qualifications.

All project implementation units were state-owned companies at the time of the appraisal, but at the time of the ex-post evaluation, three within 15 companies (Kuitun Dzungar Heat Supply Limited Liability Company (hereinafter referred to as "LLC"), Altay Guanghui Natural Gas LLC, and Atushi Guang Zheng Heat Supply LLC) were privatized.[28] In China, public service sections have been privatized for the purpose of conducting efficient management; however, at the time of the ex-post evaluation, the organization chart of all project implementation units including privatized project implementation units was made clear and has a scale necessary for operation and maintenance. At the same time, the system for decision-making, instruction system, instruction and supervising functions, etc., are sufficient systems to secure sustainability of this project.

3.4.2 Technical Aspects of Operation and Maintenance

Technical aspects of operation and maintenance of the departments executing this project were evaluated based on the familiarity of technology adopted by the facility developed by this project, especially the number of people who acquire national certification, maintenance of training system, operation and maintenance manuals and usage situation.

In regard to technical standards and training system of operation and maintenance of personnel, technicians who have the necessary national certification and engineers who have expert knowledge are assigned about 60% to 70% in most

Various certificates of qualifications (City gas project from Atushi City)

[28] In the case of Kyutun Zuungar Thermal LLC and Atushi Guanzheng Thermal LLC, property and obligation to pay are passed to private companies, but local government and the autonomous region financial office secure their repayment. In the case of Altay Guanghui Natural Gas LLC, the municipal government has an obligation to pay and the autonomous region financial office secures them. Each municipal government has authority of supervision.

of project implementation units of water and sewer service, centralized heat supply and city gas; therefore, there is no issue on technical aspects (Refer to Table 8). Occupations requiring national certification are mainly: electrician, electric welder, desulfurization staff, water treatment staff, water quality staff, boiler operator, meter operator and water heat operation worker, etc. Acquisition of certification is managed by every project implementation unit. With regard to training, each department grasps the needs for training every year in all project implementation units, reports to the "human resources section" and creates an annual human resources development plan. Necessary budget is then included in the budget of the next fiscal year and it is conducted mostly as planned. Skill evaluation is conducted on a regular basis by combining in-house training (lectures by invited domestic specialists and training by manufacturers, etc.) and outside training organizations. Outside training is conducted mainly to professionals of electricity, plumber, boiler operation, water examination, sewage plumber and sewage treatment investigation, etc. and for most of the cases, training is conducted in Urumqi City. Regarding water and sewer service, some technical training is conducted by municipal and autonomous wastewater association. National certification is categorized as beginner, intermediate and advanced-level. Three to five years of experience, taking lectures, and national certification are required. All personnel take a certain amount of training and knowledge is always updated. Experienced engineers and young members always form teams on the spot to pass on techniques and knowhow in the workplace.[29]

Operation and maintenance manuals are developed and maintained in all project implementation units of water and sewer service, centralized heat supply and city gas. Originals of manuals are stored and managed in a section of each project implementation unit and content of main operation processes is displayed on poster-sized sheets and installed on the wall so that anyone can refer to it at any time. Operation and maintenance records are kept in each main facility and flow and daily reports are also kept. Water examination is conducted ,monitored and recorded at a frequency defined by the national environmental protection agency.

Overall, employees in charge of operation and maintenance in every project implementation unit have sufficient technical level. The training system is well organized, and the company always works to maintain and improve technical level and technology for sustainability of this project.

[29] Training in Japan was held in Phase 1 only, but among trainees who participated in this training, only three in Kuitun City belong to each project executing department at the time of the ex-post evaluation. This training in Japan resulted in the materialization of the technology and equipment that should be brought in the project. As training participants from other three cities were positioned as managers, they are relocated or changed their job at the time of the ex-post evaluation. They do not stay in the project executing department. In the case of Kuitun City, promising young personnel at a practical level who have technical expertise are selected from each project execution department and asked to participate in the training. Therefore, they remain in each project executing department and succeed to work as middle managers on the spot.

3.4.3 Financial Aspects of Operation and Maintenance

In this project, expenses for operation and maintenance after the project completion are covered by income from charges (such as sewage fee, water charge, heat supply fee and city gas fee).[30] If funds go into shortage, financial funds from each municipality are additionally expended and there was no change to this system at the time of the ex-post evaluation.[31] In this project, it is estimated that cities where the scope of development was limited to sewage pipeline and piping for water and sewer service in particular can reduce maintenance costs; therefore, charges at the time of the project completion are reduced from those at the time of the appraisal. However, at the time of the ex-post evaluation, all sectors in six cities except water and sewer service in Atushi City had increased their charges. Meanwhile, charges to households are slightly reduced and charges increase only to commerce and industry.

Among 15 project executing units, 14 units except Wusu City Water Supply and Sewage LLC obtained profit and loss statements of the past three years (Refer to Table 9.)

[30] Authorization of public service charges in Xinjiang Uygur Autonomous Region is owned by each municipality. When charges are revised, the project executing department applies, holds a public hearing to reflect user needs and the municipality approves it. In every project operating department, charges are paid in bill collecting places or via prepaid card. Some cities allow payment of charges via mobile phone.

[31] Privatization is promoted as a policy of the Chinese Government. However, in regard to companies related to basic infrastructure such as water and sewer service, heat supply and town gas, it is determined by the law that these companies are subject to receive national, autonomous and each municipal preferential treatment (such as subsidy, tax exemption, loan, etc.) ("Guidance and opinion related to cooperation between government of national development/reform committee and private capital" development and reform investment (2014) No. 2724), Finance Department of National Tax General Office "Notification about tax increase to heat supply company, real estate tax and urban land use tax preferential treatment" Property and tax (2016) No. 94 and Finance Department, National General Tax Affairs "Measure to collect and use urban public infrastructure maintenance in Xinjing Uygur Autonomous" August 24, 2016.)

Table 9　Income Statements of the Project Implementation Units

(Unit: 1000 yuan)

Phase 1

Hami City Sewage Treatment Plant		2015	2016	2017
	Operating Income	10,329	10,147	10,521
	Operating Expense	16,340	15,641	18,981
	Operating Profit	▲ 6,011	▲ 5,494	▲ 8,460
	Other (Subsidies, etc)	2,434	2,223	3,509
	Ordinary Profit	▲ 3,577	▲ 3,271	▲ 4,951
Xinjiang Hami Water Works Limited Liability Company		2015	2016	2017
	Operating Income	75,407	89,669	84,145
	Operating Expense	75,619	84,700	78,033
	Operating Profit	▲ 212	4,969	6,112
	Other (Subsidies, etc)	2,202	8,898	18,744
	Ordinary Profit	1,990	7,394	24,856
Hami Mingzhū Heat Supply Limited Liability Company		2015	2016	2017
	Operating Income	16,287	16,287	10,598
	Operating Expense	19,877	19,878	19,794
	Operating Profit	▲ 3,590	▲ 3,591	▲ 9,196
	Other (Subsidies, etc)	3,894	3,895	10,712
	Ordinary Profit	304	304	1,516
Xinjiang Turpan City Wanquan Water Supply and Sewage Company		2015	2016	2017
	Operating Income	18,797	23,011	29,522
	Operating Expense	22,865	24,871	26,989
	Operating Profit	▲ 4,068	▲ 1,860	2,533
	Other (Subsidies, etc)	1,578	537	11
	Ordinary Profit	▲ 2,490	▲ 2,397	2,544
Turpan City Heat Supply Company		2014	2015	2016
	Operating Income	30,180	34,645	35,881
	Operating Expense	31,244	33,993	34,562
	Operating Profit	▲ 1,064	652	1,319
	Other (Subsidies, etc)	1,677	2,653	1,540
	Ordinary Profit	613	3,305	2,859
Kuitun City Water Supply Company		2014	2015	2016
	Operating Income	27,262	27,651	29,581
	Operating Expense	22,600	26,748	27,176
	Operating Profit	4,662	903	2,405
	Other	▲ 443	60	▲ 64
	Ordinary Profit	4,219	963	2,341
Kuitun City Sewage Treatment Plant		2015	2016	2017
	Operating Income	10,767	10,950	11,680
	Operating Expense	9,992	10,103	10,830
	Operating Profit	775	847	850
	Other	▲ 116	▲ 128	▲ 127
	Ordinary Profit	659	719	723
Kuitun City Heat Supply Company		2015	2016	2017
	Operating Income	45,934	44,850	5,133
	Operating Expense	46,261	47,879	3,243
	Operating Profit	▲ 327	▲ 3,029	1,890
	Other (Subsidies, etc)	3,256	3,171	▲ 37
	Ordinary Profit	2,929	142	1,927

Phase 2

Altay City Jinshan Water Supply Company		2015	2016	2017
	Operating Income	9,124	9,337	7,544
	Operating Expense	8,702	8,742	6,773
	Operating Profit	422	595	771
	Other	▲ 96	▲ 179	▲ 72
	Ordinary Profit	326	416	699
Altay City Sewage Treatment Plant		2015	2016	2017
	Income (including subsidies)	6,206	8,390	5,601
	Expense	6,243	8,390	5,251
	Difference	▲ 37	0	350
Altay City Central Industrial Heat Supply Limited Liability Company		2015	2016	2017
	Operating Income	35,916	28,572	30,102
	Operating Expense	37,051	30,908	31,324
	Operating Profit	▲ 1,135	▲ 2,336	▲ 1,222
	Other (Subsidies, etc)	1,600	2,932	2,214
	Ordinary Profit	465	596	992
Altay Guanghui Natural Gas Limited Liability Company		2015	2016	2017*
	Operating Income	27,086	32,886	24,255
	Operating Expense	22,787	25,864	21,499
	Operating Profit	4,299	7,022	2,756
	Other	▲ 488	▲ 554	▲ 440
	Ordinary Profit	3,811	6,468	2,316
Atushi City Quankang Water Supply and Sewage Limited Liability Company	Water Supply Business	2015	2016	2017
	Income from charges (A)	10,690	2,900	3,100
	Labor Expense	80	40	60
	O&M Expense	350	390	410
	Other Expenses	340	380	360
	Total Expenses (B)	0	3,710	3,930
	(A)-(B)	10,690	▲ 810	▲ 830
	Sewage Business	2015	2016	2017
	Income from charges (A)	2,930	3,330	3,080
	Labor Expense	900	1,020	840
	O&M Expense	110	140	160
	Other Expenses	350	410	540
	Total Expenses (B)	1,360	1,570	1,540
	(A)-(B)	1,570	1,760	1,540
Atushi City Guang Zheng Heat Supply Limited Liability Company		2014	2015	2016
	Operating Income	12,707	13,725	15,162
	Operating Expense	14,732	16,085	19,466
	Operating Profit	▲ 2,025	▲ 2,360	▲ 4,304
	Other	0	2,877	▲ 22
	Ordinary Profit	▲ 2,025	517	▲ 4,326

Source: Documents provided by the Executing Agency
*: Actuals up to November 2017

In the past three years, 10 out of 14 companies were able to cover operation and maintenance with income from charges (operating profit is in black) and the operating profit of the following four companies only went into the red: Hami City Sewage Treatment Plant, Hami City Mingzhu Heat Supply, Kuitun City Sewage Treatment Plant, and Altay City Industrial Central Heat Supply LLC. However, subsidy is invested to Hami City Mingzhu Heat Supply, Kuitun City Sewage Treatment Plant, and ordinary profit went into the black. From the

perspective of “securing people’s livelihood,” water and sewer service, centralized heat supply and city gas are committed to continuously receiving various subsidies from the government (Refer to footnote 31 for details.) When considering this matter, it is fair to say that financial sustainability of the project implementation unit in charge of operation and maintenance of this project is generally secured.

3.4.4 Status of Operation and Maintenance

The operation and maintenance statuses of all facilities and equipment developed in this project are as follows. Some cities and sectors need improving but the operation and maintenance statuses are generally satisfactory. Even if there is a matter to consider, efforts to improve are already conducted.

- Hami City: As for the sewage project, all sewage pipe networks are cleaned twice a year, but existing dredging devices and garbage collection vehicles are not sufficient given the scale of the city. In the next two to three years, it is planned to upgrade machinery such as water-pipe survey equipment, etc. In addition, some industrial drainage does not follow drainage standards, which increases burden in the sewage treatment plant. The project implementation unit requests that the government tighten regulations.
- Turpan City: As for sewage, it aims to achieve at least the National Sewage Drainage Standard Class B after a new sewage treatment plant is completed in the second half of 2018. As for the water project, leakage problems occurring in partially deteriorated drainpipes (mainly branch pipe network) in the city area are worsening, which causes insufficient quantity of water supply. It is planned to update these drainpipe networks. As for the centralized heat supply project, water treatment equipment needs to be updated, which is already included in the FY 2019 budget. In addition, as problems occur in the online system of the heat supply factory and heat exchange station on rare occasions, this system will be upgraded and monitoring control will be installed in 2019.
- Altay City: As for sewage, a “plan to mechanize Altay City drainage pipe networks” has been promoted. By 2020, it is planned to mechanize maintenance of drainage pipe networks (install four smart device cleaners.) Furthermore, it aims to raise the national sewage drainage standard of treated water from the current grade B to grade A. To do so, existing equipment is being reformed (such as aeration sedimentation tank, biological reaction tank, replacement of screen, sand filter process, etc.), which will be completed at the end of 2018.

Overall, through observation of local surveys and interviews with each project implementation unit, operation and maintenance of all facilities in six cities are generally satisfactory. Each project implementation unit operates facilities more efficiently and installs new equipment to always make an improvement.

From the above, it can be said that no major problems have been observed in the institutional, technical, financial aspects and current status of the operation and maintenance system. Therefore, sustainability of the project effectiveness is high.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

This project was conducted with the aim to improve sewage treatment and water supply capacity and reduce water and air pollutants in a total of six cities, namely Hami, Turpan, Wusu, and Kuitun (Phase 1), and Altay and Atushi (Phase 2) in XUAR, China, by developing sewage, water supply, centralized heat supply, and city gas (Altay City only) facilities, thereby contributing to the improvement of the environment and living standards of residents in the six cities. This project was fully consistent with the development and environmental protection plans and development needs of China and XUAR at the time of the appraisal and the ex-post evaluation as well as Japan's ODA policy toward China at the time of the appraisal, therefore the relevance of the project is high. The outputs of the project were partially reduced in Phase 1 but were as initially planned in Phase 2. In both phases, the total project cost remained within the initially planned range, but the project period exceeded the initial plan. Thus, the efficiency of the project is fair. The outcome expected as the project's effect was to improve sewage treatment and water supply capacity and reduce water and air pollutants, and its impact was to contribute to the improvement of the environment and living standards of residents in the six cities. In both phases, with regard to outcome, the project achieved major indicators' targets set for each sector at the time of the appraisal; therefore, the effectiveness of the project is high. Regarding impact, it was confirmed through interviews with groups of beneficiaries that in the project area of each city, water service /sewage, centralized heat supply, and city gas facilities had been developed and that this contributed to improvement of the environment and the living standards of residents. Land acquisition was carried out appropriately, and no resettlement of residents occurred. During the construction work and at the time of the ex-post evaluation, impacts on the natural environment were monitored appropriately with environmental measures taken properly, and no negative impact was confirmed. As described above, the effects of the project manifested themselves as planned, and the effectiveness and impacts of the project are high. The current statuses of the institutional, technical, and financial aspects at the 15 units that were responsible for the operation and maintenance management of the project implementation are generally favorable, and the sustainability of effects brought by the project is high.

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

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

In regard to efforts described in "3.4.4 Status of Operation and Maintenance," each project implementation unit in each city conducts as planned and will make efforts to ensure sustainability of effectiveness expressed in this project in the future.

4.2.2 Recommendations to JICA

None

4.3 Lessons Learned

Plan measures related to project supervision when the project extends to many cities and sectors and the executing agency and/or municipalities do not have experience in Japanese ODA loan projects

This project conducts projects of three to four sections in six cities in the extensive Xinjiang Uygur Autonomous Region. As described in "2.3 Constraints during the Evaluation Study," project progress reports were not regularly elaborated and submission of project completion reports was limited to a few cities. These factors hinder collection of information related to the project executing period. In addition, as it was not possible to go into the project site at the second local survey in this project owing to the safety management issues in Xinjiang Uygur Autonomous Region, information that was possible to collect was limited. This information contains data to be described in project progress reports and project completion reports that are mandatory to submit for loan contracts. Like China where this project was being conducted, if many official development assistance projects are conducted at the same time, it is admittedly difficult to monitor all projects in detail. However, from the perspective of project cycle management, if the next "risk" is confirmed, it is desirable to conduct proper project supervision according to the current situation as follows: (1) municipalities with no experience in Japanese ODA loan projects (provincial governments and city governments), (2) there is a shortage of human resources in the executing agency in charge of many projects when considering the scale of the project, (3) location of the project is physically away from the local office location and it is estimated that it is difficult to make a procedure to obtain information because of safety management when compared to other municipalities. In this case, (1) increase the frequency of mid-term review and supervise projects in more detail, (2) although the frequency of submitting project progress reports is reduced from the current twice to once, be sure to submit reports at the agreed frequency, and (3) submit project completion reports thoroughly and provide support to create such reports if necessary. Doing this enables course correction as necessary from time to time in the project cycle. Even if human resources of the executing agency and municipality related to the project change, the project management will be taken over, and will contribute to the project's further efficiency and effectiveness.

END

Comparison of the Original and Actual Scope of the Project

Item	Plan (after revision)	Actual
(1) Project Outputs 【Development of facilities, procurement of equipment】		
＜Phase 1＞		
Hami City		
1. Construction and repair of drainage pipe system	74.8km	49.8km
2. Construction of water distribution pipeline	26.5km	31.4km
3. Construction of new water treatment plant	50,000m^3 /day	As planned
4. Construction and repair of water supply pipe system	94.3km	99km
5. Construction of heat supply plant	3×29MW	As planned
6. Construction of heating power supply pipe network	56.4km	21.3km
7. Construction of heat exchange stations	31places	As planned
Turpan City		
1. Construction and repair of drainage pipe system	50.4km	40.4km
2. Construction of new sewage treatment plant	20,000m^3 /day	As planned
3. Repair of existing sewage treatment plant	No information	No information
4. Construction of water distribution pipeline	51.7km	46.9km
5. Construction and repair of water supply pipe system	77.7km	69.8km
6. Construction of heat supply plant	3×46MW	As planned
7. Construction of heating power supply pipe network	26.0km	22.63km
8. Construction of heat exchange stations	25 places	21 places
Wusu City		
1. Construction and repair of drainage pipe system	71.3km	71.6km
2. Construction and repair of water supply pipe system	73.9km	67.4km
Kuitun City		
1. Construction and repair of drainage pipe system	73.2km	50.1km
2. Construction of new sewage treatment plant	60,000m^3 /day	As planned
3. Expansion of sewage treatment plant	An activated sludge tank was added to an existing plant with a sewage treatment capacity of 40,000 m^3/day	As planned
4. Construction and repair of water supply pipe system	81.0km	82.0km
5. Construction of heat supply plant	3×46MW	2×72MW

6. Construction of heating power supply pipe network	45.5km	47.4km
7. Construction of heat exchange stations	30 places	32 places
<Phase 2>		
Altay City		
1. Construction and repair of drainage pipe system	59.8km	As planned
2. Construction of new sewage treatment pond	4.86 million m^3	As planned
3. Construction of new water intake facility	16,000 m^3 /day	As planned
4. Construction of water supply pipe	19.8km	As planned
5. Construction of new water treatment plant	16,000 m^3 /day	As planned
6. Construction and repair of water supply pipe system	20.0km	As planned
7. Construction of heat supply plant	4×14MW	As planned
8. Construction of heating power supply pipe network	14.2km	As planned
9. Construction of heat exchange stations	14 places	As planned
10. Construction of LNG gasification facility	3.6 million Nm^3 /year	As planned
11. Construction of gas supply pipe network	15km	As planned
Atushi City		
1. Construction and repair of drainage pipe system	67.86km	As planned
2. Construction of new sewage treatment plant	3,500 m^3 /day	As planned
3. Expansion of existing sewage treatment plant	8,000 m^3 /day	As planned
4. Construction and repair of water supply pipe system	22.7km	As planned
5. Construction of heat supply plants	28×1.4MW 25×2.8MW 8×4.2MW	As planned As planned As planned
6. Construction of heating power supply pipe network	41.6km	As planned
7. Construction of medium pressure fuel gas supply network	17.23km	As planned
【Training】		
1. Target Cities	6 cities	Only Phase 1 (Hami, Turpan, Wusu, Kuitun)
2. Content	Technologies on projects related to sewage, heat supply facilities and city gas supply	Technologies related to water supply and sewage, waste treatment and heat supply
3. Number of persons	No information	11 persons
4. Period	No information	October 18 to 27, 2008
(2) Project Period	【Phase 1】 May 2007 to December 2012	【Phase 1】 March 2007 to June 2015

	(68 months, 5 years 8 months) 【Phase 2】 January 2008 to June 2013 (66 months, 5 years 6 months)	(98 months, 8 years 2 months) 【Phase 2】 March 2007 to September 2013 (70 months, 5 years 10 months)
(3) Project Cost Amount Paid in Foreign Currency Amount Paid in Local Currency Total ODA Loan Portion Exchange Rate Foreign Currency Domestic Currency Total ODA Loan Portion Exchange Rate	【Phase 1】 14,144 million yen 4,568 million yen (309 million yuan) 18,712 million yen 12,998 million yen 1yuan=14.8 yen (As of December 2006) 【Phase 2】 4,043 million yen 2,115 million yen (259 million yuan) 6,158 million yen 3,802 million yen 1yuan＝15.6 yen (As of June 2007)	【Phase 1】 10,586 million yen 4,822 million yen (333 million yuan) 15,408 million yen 10,586 million yen 1 yuan=14.5 yen (Average between March 2007 and June 2015) 【Phase 2】 3,185 million yen 2,170 million yen (160 million yuan) 5,355 million yen 3,596 million yen 1yuan＝13.6 yen (Average between December 2007 and September 2013)
(4) Final Disbursement	【Phase 1】September 2015 /【Phase 2】July 2016	